Solar Power
Demonstration Project Report

Roof-Mounted Solar Installations

Oberlin, Ohio
and Other AMP-Member Ohio Communities

May 1, 2011

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SOLAR POWER DEMONSTRATION PROJECT REPORT

ROOF-MOUNTED SOLAR INSTALLATIONS

1. EXECUTIVE SUMMARY

In recent years, both the State of Ohio and the federal government have offered unprecedented support and financial incentives for the development of renewable energy technologies. This support has given rise to a variety of installations across the State that range from small residential photovoltaic arrays and wind turbines to utility scale solar and wind farms. This is the second of three reports that will evaluate the issues and opportunities facing renewable energy development in the 9th Congressional District. The first report focused on wind energy development, while this report will review roof-mounted solar installations, and the third report will consider solar farms. Each of these reports will focus on renewable energy development through the lens of a model project in Oberlin, Ohio. In this report, we will outline the applicable subsidies and financing mechanisms that can be utilized by roof mounted solar projects as well as the regulations that may impact a potential project. Furthermore, we will provide an overview of the various ways that solar installations can and are being structured and how communities across the District can evaluate these projects. Lastly we will highlight several America Municipal Power (AMP) cities within the District that could adapt the proposed Oberlin model.

The solar resources available in Ohio are significant, and in many cases are comparable to the resources available in states that are rapidly developing new solar installations like New Jersey and Massachusetts, and even exceed the resources in countries like Germany and Italy who have been leaders in the deployment of solar energy. The key to the viability of large-scale solar is not just the solar resources available in a given location, but also the presence of sustained and significant programs available to support solar energy deployment. Over the past few years, as both the federal and state government have increased their support of renewable energy, we have seen a marked increase in solar installations across the State of Ohio. Ohio's place as a potential leader in the solar energy field is aided by both its adoption of Renewable Portfolio Standards, which gave rise to the State's solar renewable energy credit (REC) market, and the burgeoning photovoltaic manufacturing firms and critical supply chain businesses that are emerging within the State. The Oberlin case study outlines the viability of rooftop solar installations assuming the continuation of the current federal and State support. The case study also reviews the various development methods that are occurring across the State and highlights the power purchase agreement structure as good vehicle for the continued deployment of rooftop solar projects in the 9th Congressional District.

2. SOLAR POWER OVERVIEW

2.1. POWER FACILITY BASICS

This section introduces the basic components and concepts of a solar photovoltaic (PV) system.

Components.

Solar PV systems include several components working together to convert the sun's energy into electrical power that can be connected to a building's standard electrical infrastructure and the utility grid.

- **PV Cells**. PV cells are the basic engine of a solar power system. PV cells convert the sun's energy into electricity. When sunlight hits a PV cell, it produces an electric current.
    - A crystalline PV cell is most often made of a thin wafer of silicon modified with small amounts of other materials that give the silicon wafer special electrical properties.
    - A thin film PV cell is made of very thin layers of semiconductor materials allied to glass or in some cases a plastic material. Thin film performs better in diffuse light and usually costs a little less but its conversion efficiency is usually half that of crystalline cells and therefore requires more overall space to generate a similar amount of energy.
- **Solar Modules**. PV cells are connected together in a solar module, which usually has a non-reflective glass front, a protective insulating backsheet, and usually an aluminum frame for strength and mounting. Typical grid tied modules are currently sized between 170 Watts (W) DC and 300W DC.
- **Module Series String.** In most applications, modules are interconnected electrically in groups called series strings or strings for short. Connecting in this fashion allows the DC voltage to be increased for more efficient energy transfer.
- **Combiner**. The combiner connects multiple wires carrying the electrical current generated by individual solar panels together into a single, larger capacity wire, which then flows to the inverter. The combiner works in a solar electrical system much like a manifold does in a hydraulic system.
- **Inverters**. The inverter transforms direct current (DC) electricity produced by the solar panels into alternating current (AC) electricity -- the form of electricity used by most standard lights, motors, computers and air conditioners. They employ sophisticated electronics and software algorithms to manipulate the incoming voltage and current parameters to create the maximum energy for the given operational conditions. The inverter also provides safety functions such as automatic shutdown of the solar electric

system in the event of grid power failure. Inverters are configured for single or three phase operation or are provided with a suitable transformer to match the electrical grid voltage at the Point of Interconnection (POI).

