Delaware Department of Agriculture

Solar Technology Guide & Resources V.1.0

March 31, 2011

Prepared by: Brian K. White, Lally White LLP

Table of Contents

Solar Technology in Delaware Agriculture

Solar Photovoltaics or Solar PV is a developing technology that is not fully understood by many. The majority of skepticism to date has been placed on pricing, and correctly so. A few years ago the cost to install a solar PV array was substantially above the market price for electricity in Delaware. Market and regulatory forces have recently converged to materially reduce the cost of solar technology. As a result, solar projects are now more feasible than in the past and may benefit the agricultural community in Delaware by providing stable, environmentally friendly electrical energy at a fair price. Best practices are also emerging to help reduce the risk in solar project development and increase the benefits to interested parties.

Understanding the varied aspects of a solar project is essential to determine if solar is right for your agricultural operation. The Delaware Department of Agriculture (DDA) developed this guide as an educational resource to assist agricultural entities in understanding the numerous and interconnected aspects of a solar project. And, on a preliminary basis, aid in the assessment of its feasibility within their operations.

Solar Project Feasibility Considerations

From energy cost reductions and energy price certainty to environmental benefits, there are many potential reasons to consider solar for your operation. Environmental benefits aside, two primary determinants for feasibility are the system's ability to match end-user electric demand and the system's price. Historical electric usage, consumption patterns, and current and projected electric prices must be assessed to determine the likelihood of any proposed system's ability to provide an appropriate energy supply at a competitive price. The feasibility of any solar project should consider the current regulatory environment including interconnection and transmission considerations, available financial incentives, a physical site evaluation, available technology, and financing options. A well-designed system should optimize all of these aspects to arrive at the lowest possible price to achieve the maximum benefit.

Regulatory Environment

Delaware's regulatory environment is comprised of laws designed to support the implementation of renewable energy resources for economic and environmental reasons and the oversight of electric service providers within the state. An understanding of the key regulatory aspects is important when considering a solar project. Key regulatory considerations include:

Renewable Portfolio Standard (RPS)

Delaware is among 29 other states that have adopted a renewable portfolio standard or RPS. An RPS is a regulation that requires the increased production of energy from renewable energy sources, such as solar, wind, biomass, and geothermal. Delaware recently modified its RPS to increase the renewable percentage to 25% by the year 2025 with 3.5% dedicated to solar.

Net Metering

Net metering enables renewable energy system owners to offset their consumption over a billing period by allowing their electric meters to "spin backwards" when they generate electricity in excess of their demand. System owners are compensated for excess electricity they generate. Delaware recently modified its net metering regulations to allow entities that have multiple meters at one location and/or multiple locations (within the same service providers territory) to aggregate and net the metered demand of all meters combined together.

Electric Service Providers

Delaware is served by three energy service providers: Delmarva Power (DPL), The Delaware Municipal Electric Corporation (DEMEC), and The Delaware Electric Cooperative (DEC). DEMEC is comprised of nine municipalities. Currently, DPL is the only regulated utility in Delaware and is required under the RPS to purchase a certain percentage of energy, including solar, from renewable energy resources. DEMEC and DEC currently are proceeding with renewable energy implementation on a voluntary basis and are required by 2013 to achieve similar goals set by the RPS.

Financial Incentives

A variety of financial incentives are currently available to reduce the cost of solar project development. These incentives typically correlate to market conditions and can vary over time. Key financial incentive considerations include:

Solar Renewable Energy Credit (SREC)

A solar renewable energy credit or SREC is generated from a solar installation. One SREC is created for every 1,000 kWh of solar energy. SREC credits can be sold in various markets for cash and play an integral role in reducing payback periods for a system purchase and a decisive role in financing solar systems. As a result of recent changes to Delaware's RPS, SREC prices are expected to be standardized for a 20 year term. A stable SREC market provides a level of certainty to both system payback periods and financing options.

