Energy Sprawl in Connecticut

January 4, 2017 DISCUSSION DRAFT

Why Farmland and Forests are Being Developed for Electricity Production; Recommendations for Better Siting

One industry that continues to grow in Connecticut is the installation of photovoltaic equipment that converts sunlight to electricity.

Not all solar installations yield equal benefits. Solar panels on commercial rooftops, industrial lands and old landfills can be sustainable home runs. Unfortunately, Connecticut adopted laws and policies that encourage utility-scale solar photovoltaic facilities* to be developed on farmland and forest land. Connecticut was, and still is, unprepared to guide the placement of solar facilities to minimize their environmental damage.

Laws that encourage utility-scale solar facilities should remain in place but be corrected. Drawing on hindsight and five years of other agencies' experiences, the Council on Environmental Quality has identified two critical deficiencies and offers several recommendations (and is seeking more).

Deficiencies and Recommendations (Added recommendations appear in red on other pages.)

Deficiency A: Current selection criteria value short-term price above all else. DEEP selects renewable energy projects which promise to deliver electricity at the lowest cost while effectively excluding environmental siting considerations and long-term indirect costs. Energy facilities are no exception to the general rule guiding development: it is nearly always cheaper to build on agricultural land and clean forest land than it is to remediate a parcel that might be contaminated or in some way complicated by previous land uses. As a result, the solar facilities are directed by the market to farmland and forest land and away from previously-developed land.

> **Recommendation 1 (Concept): State agencies should not encourage developments that consume agricultural land or forested land.** (Note: The Council is not recommending that agricultural or forest landowners be prohibited from leasing their land to energy producers; the Council intends to offer recommendations affecting agency actions.)
>
> **Recommendation 2: Solar developers should realize substantial incentives if they use previously-developed land.** Details to be determined.

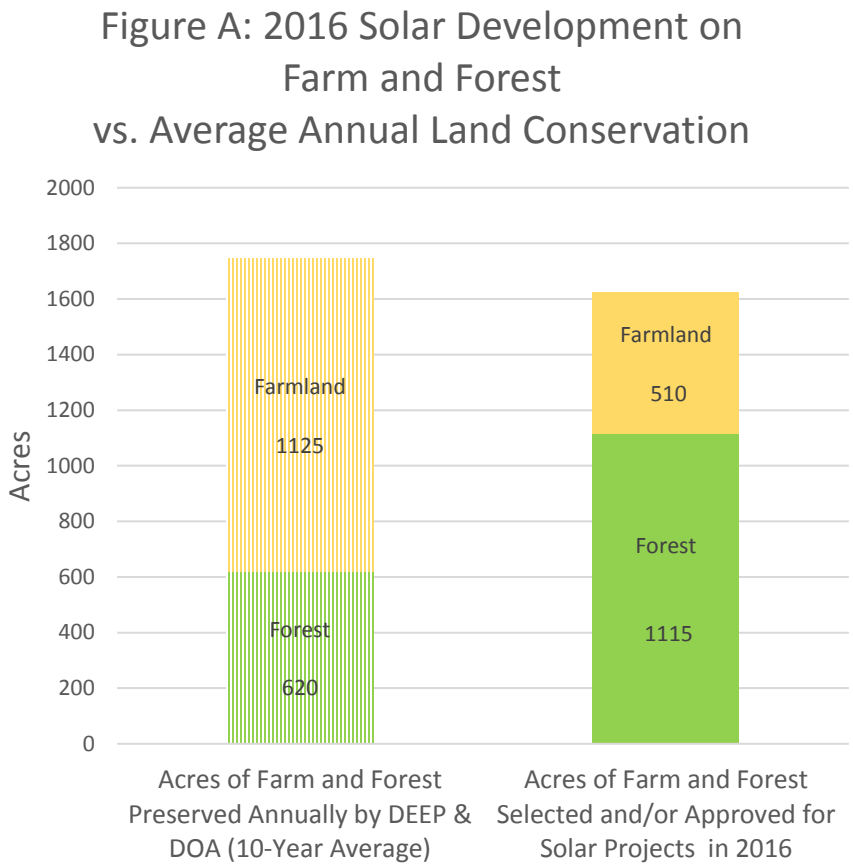
Deficiency B: Regulatory approval of solar utility-scale photovoltaic facilities is nearly automatic. The Connecticut Siting Council, required to approve solar facilities by declaratory ruling, cannot deny approval for a solar photovoltaic facility no matter how many acres of farmland, forest or wildlife habitat (outside of wetlands) will be eliminated. Municipal regulation is pre-empted.