- **Micro-Inverters**. Micro-inverters are newer technology that pairs a smaller inverter with either one or two modules, and are installed underneath each PV module. They main benefits are that they reduce the space needed in an electrical closets or on ground level walls (thus enhancing aesthetics), and they provide the greatest flexibility relative to shading concerns in problematic mounting locations because only one module is being affected by the shading instead of a string of modules. Micro-inverters will cost more per project than string or central inverters.

- **String Inverters**. These are stand-alone units, larger than micro-inverters, and are usually hung in an electrical closet or on a nearby wall. String inverters can be deployed on projects of any size, but are typically used for residential and small commercial projects or where there are numerous orientations of the PV modules. They are typically sized to accommodate between 2 and 10 kilowatts (kW) of modules. They are approximately 18 inches wide and 30 tall. They require typical National Electric Code (NEC) clearances to the front and side.

- **Central Inverters**. These are large (refrigerator- or larger-sized) units that are typically deployed on bigger projects (over 30 kW). Central inverters are preferred on suitable projects because they can reduce overall system costs. Central inverters are manufactured in the following sizes (kW DC): 30, 50, 75, 100, 125, 250, 500 and 1000. Larger systems are configured around theses sizes and may use combinations of them in the design. Like string inverters, they require the modules to be grouped in series strings to increase the voltage. A 100kW central inverter typically requires 4'x5' of ground space with typical NEC clearances to the front and sides.

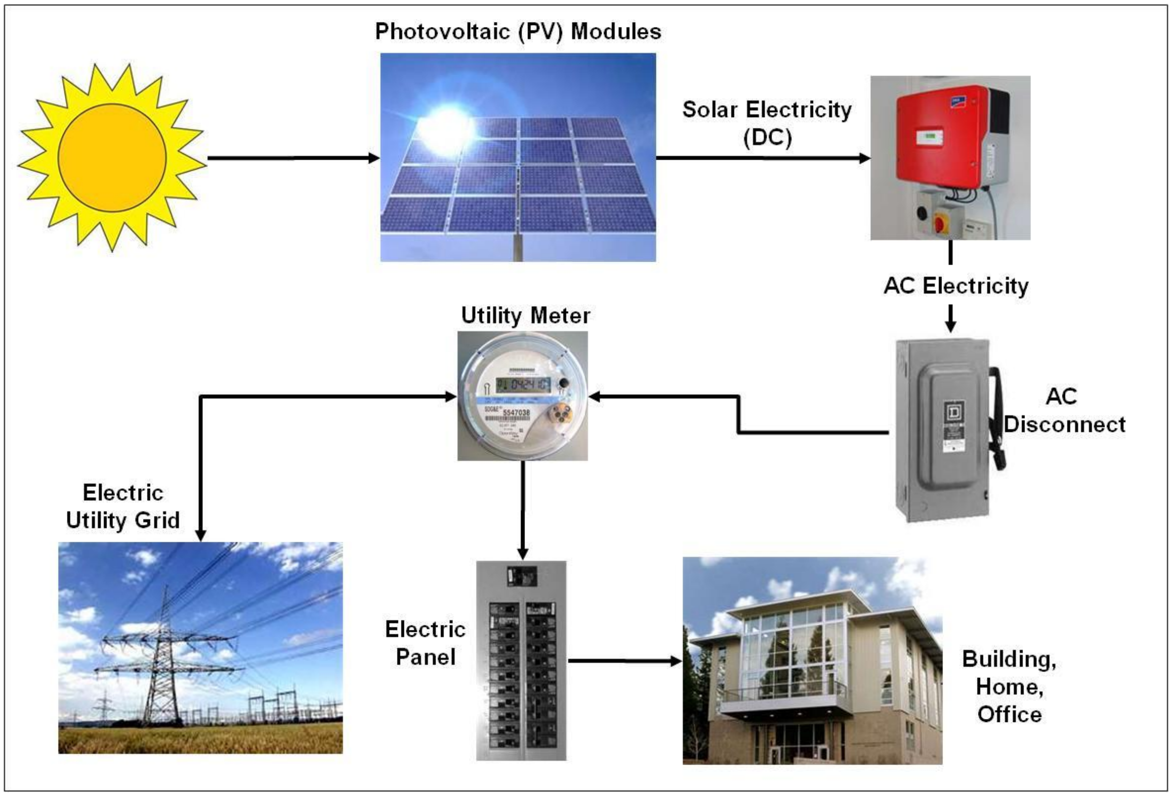
- **Inverter Location**. The optimal placement for a string or central inverter is to locate it as close to the POI as possible. The larger (central inverter) units can produce 50-65 decibels so placement should also take that into consideration. Inverters begin to lose conversion efficiency when exposed to temperature above 113°F. Providing a shade structure or electrical closet is helpful to control thermal gain. Inverters also produce heat, so if located in an enclosed space the room must allow heat to escape so as to provide maximum conversion efficiency and not add cooling load to the building. String and central inverters are weather and water resistant and do not experience degradation in cold temperatures so heated rooms are not needed.