Investment Tax Credit (ITC)

An investment tax credit or ITC provides a reduction in tax liability and is available for investments made in a solar energy project. Currently, federal ITC is 30% of the cost of development, with no cap, through the year 2016. ITC can be utilized for both commercial and residential solar installations and is generated when the system is placed into service. Another federal incentive currently available to solar projects is an accelerated depreciation schedule. The accelerated depreciation provides additional tax benefits.

Renewable Energy Grants

Delaware's Energy Office (DEO), a division of the Department of Natural Resources and Environmental Control (DNREC), established the Delaware Green Energy Program to provide cash grants to individuals and businesses for the installation of renewable energy systems. Solar is a qualifying technology. Solar grant amounts and terms vary by service provider and are periodically adjusted by DEO to account for market variables, such as consumer demand and installation cost. Up to date grant information can be found online at www.dnrec.delaware.gov/energy/Pages/default.aspx .

Other Incentives

In-state labor bonuses
In-state equipment manufacturing bonuses

Site Evaluation

With an understanding of the regulatory environment and financial incentives, the process of analyzing the feasibility of solar energy begins with a site evaluation. The two primary installation types applicable to agriculture are ground mount systems and roof mount systems. Both require large open space to accommodate solar equipment.

Physical attributes such as shading, general soil conditions and grading, roof conditions, roof warranties and replacement schedules, environmental concerns, safety considerations,

vandalism potential, meter location, and other specific site characteristics must be evaluated on a site-by-site basis. Key considerations for roof mount and ground mount site location include:

Roof Mount Systems

These systems utilize open roof space for power production, have a minimal impact on productive or potentially productive facility footprint, reduce safety and vandalism concerns due to the location of the hardware, and have negligible transmission loss. Roof mount solar is limited by the available open space which may limit system size and output potential. Roof mount installations can be more expensive than ground mounted solar due to higher labor expenses. Structural limitations and technological barriers are also limiting factors.

Ground Mount Systems

These systems are typically constructed in fields or other locations with ample open space, minimal to no shading, and little existing or potential economic value. Ground mount systems are typically less expensive to install due to the relative ease of installation. Technological flexibility is a hallmark of ground mounts as different solar modules and sun-tracking systems can be used to optimize power production. Drawbacks include heightened concerns and added expense for safety and vandalism issues, potential transmission loss due to interconnection location, and lack of appealing aesthetic options.

Technology

Solar systems are comprised of a variety of technological components. Key technology considerations include:

Solar Modules

Modules or “solar panels” convert the sun’s energy into electricity. Price, quality, product warranty terms, and efficiency (a measure of the sun’s power converted to electricity by a module) are important factors in selection.

Racking Systems

Racking is used to optimize the angle of the solar array to the sun to maximize output.

Inverters

Electrical components that convert the direct current produced by the modules to useable electricity in the form of an alternating current. Maximizing efficiency to keep inverter losses low becomes an important factor to consider in their selection.

Tracking Systems

Tracking systems can improve solar output from ground mount systems. Using single or dual axis tracking technology, they continuously orient the array to the sun to maximize output. Drawbacks include system reliability, potential for increased operation and maintenance expense, geographical constraints, and increased financing risk.

Monitoring Systems

Computer-based systems that provide remote access to system performance. These systems are critical to ensure the solar array is working properly and output is within an acceptable tolerance range.

Electrical Equipment

Miscellaneous equipment that completes the system is comprised of standard, off the shelf wiring, boxes, clips, connectors, and other necessary materials.