> **Recommendation 3: To be determined.**

*Solar photovoltaic panels convert sunlight to electricity. This report considers "utility-scale" photovoltaic facilities to be those capable of generating more than two megawatts (MW) of electricity (after conversion to alternating current, or AC). A two MW (AC) facility usually will have about 8,000 panels across ten acres.

Hindsight

Important laws to encourage renewable energy development were adopted in 2005, 2011, 2013 and 2015. Probably few residents in 2005 realized that, by 2016, solar photovoltaic facilities would be the largest single type of development consuming agricultural land and forest land in Connecticut. In 2016, the area of farmland and forest selected and/or approved for development of solar photovoltaic facilities nearly equaled the area of such lands preserved by the state in an average year.



"Selected" means selected by DEEP; "Approved" means approved by the Connecticut Siting Council. The 2016 figures do not include the 25 small-scale (less than 20 MW each) projects selected in November.

The category of land – farmland or forest – was determined from information provided by the applicants. If the land was being used for agriculture currently or recently, it was counted as farmland. If trees grew on most of a parcel, it was counted as forest; zoning was not considered.

The trend toward placement of solar photovoltaic facilities on farmland and forest is accelerating, with 1600 acres selected and/or approved in 2016 (Figure A), up from 200 acres in 2015. There is an irony in the state's spending millions of dollars to preserve agricultural and forest land and to encourage private forest management and conservation while, with another hand, encouraging conversion of similar lands into electricity-generating facilities.

In 2011, DEEP made its first foray into selecting large solar projects to provide renewable power to the major electric distribution companies (EDCs). After soliciting bids from 21 projects, DEEP selected two. One has been built on (formerly) active farmland and one on inactive agricultural soils. DEEP awarded points for non-price criteria, but the weighting was done in a way that caused pricing criteria to completely overwhelm non-price considerations. Several projects were proposed for brownfields or other developed sites but were not selected. Predictably, the proposed electricity price from some of those projects was higher than from farmland-based projects, but that was not true in every case. Either way, the differences in price were small, and the actual impact, if any, of the price differential to retail electricity customers was not determined prior to selection.

Even if the selection criteria had been designed so that siting criteria *could* have made a difference, DEEP did not intend to disadvantage farmland. The projects proposed for farmland received three out of a possible five points awarded for siting criteria (a very small percentage of the overall selection criteria) because farmland was classified as "otherwise reclaimed space;" there was very little opportunity for the brownfield projects (getting all five points) to gain any advantage. As noted above, the pricing criteria dominated the point system completely; the siting points were effectively meaningless.

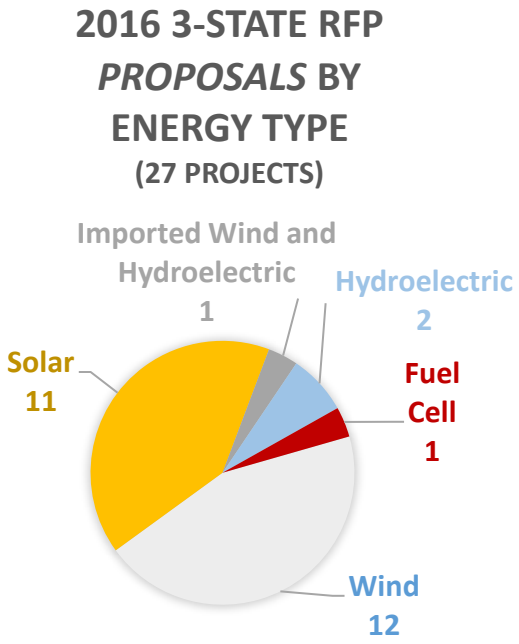
Corn & Birds vs. Kilowatts?
Or Corn, Birds *and* Kilowatts?