- **AC Disconnect**. An AC safety switch, or disconnect, is a manual switch that can be used to disconnect the solar electricity system for the grid for maintenance or other purposes.

- **Electric Meter**. An electric meter is usually needed to measure the energy being produced by the PV system. The PV system will be connected to the grid through either a bi-directional electrical meter that measures both the load from the building and the energy generated by the system or a separate net generation meter that measures only the energy generate by the system.

- **Monitoring System**. Most larger system owners and operators desire the ability to remotely monitor their system to assist in optimizing its energy generation potential. The system is linked to a series of electronic sensors that function as a performance monitoring reporting system (PMRS). The PMRS measures and monitors the operation of the inverters and sends alerts regarding system or equipment issues. The PMRS can also monitor local weather conditions and generate reports that link weather conditions to kilowatt-hour output.

Overview diagram of solar electricity path:



Other System Factors/Considerations

- **Size**. Systems are generally rated by their DC nameplate capacity, expressed on kilowatts (kW) or megawatts (MW), where one kilowatt equals 1,000 Watts.

- **Productivity Factors**. Many factors affect how much energy (generally expressed in kilowatt-hours (kWh) or megawatt-hours (MWh) a particular system can produce including the geographic location, solar irradiance, temperature, if modules automatically track the location of the sun or are in a fixed orientation, the orientation and tilt angles, shading, temperature and others. All of these factors are considered when a system is developed and designed.

- **Costs**. Costs typically range from $4.50 to $8.00 per Watt (DC) for installation, depending on a wide variety of factors, including: overall system size, material types, equipment manufacturer, labor costs, number of roof surfaces, wind loads, structural considerations, building height, roof pitch, roof covering, number and type of inverters, design and engineering cost, location, permit costs and overall site complexity.

- **Operations and Maintenance**. All systems require some maintenance. In order to keep the system performing at its optimum level, electrical connections must be periodically checked and tightened, inverters may require some cleaning and adjustments, blown fuses may need replacement and modules may require periodic cleaning. Over the 30+ year life of a system, there will be a need to replace some inverter components such as cooling fans, capacitors, gaskets and control electronics.

2.2. SITE BASICS

There are a variety of factors that must be assessed when evaluating a potential site for a roof mounted PV system. A list of such considerations includes:

- **Structural Engineering**. The building, and particularly the roof, must be capable of bearing the added loads imposed by the new equipment. Point and overall load should be considered. An average system load is 4 lbs/ft^2. A structural analysis is required for any installation to account for all the variables of the specific design.