Financing

The final component to assess the feasibility of a solar system is the financing options available to fund and implement a proposed system. The up-front capital costs to construct a solar system are large. While the actual power resource (the sun) is free, the initial capital outlay is essentially paying for all the power the system will produce upfront. The upfront capital costs are onerous and can prevent implementation in many instances. Key financing considerations include:

Direct Purchase

Purchasing the system outright via cash or credit is the most straightforward financing option. The host contacts a solar installation company to build a solar array and utilizes cash on the balance sheet or debt to pay for the system. The host takes full ownership of the system and retains all the direct and ancillary benefits including:

- A fixed price of energy generated from the system for the life of the system
- Access to Federal and State tax incentives related to renewable energy system construction
- Potential access to State Green Energy Fund grants and/or other incentive-based programs related to the implementation of a renewable energy system
- Ownership of Solar Renewable Energy Credits (SRECS)

Some potential drawbacks include:

- Large up-front capital outlay
- Potential inefficient utilization of tax credits, accelerated depreciation and other incentive programs
- Permitting, environmental, safety, and monitoring expenses
- Ongoing operation and maintenance expenses

Power Purchase Agreement (PPA)

With a PPA, the host enters into an agreement with an investor and only pays for energy actually produced and supplied by the system. The investor aggregates and monetizes the various incentive programs (tax credits, SRECS, etc.) to gain access to project financing. Once financing is in place, the investor provides the upfront capital and contracts with a solar installation company to build the project. The project is placed into service, begins to generate electricity and power is supplied to the host. The investor owns the system and sells the energy to the host. Benefits include:

- Zero to minimal upfront capital requirement

- Pricing fixed for the term of the PPA (typically 20 years with an escalation rate embedded in price)
- Investor responsible for operation and maintenance expense
- Investor responsible for monitoring and billing expense
- System purchase options at various times during the PPA contract
- Flexible end-of-term options including: system purchase at fair market value, extend the term of the PPA, or remove the system at investor expense
- Maximizes value of various incentive programs

Some potential drawbacks include:

- Legal review and expense
- Host transfer of environmental attributes such as SRECS to investor
- Superior host credit rating required
- Small systems can be less feasible with a PPA than larger systems

Equipment Lease

Another financing option available to a potential host is a lease structure. A lease can greatly reduce or eliminate the large capital expense associated with a balance sheet purchase. In a typical lease structure the host contracts with a solar installer to construct the system and accesses financing via the lessor (owner of the system) to pay monthly lease payments rather than paying for the entire system upfront. Some general advantages to leasing include:

- Minimal to zero upfront capital requirement
- Lease payments may be fixed
- A net reduction in total expenses (power and leasing) vs. escalating market prices for electricity
- Lessor may guarantee system output
- Flexible end-of-term options including: system purchase at fair market value, extend the term of the lease, removal of the system at lessor expense

Some potential drawbacks include:

- Lease payments may vary and escalate over time
- Host may retain operation, maintenance, and monitoring expenses
- The system's solar power production may not be applicable to further offset host power demand above the contracted amount
- Superior host credit rating required
- Sale of the facility may result in ownership sale complications arising from the transfer of lease responsibilities
- Potential loss of access to state and federal tax incentives
- Potential loss of rights to environmental attributes such as SRECS

Third Party Land Leases

Another mechanism by which the agricultural community can participate in solar project development is a third party land lease. In a typical third party land lease the host leases a parcel

of land to a solar developer to install and operate a solar array as an independent power producer or IPP. The host receives no electric power from the project but does receive land lease payments from the developer. Some general advantages to leasing include:

- Lease payment income stream
- Potential for higher land valuation than in agricultural production
- Potential use of fallow or non-productive land
- Removal of the system and land restoration at lessor expense

Some potential drawbacks include:

- Legal review and expense
- Sale of the property may result in ownership sale complications arising from the transfer of lease responsibilities
- Potential loss of productive tillable land for term of lease

How Do I Know if Solar is Right for My Operation?

With an understanding of solar feasibility considerations, the balance of this guide provides Examples of Potential Solar Applications in Agriculture, a Solar Feasibility Decision Tree to aid in determining if solar is right for your operation, Best Practices when contacting solar installation companies, and Additional Resources to further your understanding of solar.

Examples of Potential Solar Applications in Agriculture

To further assist in understanding solar applications in agriculture, an analysis of three typical agricultural applications have been provided for high-level evaluation purposes. These examples do not include any residential or other secondary electrical energy demand sources. As every operation is different, the specific application and appropriate solar PV system can only be determined on a case-by-case basis.