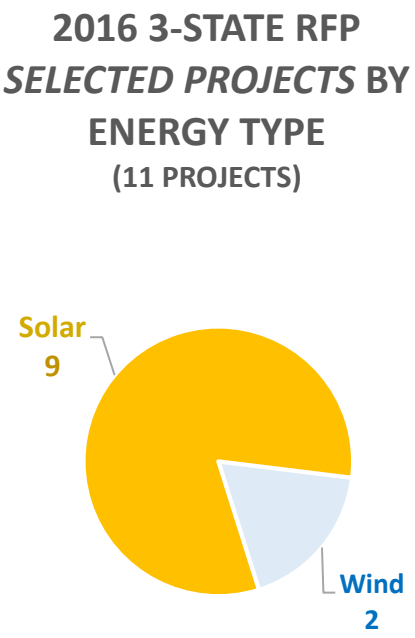
Like all states, Connecticut operates a Department of Agriculture to "foster a healthy economic, environmental and social climate for agriculture by developing, promoting and regulating agricultural businesses; protecting agricultural resources…" To accomplish this mission, Connecticut spends more than ten million state dollars every year, much of which is matched or boosted by federal, municipal and private funds. In 2011, the General Assembly directed the Governor's Council for Agricultural Development to recommend ways to increase consumer spending on food grown in-state to five percent of all food spending (double its current share). Does it make sense for another agency to promote industrial development of productive farmland?

Until the past decade, housing and commercial development were the biggest sectors converting land out of agriculture. Then, according to land-cover data presented in *Environmental Quality in Connecticut*, the acreage of land used for agriculture remained fairly steady during and after the recession that began in 2007. It now appears that development of energy facilities is the largest single factor driving land out of agriculture. While agricultural landowners benefit from leasing land for energy production, other farmers lose leased acreage essential to their business. Connecticut long ago concluded that support of the agricultural sector and conservation of productive land was worth state investment. When the state selects energy facilities solely on the basis of their electricity price, it neglects the costs incurred elsewhere in the economy. Farmland and forest land provide important ecosystem services, including dampening the effects of a changing climate, that benefit Connecticut residents.

In 2016, DEEP worked with Massachusetts and Rhode Island to issue a three-state Clean Energy Request for Proposals for large (at least 20 MW capacity) renewable energy projects. From 27 proposals, which included solar, wind, fuel cells, hydroelectric and interstate transmission lines, the winners were overwhelmingly solar farms proposed for farmland and forest (see Figures B and C, next page).

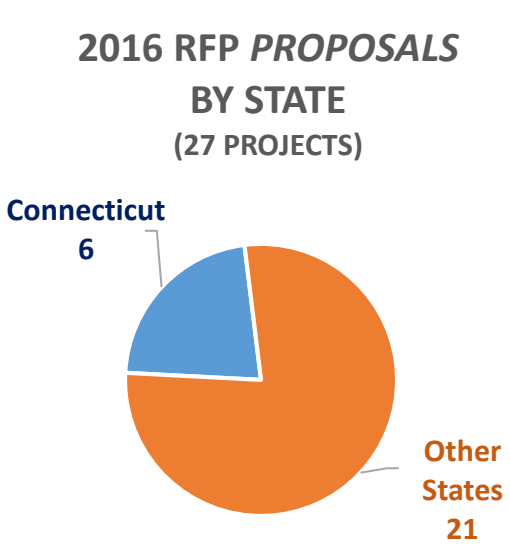
Figure B: Types of Utility-Scale Renewable Energy Facilities, Proposed vs. Selected in 2016

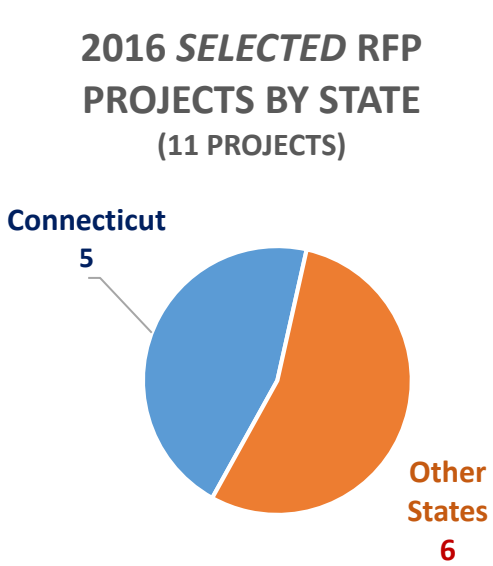




Conclusion: Economic criteria alone strongly favored solar over other project types.