- **Existing Electrical System**. An electrical engineer will have to evaluate the PV system compatibility to the existing electrical equipment and loads. The NEC contains requirements for this compatibility and must be evaluated as a part of the system design. Existing equipment should be checked for nameplate rating and compared mathematically to the desired PV system size. In some cases, older and smaller equipment may need to be replaced in conjunction with the PV system installation.

- **Electric Loads**. An evaluation of the site's historical electrical loads is required to help size the system to meet requirements of local utility net metering, interconnection criteria, rebate programs and other constraining factors. A minimum of 12 months of prior utility bill should be considered during the evaluation. PV systems are generally not sized above 90 percent of the existing load to ensure compliance with some of the constraining criteria. If the PV system is approaching the 90 percent mark and certain requirements relative to net metering exist in the jurisdiction, then future energy efficiency efforts should be considered as well, as such efforts will reduce usage. It is possible that the PV system could be oversized in the future if energy efficiency improvements reduce the overall load.

- **Flat vs. Sloped Roofs**. The roof configuration will be taken into account during the conceptual design phases. Mounting techniques and equipment vary depending on roof type with the main difference being the possibility for mounting with minimal to no penetrations on appropriate flat roofs. Any roof penetrations to secure the racking to the structure are carefully waterproofed by certified roofers to ensure the integrity of the building envelope.

- **Orientation and Tilt of PV Modules**. True South, or 180°, is generally optimal. Also, 90° to 270° is sometimes acceptable with an understanding that production will fall off by as much as 20 percent as the orientation shifts away from 180°. Generally the best tilt for annual production is latitude (i.e., if the site is at 45° latitude, then the tilt would be 45°. Changing from 0° to 30° can increase production by 15 percent. Consideration must be given to utility charges (seasonal shifts in rates), seasonal weather concerns, building orientation, roof orientation, roof tilt, seasonal loads and other factors when considering the optimum orientation and tilt for the modules. Rebates may be affected by tilt angle and orientation as well.

The following tables illustrate the effect of changing tilt and orientation on the production of a specific fixed sized PV system:

Tilt Angle	**Annual kWh for a Representative PV System**
0	131403
5	136893
10	141440
15	144999
20	147554
25	149168
30	149867
1 axis	187663
2 axis	196886

For a given fixed size and fixed tilt array, altering module tilt angle results in these changes in annual output.

Azimuth (°){180°= South}	**Annual kWh for a Representative PV System**	**Production Difference From 180°**
90	98101	22.44%
110	108351	14.33%
130	116879	7.59%
150	123067	2.70%
170	126369	0.09%
180	126482	0.00%
190	126420	0.05%
210	122752	2.95%
230	116647	7.78%
250	107937	14.66%
270	97638	22.80%

For a given fixed size and fixed tilt array, rotating to different azimuths results in these changes in annual output.

- **Fire Code Setbacks**. Local fire codes will require certain setback distances and that access ways be left available to them. These space constraints must be considered during the PV system design.

- **Shading**. Any type of module shading—from trees, other buildings, roof mounted equipment, vents, and even the roof structure itself – will have an impact on electricity production. Below are some considerations and “rules-of-thumb.”

    - A general rule is that an array should not be located closer than 2-2.5 times the height of the shade producing object.

    - Most PV designers do not allow anything to shade a module between the hours of 9AM and 3PM on the Winter Solstice.
    - Some shading may be acceptable if production losses fit into the financial model.
    - With string and central inverters, even a small amount of shade on one module can deactivate 1-3 kW worth of modules because the modules are typically connected in series in groups of 8-16.
    - Steam plumes create shade but are frequently overlooked because they are not seen during the time a site evaluation is being conducted.
    - Self shading – This includes areas where modules in an array shade other modules in the array. Designers will configure modules such that they do not shade each other. Single axis trackers are usually spaced so there is some shelf shading and the control program backs off providing a fully perpendicular orientation early in the morning or late in the evening to avoid shading while still allowing production.