Center Pivot Irrigation System with an Electric Motor Powered Pump

- Center Pivot Size: 100 Acres
- Water Applied Annually: 10 inches
- Annual Electrical Energy Demand: 18,000 kWh
- Solar PV System Size to Meet Demand: 14 kW
- Size of PV Array: 76 Solar Modules
- Approximate Array Footprint: 3,000 square feet (e.g. 25 ft. by 120 ft.)

Grain Farm with Out-Buildings Including a Shop and Grain Dryer

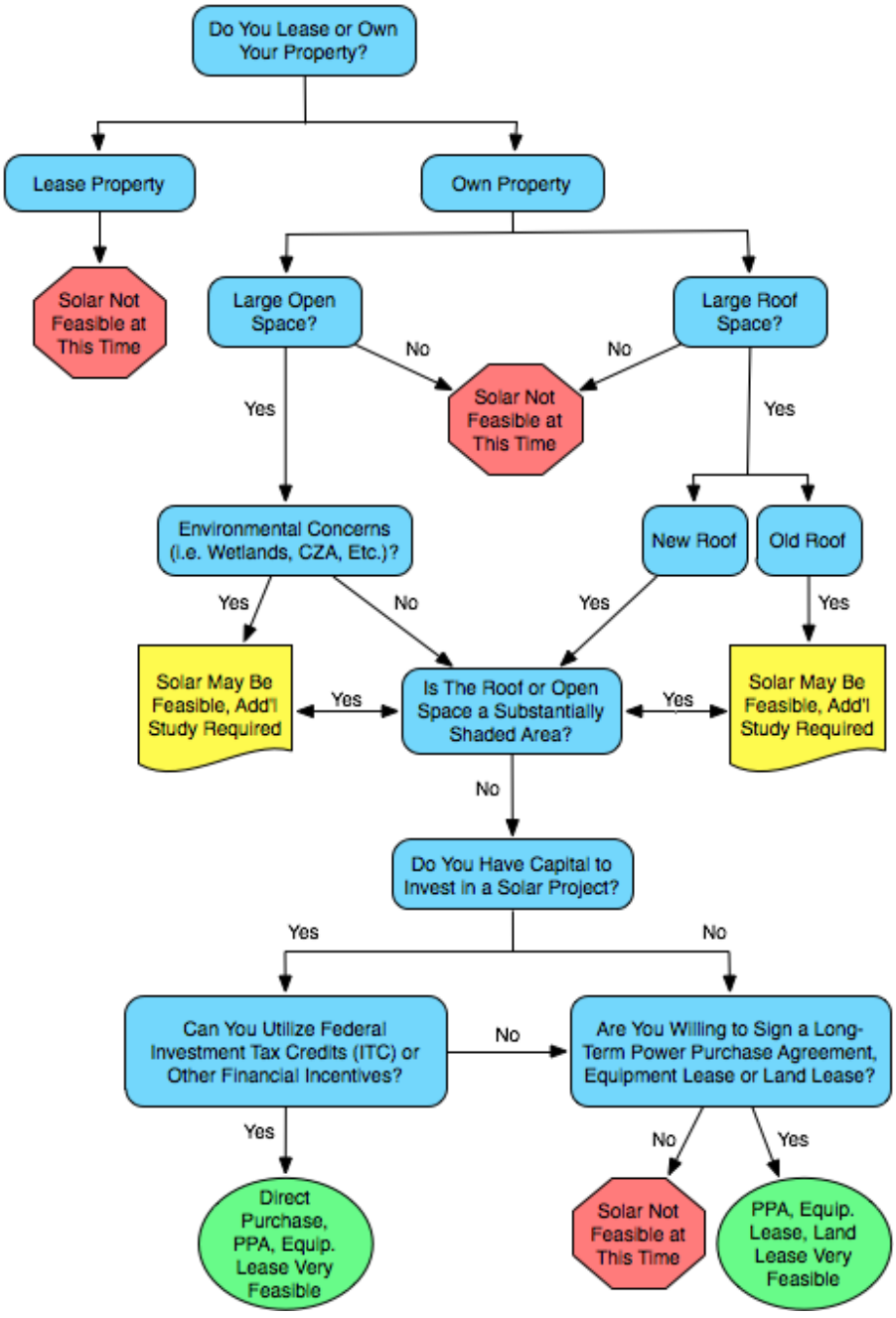
- Farm Size: 1,000 Acres
- Annual Electrical Energy Demand: 12,000 kWh
- Solar PV System Size to Meet Demand: 10 kW
- Size of PV Array: 45 Solar Modules
- Approximate Array Footprint: 2,200 square feet (e.g. 25 ft. by 90 ft.)