Figure C: Location of Utility-Scale Renewable Energy Facilities Proposed vs. Selected in 2016





Conclusion: The 2016 project-selection process resulted in a disproportionate number of projects in Connecticut. All of the projects selected for Connecticut (unlike other states) were proposed for farmland or undeveloped land.

Breaking News

In late November, 2016, DEEP selected 25 smaller-scale (between two and 20 MW) renewable energy projects out of 105 proposed. Some of the selected projects are proposed for landfills or other previously-developed sites, but the locations of others are not yet available to the Council. Because bidders (and DEEP) are allowed to keep the proposed locations secret from the public, it is taking the Council some time to analyze the siting consequences of this bidding round. When obtained by the Council, the information will be analyzed in a manner similar to the large-scale project information (Figures A through C, above).

The outcome of the 2016 selection process could have been predicted to result in a preponderance of solar photovoltaic power facilities on farmland and forest. Reports from as long ago as 2012 explain very clearly why developers of such facilities prefer farmland.[1] Also, it has been reported to this Council that the site-selection criteria of some solar development companies clearly favor flat, cleared land away from ledge and shallow bedrock that can be developed rapidly. One of the criteria – proximity to transmission facilities – means that some farmland that was adjacent to transmission lines was selected for solar development and probably was not in jeopardy of being developed for other purposes and therefore would have remained productive farmland.

Without policies that guide solar photovoltaic power facilities toward brownfields, industrial lands and other disturbed areas, the market will place them on farmland and forest.

A surprising result (to this Council) of the 2016 three-state RFP process is that two of the six solar photovoltaic power facilities selected for Connecticut were selected by Massachusetts and Rhode Island but not Connecticut itself. Nevertheless, the projects probably will be constructed here.

What is Driving the Push for Solar on Farms and Forests?

The Need for Renewables

For nearly 20 years, Connecticut's electric distribution companies, or EDCs – Eversource, United Illuminating, etc., or what we used to call utilities – have been required by statute to certify that a certain percentage of the electricity sold to customers is from renewable sources (solar, wind, and nine other types). Each year, that percentage escalates. Since 2011, and especially more recently, the state, through DEEP, has assisted the EDCs by selecting renewable-energy projects to supply the EDCs. Generally, as this report documents, the selected projects in Connecticut are solar photovoltaic facilities on farmland and forest land.

Connecticut's EDCs are not expected to meet the minimum required renewable-source electricity this year; they must pay fees (compliance payments) for missing the target.

Large-scale Waste

Much of the electricity generated in Connecticut, including that generated by solar panels, is wasted. This is true because many of the devices using the electricity – air conditioners, heating units, appliances, computers and televisions – are old and/or inefficient, meaning they use measurably more electricity than necessary to get the job done. If Connecticut's residential consumers and companies used more efficient equipment, then the amount of electricity needed from all sources, including renewable sources, would decline.

Energize Connecticut aptly advises residential solar purchasers that "it's important to make your home as energy efficient as possible" first. Meanwhile, utility-scale generation is fed into a system that leaks electricity throughout.

Successful Projects Away from Farm and Forest

The unimpeded rays of the sun that fall on several Connecticut landfills have been exploited successfully, and more landfill-based systems are under development or consideration. DEEP has encouraged municipalities to develop closed landfills for energy production. It maintains a list of 17 municipalities and other entities that are seeking developers interested in solar projects, and offers some incentives. At least two of the 17 are among the sites of smaller-scale projects selected by DEEP in November 2016 (see Breaking News on previous page).

The Hartford Landfill 1 MW solar array started production in 2014

Several large companies have installed significant solar arrays on their roofs. (See below)

What Are the Options?

State Lands -- This Council has received numerous comments from Connecticut residents who have noticed the prominent solar arrays along the Massachusetts Turnpike (I-90). They are indeed prominent, but not truly significant in terms of power production. Their total generation capacity is about six MW. (If on farmland, that capacity would consume approximately 30 acres.)

Could Connecticut identify non-conservation state properties that might be suitable for solar photovoltaic facilities and lease them to bidders? To do so might conserve private forest and farmland and generate revenue for the state. Potential lands might include highway corridors and institutional land. It is an opportunity to explore, but the Council is not aware of many large state properties that would be available. Nonetheless, t**he Council recommends completion of an inventory of such lands**, as the benefits of their development for renewable energy could exceed the costs.