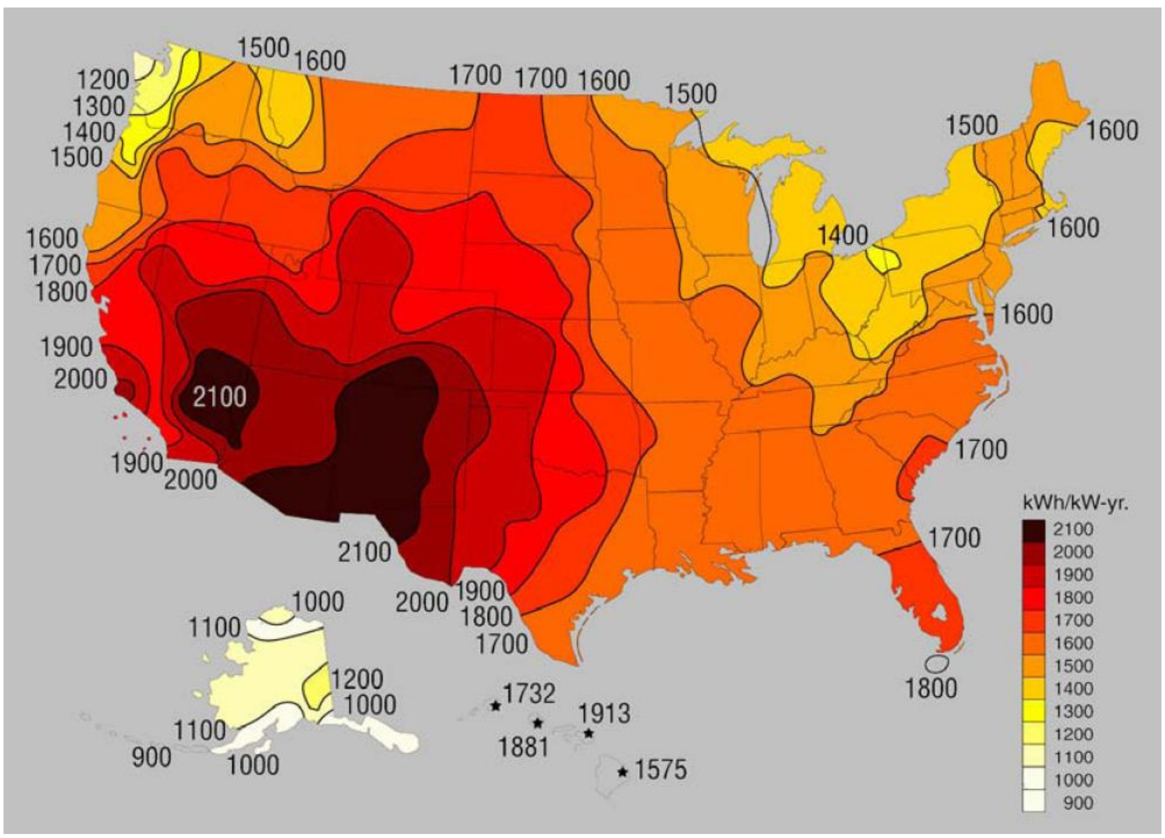
- **Available Space.** In addition to the space needed for modules, space is also needed for inverter and other equipment placement. See previous section, *2.1 Power Facility Basics*.
- **Site Evaluation.** A thorough site investigation is required prior to preliminary design to identify factors affecting the design. Roof surfaces, structural stability, shading, orientation, roof age and wear, existing electrical equipment compatibility, etc. will all be considered.

3. SOLAR RESOURCES

3.1. OVERVIEW

Solar modules require access to the sun to perform their functions -- the more photons they are exposed to, the more electricity they produce. Location is very important to solar energy productivity. Each geographic location's solar resource availability is a combination of annular solar irradiation, weather patterns and conditions, and elevation. During the 50+ years that solar equipment has been available, certain governmental agencies like NREL (National Renewable Energy Laboratory), NOAA (National Oceanic and Atmospheric Administration) and Sandia National Laboratories have collected and analyzed solar irradiance and general weather data for thousands of sites around the country. This data is used in conjunction with engineering algorithms to create solar production models for any location in the U.S. These models have been tested, updated and validated over the decades to allow accurate predictions for annual energy production based on a "standard weather year." One of the most commonly used models is NREL's PV Watts which is the basis for estimated values below.