Poultry House

- House Size: 40 feet by 500 feet
- Annual Electrical Energy Demand: 30,000 kWh
- Solar PV System Size to Meet Demand: 25 kW
- Size of PV Array: 130 Solar Modules
- Approximate Array Footprint: 5,000 square feet (e.g. 25 ft. by 200 ft.)

Solar Feasibility Decision Tree

The Solar Decision Tree can help you self-assess the high-level feasibility of solar energy on your operation. It asks questions and provides outputs to assist you in the decision making process.



Best Practices

When considering any solar project, having an organized plan can reduce risks, increase benefits, and effectively aid in determining whether solar is right for you. Some best practices to developing a plan include: collecting pertinent information about your operation, knowing how/where to locate qualified solar installation companies, and asking solar installation companies the right questions.

Information You Will Need Before Contacting Solar Installation Companies

- Number and address of electrical meters
- Copies of 24 to 36 months of your electric bills
- Potential site locations (i.e. ground or rooftop)
- If considering a rooftop location: the age and type of structure, type of roof, age of roof, roof warranty information, and shading level
- If considering a ground location: space size in acres, open or foliaged, identified environmental concerns and/or CZA, and shading level

Locating Solar Installation Companies

An up to date list of participating Delaware solar installation contractors can be found at the DEO website at www.dnrec.delaware.gov/energy/services/GreenEnergy/Pages/PVInstallers.aspx.

12 Questions to Ask Solar Installation Companies

- Where is your company located?
- How long have you been in business?
- How many solar installations have you completed?
- Do you use your own employees or sub-contract aspects of the solar installation?
- Do you have a valid contractor's license?
- Do you have a master electrician on staff?
- Is you installation team certified by NABCEP (North American Board of Certified Energy Practitioners)?
- What module and inverter brands do you represent?
- Do you handle the paperwork, permits, and interconnection of the system?
- Does your company manage the sale of my SRECs?
- What financing options does your company offer (i.e. equipment lease, PPA, etc.)?
- Can you provide references and/or examples of completed projects?

Proposal Considerations

To help ensure proposals from multiple vendors can be accurately compared, key assumptions should be constant across several proposal variables. Some important considerations include:

- Life expectancy of solar system
- Escalator rate used for electricity prices
- Solar system efficiency degradation rate over time
- SREC sale price

- Timing and cost of inverter replacement
- System resale value
- Amount and date of expected receipt for any Delaware State grants/rebates and/or federal tax credits
- Maintenance cost

Additional Resources

- Delaware Department of Natural Resources and Environmental Control (DNREC)
  - www.dnrec.delaware.gov/Pages/default.aspx
- Delaware Energy Office
  - www.dnrec.delaware.gov/energy/Pages/default.aspx
- Delaware Solar Energy Coalition (DSEC)
  - www.delsec.org
- Internal Revenue Service (IRS)
  - www.irs.gov
- National Renewable Energy Laboratory (NREL)
  - www.nrel.gov
- Solar Energies Industry Association (SEIA)
  - www.seia.org
- United States Department of Agriculture (USDA)
  - www.usda.gov
- United States Energy Information Administration
  - www.eia.doe.gov