Landfills – The typical landfill solar installation in Connecticut is between one and two MW (but generally toward the lower end of that range). Most of the 17 closed landfills mentioned above are small, but three exceed 50 acres. Based on gross acreage, development of all 17 landfills mentioned above could perhaps yield up to 80 MW of clean electricity – worth pursuing, but not the major portion of Connecticut's goal for Class I renewable energy generation (estimated to be 2,000 MW by 2030). (For perspective, Connecticut's peak electricity demand on a hot summer day reaches about 7,000 MW.) Because nearly every municipality has one or more closed landfills, there likely are additional ones suitable for solar photovoltaic development.

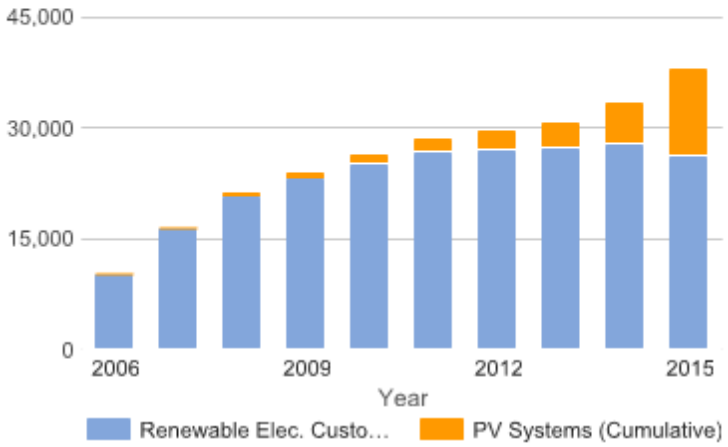
Brownfields and Industrial Lands – If effective incentives were offered to develop solar generating facilities on brownfields (which include derelict or underused contaminated properties but not landfills), could the electricity generation be significant? The National Energy Research Laboratory answered that question for the nation as a whole: only a small fraction of disturbed and contaminated lands are suitable for utility-scale solar photovoltaic facilities, but even those sites would yield enough electricity to meet federal solar-energy goals without disturbing any agricultural or forested lands at all![3]

The national data reveal that the largest contaminated and disturbed sites are well west of Connecticut. For a more local projection, the Unites States Environmental Protection Agency (USEPA), through its Re-Powering America's Land project, estimates that the solar photovoltaic capacity on brownfields and certain other potentially-contaminated industrial lands in Connecticut is about 2,000 MW, an astounding amount that would nearly equal the potential output of Millstone nuclear generating station (which in 2015 produced 46 percent of the electricity generated in Connecticut). However, review of the site-by-site data shows that many of those industrial sites, whether currently contaminated or not, are in use for regular commercial or industrial purposes; the actual area of abandoned or underutilized brownfield properties would yield far less electricity. Nobody knows how many brownfield sites in Connecticut would be suitable. Despite these weaknesses in the USEPA data, the composite potential of these currently unproductive brownfields, of which there are hundreds, could be significant and worth pursuing.

Rooftops – The potential is enormous. Dozens of companies have installed solar photovoltaic panels on their extensive rooftops. These companies stand to benefit financially, in part because of incentives offered through tax credits and successful financing mechanisms adopted to spur the adoption of solar energy. Dozens more manufacturing firms expressed interest in a 2016 incentive program administered by the Connecticut Green bank.

More than 12,000 single-family Connecticut homes sport photovoltaic panels. The growth in residential systems has been rapid (Figure D, next page), and the growth potential is even greater: more than 70 percent of Connecticut homes could benefit from solar photovoltaic systems, according to a 2013 study commissioned by the Connecticut Green Bank.[2] In total, those properties could generate nearly 4000 MW of electricity during the day. Complementary battery storage systems will satisfy part of the nighttime demand. If homeowners who do not have favorable conditions for their own photovoltaic systems were allowed to partner with others through community systems, the potential would be greater still.