A typical solar resource map of the U.S:



By comparison, below is a typical solar resource map of Germany, the country with the greatest amount of deployed PV. While the solar resources of Germany are far less than in the U.S., Germany has long had a strong national policy of subsidies and other support to incentivize solar installations.

3.2. OHIO SOLAR RESOURCES

The following table provides a simple comparison of solar resources in selected Ohio cities with those of other cities within the U.S. as well as Spain, Germany and Italy. Spain is also a global leader in solar deployment. Note that locations in Ohio have similar solar resources to New Jersey and Massachusetts, states that have strong solar industries, incentives, and deployment. Oberlin, at 41.4° North latitude, has gross solar radiation of 4.06 kWh per square meter per day (annual average) and estimated annual production of 1190 kWh/kW DC (with fixed tilt).

City:	Latitude:	Array Type:	Array Tilt:	Annual Production (kWh/kW)
Toledo, OH	41.60° N	Fixed Tilt	41.6°	1207
Toledo, OH	41.60° N	Fixed Tilt	20.0°	1194
Toledo, OH	41.60° N	1-Axis Tracking	1-Axis Tracking	1498
Mansfield, OH	40.82° N	1-Axis Tracking	1-Axis Tracking	1424
Columbus, OH	40.00° N	1-Axis Tracking	1-Axis Tracking	1434
Akron, OH	40.92° N	1-Axis Tracking	1-Axis Tracking	1416
Newark, NJ	40.70° N	1-Axis Tracking	1-Axis Tracking	1502
Atlantic City, NJ	39.45° N	1-Axis Tracking	1-Axis Tracking	1613
Worcester, MA	42.27° N	1-Axis Tracking	1-Axis Tracking	1553
Phoenix, AZ	33.43° N	1-Axis Tracking	1-Axis Tracking	2120
San Francisco, CA	37.62° N	1-Axis Tracking	1-Axis Tracking	1896
Dagget, CA	34.87° N	1-Axis Tracking	1-Axis Tracking	2363
Sacramento, CA	38.52° N	1-Axis Tracking	1-Axis Tracking	1892
Munich, Germany	48.13° N	1-Axis Tracking	1-Axis Tracking	1089
Naples, Italy	40.85° N	1-Axis Tracking	1-Axis Tracking	1390
Palma, Spain	39.55° N	1-Axis Tracking	1-Axis Tracking	1661

3.3. OHIO – MANUFACTURING, SUPPLY CHAIN

Ohio is rapidly becoming a national leader in several different spheres of the solar industry such as manufacturing, critical supply chain businesses, PV installation integrators, and institutional research centers and business incubation programs. Moreover, through the creation of financial incentives and pro-renewable energy polices, the recent State leadership created a model for State support for the renewable energy sector.

It is estimated that there are 63 solar power supply chain businesses and nearly 1,500 solar manufacturing jobs currently in the state of Ohio.[1] Additionally, an increasing number of existing manufacturing facilities are being re-tooled to produce renewable energy equipment. This is particularly true in Toledo where established glass and plastic film industries are working in conjunction with research institution like the University of Toledo to advance technology and further support the solar supply chain.[2]

Examples of the growth that Ohio has seen in the solar field include:

- **First Solar** specialized in the thin film technology developed from research programs at the University of Toledo. The company recently completed a 500,000 square-foot, $141 million addition to its existing thin film plant in a suburb of Toledo. The company, awarded a $16 million federal manufacturing investment tax credit, added 200 workers, bringing the plant's employment to 1,100. [3]