Figure D: Households Buying Renewable Electricity and Households with Solar Photovoltaic Systems



The yellow (upper) portion of the bars represent Connecticut homes with solar photovoltaic systems. (The chart is reproduced from Environmental Quality in Connecticut. The blue (lower) portion of the bars tracks customers who buy renewable electricity through a program that was discontinued in 2016.}

In sum, the potential for solar development on rooftops is so great that development of farm and forest land for electricity production could be redundant. The National Renewable Energy Laboratory estimated in 2012 that the generating capacity of solar panels on all suitable rooftops (including residential, industrial and commercial) in Connecticut would be 6,000 MW, equivalent to photovoltaic facilities on nearly 30,000 acres of rural land.[4] Assuming this estimate of technical potential to be wildly optimistic (and bringing it in line with the 2013 study of residential solar potential, discussed above), an estimate of 60-percent development of the rooftop potential would yield electricity generation equivalent to 18,000 acres of installations on rural fields and forests.

The corporate and manufacturing headquarters for Polamer Precision, Inc., in New Britain

Despite the potential for rooftop solar generation to dwarf what is being developed on farms and forests, the latter cannot simply be cast aside in favor of more rooftop generation, at least under current statutes. Rooftop generation generally is developed "behind the meter" to reduce the property owner's own electricity purchases, not to supply the grid and EDC with a stream of renewable electricity for its portfolio. If utility-scale generating facilities on farm and forest are to be displaced by rooftop generation, statutes will need to be amended extensively (following a thorough study of the potential benefits and inefficiencies).

Connecticut's Sustainable Economy

Achieving Connecticut's goals for stability, efficiency, land conservation, economic opportunity, health and happiness requires more than a fixation on the lowest price for a commodity. To choose a supplier solely because its product is the cheapest ignores the costs that its production imposes elsewhere in the economy. In the case of solar photovoltaic generation, widespread use of farmland and forest is likely to result in several costs that should be considered in decision making: the reduction in available farmland and consequent rent increases; the loss of jobs in agriculture and forestry; the continued costs of carrying brownfields and under-utilized lands that could be hosting energy facilities if those facilities were not built on green fields; the additional costs of finding alternate uses for the brownfield sites; the loss of jobs in one renewable-energy industry that is based in Connecticut if another technology built with imported materials is selected instead; the additional costs of making up lost progress toward the state's goals for Connecticut Grown food and wood; and ecological costs such as habitat fragmentation and destruction .

The Balance Trap

The simultaneous pursuit of two state goals which appear to be in conflict is often portrayed as a balancing act. Unfortunately, the "balancing" approach usually results in the diminishment of both pursuits. In the case of renewable energy and the conservation of land – two goals in which the state has invested much – the solution is to integrate or harmonize the two: find a way to stimulate the development of renewable energy on appropriate sites while continuing policies that conserve productive lands. An integrated approach will require accurate evaluation of all costs and benefits.

In future rounds of renewable project selection, **the Council recommends that DEEP 1) develop a formula for assessing the comprehensive costs of each proposal and 2) select projects from the vantage point of leveled costs**. Identifying all of those costs and their value would require a thorough analysis. One economist has suggested that proposals for solar photovoltaic facilities should carry a two-cents-per-kilowatt-hour penalty when competing for selection against other renewable sources. With expert analysis, accurate costs could be calculated and used to select projects advantageously and to properly value incentives that might be offered.

Incentives?

The Connecticut Green Bank manages powerful incentives for solar development. However, its successful efforts to spur solar development by homeowners and corporate consumers have not eliminated the push for utility-scale solar photovoltaic facilities that consume farm and forest. If

Connecticut continues to seek utility-scale solar photovoltaic generation, incentives will be needed to overcome the market's bias toward farmland and forest.

The Department of Economic and Community Development periodically awards competitive grants to municipalities to assess and/or clean up brownfield properties. Points are awarded for projects that include renewable energy production, but the total (five out of 130) probably is too small to be a powerful incentive. Developers will need something more substantial to abandon farm and forest for brownfields, especially brownfields that might be small and scattered.

Major impediments to siting generating facilities on brownfields are the same ones that impede other types of development: the cost, time and uncertainty inherent in cleaning up contaminated property. As long as it is faster, cheaper, and more certain to develop on uncontaminated properties, the results are predictable: Connecticut residents will watch productive green lands be converted to industrial uses while the abandoned properties sit idle, untaxed and possibly blighted. There is, however, a big difference between most uses and a solar photovoltaic facility: the solar facility has no one living or working in a building on the property. If the choice is to have the property sit contaminated and abandoned for decades longer or to have it covered in solar panels, the latter might be the better choice, especially if the developer is required to set aside some portion of the energy revenue for cleanup. **The Council is recommending exploration, perhaps through a pilot program, of incentives that would lead to use of brownfields for solar development.** Very importantly, this incentive should apply only to sites that do not have contaminated groundwater flowing to adjacent properties or volatile chemicals that would present a risk to people (a qualification that will limit substantially the number of potential sites).

Regulation of Location

Under current law, there are only two major governmental decision points influencing the siting of utility-scale solar photovoltaic facilities: 1) DEEP's selection of renewable-energy projects for electricity procurement, discussed above, and 2) approval by the Connecticut Siting Council.

Most large fossil-fueled electric generating facilities proposed in Connecticut must obtain a Certificate of Public Need and Environmental Compatibility from the Connecticut Siting Council. The application process for obtaining a certificate affords each project a high level of scrutiny and grants the Siting Council considerable decision-making discretion. However, neither is true for utility-scale solar facilities. Because of a law adopted in 2005[5], years before the current solar boom, renewable energy projects less of less than 65 MW generating capacity need not obtain a certificate.

> **"Section 16-50k** – Notwithstanding the provisions of this chapter or title 16a, the council **shall approve by declaratory ruling** [that no certificate is required for]… the construction or location of any customer-side distributed resources project or facility or grid-side distributed resources project or facility with a capacity of not more than sixty-five megawatts**, as long as such project meets air and water quality standards** of the Department of Energy and Environmental Protection." [emphasis added]

In Connecticut, utility-scale solar photovoltaic facilities are always less than 65 MW. As long as a project avoids significant impact to wetlands and watercourses, it will be approved. There are several deficiencies evident in this nearly-automatic approval required by statute; examples include:

- A 65 MW solar facility approved by declaratory ruling would consume more than 300 acres.
- If an entire project were proposed for prime agricultural soils, the Connecticut Siting Council would have no option but to approve it by declaratory ruling.
- If a project would eliminate the only known habitat of a rare species (not a wetland or watercourse), the Siting Council would have no option but to approve it by declaratory ruling.
- Destruction of historic or cultural sites cannot be considered.

The Council on Environmental Quality concludes that the 65 MW exemption is ill-suited to utility-scale solar photovoltaic installations (while being potentially useful to less land-intensive technologies). The General Assembly should amend the exemption to require utility-scale solar photovoltaic facilities to obtain a Certificate of Public Need and Environmental Compatibility and should require the Connecticut Siting Council to consider the impacts to agricultural land and the full range of environmental impacts it normally considers when evaluating energy projects.

Connecticut's 2013 Comprehensive Energy Strategy (CES) envisioned careful siting: "It is important that each renewable power project be considered in light of other state policy objectives, such as optimizing the way land is used in the state." (Page 90, CES)

Under current laws, such consideration of land-use objectives cannot be realized.

Can Utility-Scale Solar Photovoltaic Electricity Generation be *Good* for Agriculture?

In the long-term, probably not. Solar developers have asserted that photovoltaic generation could be regarded as a temporary use of land that, once restored 30 years hence, could be returned to growing crops. Information submitted to the Connecticut Siting Council by the Commissioner of Agriculture disputes that assertion, noting the trenching, mixing of soil layers and other insults to the land.[6] In one case, the soil reportedly was removed from the site. Nearly all site plans include extensive erosion and sedimentation controls, an acknowledgement that existing soil layers are being disturbed.

Other arguments have been made to the effect that farming is an uncertain business for which leasing some land for electricity production could be a stabilizing force, and in some cases essential to the long-term prospects for a farm's success. The Council on Environmental Quality does not recommend that such farms be prohibited from leasing their land for electricity production. However, the Council notes that the potential benefit to individual farms is not evaluated by DEEP when it selects renewable-energy projects, nor does DEEP consider the impacts to individual farms that might *lose* critical leased farmland. Furthermore, it appears that many solar facilities could be expanded easily to consume more of the farm. One cannot conclude, without further research, that utility-scale energy facilities are good for the overall agricultural sector in Connecticut. In any event, there should be no need to sacrifice agricultural production to increase electricity production.

Looking Ahead

The National Renewable Energy Laboratory is studying ways to integrate agriculture with solar facilities as an alternative to "balancing" the two.

Minnesota has adopted laws and policies to encourage solar photovoltaic facilities to be planted with pollinator-friendly plants. For Connecticut, this would appear to be a beneficial approach to solar facilities, but not a reason to place the facilities on farmland.

Connecticut offers "virtual net metering" policies that offer incentives for the placement of renewable energy facilities on farms *when they benefit the agricultural business*; these policies are beneficial and could be expanded if they do not take prime agricultural soils out of production.

How Have Other States Responded?

Many states, counties and municipalities have recognized the contradiction inherent in sacrificing valuable natural and economic resources for electricity production. The following is a very small sample of legislative responses. (All actions apply to utility-scale solar photovoltaic facilities.)

- Wright County, Minnesota, enacted a six-month moratorium on applications in 2016, while neighboring Stearns County convened a work group to recommend ordinance revisions, adopted in December, that require solar installations to provide habitat for pollinators.

- Baltimore County, Maryland enacted a four-month moratorium to allow for a study of economic and environmental impacts.

- Santa Clara County, California, specifically prohibits facilities on certain agricultural lands and allows them on others that are deemed to be of marginal quality for farming purposes (Ord. NS–1200.331, adopted in 2010).

- The New Jersey Energy Master Plan 2015 Update: "The State should continue its policy of discouraging the development of solar farms on farmland and undeveloped open spaces, such as forests, and encouraging their placement on or above impervious surfaces or on landfills, brownfields or areas of historic fill."

- Monson, Massachusetts approved a bylaw amendment restricting large solar facilities to industrial and commercially-zoned districts.

- Talbot County, Maryland enacted a six-month moratorium on solar arrays larger than two acres to "consider the impact of solar array energy systems on environmentally sensitive areas and agriculturally productive lands."

Unanswered Questions

These questions were raised but not answered by the Council's research to date.

- If DEEP were to select a solar development proposed for industrial land that submitted a price of one-half cent per kilowatt hour more than a project proposed for farmland or forest, what would be the financial impact (if any) to the ratepayer? This type of question needs to be answered accurately in order to evaluate proposals optimally and to place a value on incentives.

- Can facilities be steered away from farmland and forest and toward previously-developed land by offering statewide site information and guidance? To the Council, this suggested approach seems speculative if the decision-making criteria continue to emphasize price above all else.

- Which utility rights-of-way, which already consume considerable acreage, could accommodate solar photovoltaic generation? Could the benefit of the generation's proximity to the grid (in the case of electricity-transmission rights-of-way) help to overcome problems inherent in using the transmission corridors for generation?

- What is the potential for solar photovoltaic facilities over parking areas in Connecticut?

Notes

1. *Solar Siting and Sustainable Land Use*, Association of New Jersey Environmental Commissions, 2012, available at http://www.anjec.org/pdfs/SolarWhitePaper2012.pdf

2. *The Addressable Solar Market in Connecticut*, prepared for Connecticut Clean Energy Finance and Investment Authority (now the Connecticut Green Bank) by GeoStellar, Inc., 6 December 2013, available at http://www.ctgreenbank.com/wp-content/uploads/2016/03/Total_Addressable_Market_CT_Final.pdf

3. *Solar Development on Contaminated and Disturbed Lands*, National Renewable Energy Laboratory, December 2013, available at http://www.nrel.gov/docs/fy14osti/58485.pdf The estimates in this document are based on a conservative formula where one MW of photovoltaic generation needs 10 acres; most estimates use a ratio of one MW to five acres.

4. *U.S. Renewable Energy Technical Potentials: A GIS-Based Analysis*, National Renewable Energy Laboratory, July 2012, available at http://www.nrel.gov/docs/fy12osti/51946.pdf

5. The proposal to exempt facilities up to 65 MW from the certificate requirement was not the subject of a public hearing at the Connecticut General Assembly; the exemption was inserted via a floor amendment.

6. Commissioner of Agriculture Steven K. Reviczky, letter to Connecticut Siting Council Re: Petition No. 1224, May 11, 2016, available at http://www.ct.gov/csc/lib/csc/pending_petitions/2_petitions_1201through1300/pe1224-deptagriculturecomments.pdf