- **Xunlight**, a thin-film PV maker, with the help of $5 million in State incentives has opened a 122,000 square-foot, $20 million plant in Toledo that employs 200 people.[4]

- **Willard & Kelsey Solar Group** manufactures a thin film cadmium telluride solar panel and is building a 280,000 square-foot, $250 million plant near Toledo. This was made possible through nearly $20 million in State support and will create employment for 100

[1] "Ohio Quickly Becoming Hub of Solar Manufacturing. Solarpower.org 3/7/2011 http://www.solarpower.org/News/800447795-ohio-quickly-becoming-hub-of-solar-manufacturing.aspx 5/1/2011

[2] Environmental Law and Policy Center. Howard Learner, Peter Gray, Scott Miller. "The Solar and Wind Power Energy Supply Chain in Ohio." January 2011. http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf 5/1/2011

[3] Michigan Land Use Institute. Keith Schneider. "Michigan, Ohio Emerge as Solar Manufacturing Centers" 1/12/2011 http://www.mlui.org/landwater/fullarticle.asp?fileid=17464 5/1/2011

[4] Environmental Law and Policy Center. Howard Learner, Peter Gray, Scott Miller. "The Solar and Wind Power Energy Supply Chain in Ohio." January 2011. http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf 5/1/2011

people.[5] This technology has applications in the residential, commercial, industrial, and large power-generating facilities market.

- **DuPont** is constructing a $175 million, 162,000 square foot solar materials manufacturing plant that will employ 70 people. DuPont was aided by $50.1 million in federal manufacturing tax incentives from the 2009 American Recovery and Reinvestment Act and $7 million in State aid. [6]

- **American Electric Power (AEP) and Turning Point Solar** are proposing a 49.9MW solar park, considered to be the largest commercial solar development east of the Rockies to be located near Zanesville. This project has the potential to include 600 new jobs in addition to a proposed manufacturing plant for Prius and Isofoton, the Spanish solar manufacturers for the project.

- **Third Sun Solar** is a solar design build contractor and has installed over 250 solar energy systems with development costs of over $9 million. [7] Third Sun was aided at an early stage by its partnership with the technology start-up incubation program at Ohio University. [8]

- **Dovetail Solar and Wind** has designed and installed more than 185 systems, totaling more than 2 megawatts of generating capacity.[9]

A growing and robust field of manufacturers, associated supply chain businesses, and installers is a signal of the increasing importance of the solar industry in Ohio's economy. The State has played a large role in fostering this growth. A report issued by The Environmental Law and Policy Center highlighted the importance of State and national policies in the continued growth of Ohio's solar industry. Specifically, the report underscored the critical role of Ohio's Alternative Energy Portfolio Standard and Advanced Energy Fund Grants, as well as the federal Production Tax Credit (PTC) and Investment Tax Credit (ITC), and the associated Section 1603 cash grant. The Center's report concludes that these State and federal subsidies are key to encouraging investment in the solar industry.

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[5] Keith Schneider, New York Times. Midwest Emerges as center for clean energy. 11/20/2010 http://www.nytimes.com/2010/12/01/business/energy-environment/01solarcell.html?_r=1&scp=5&sq=Keith%20Schneider&st=cse 4/15/2011

[6] Michigan Land Use Institute. Keith Schneider. "Michigan, Ohio Emerge as Solar Manufacturing Centers" 1/12/2011 http://www.mlui.org/landwater/fullarticle.asp?fileid=17464 5/1/2011

[7] Environmental Law and Policy Center. Howard Learner, Peter Gray, Scott Miller. "The Solar and Wind Power Energy Supply Chain in Ohio." January 2011. http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf 5/1/2011

[8] Environmental Law and Policy Center. Howard Learner, Peter Gray, Scott Miller. "The Solar and Wind Power Energy Supply Chain in Ohio." January 2011. http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf 5/1/2011

[9] Environmental Law and Policy Center. Howard Learner, Peter Gray, Scott Miller. "The Solar and Wind Power Energy Supply Chain in Ohio." January 2011. http://elpc.org/wp-content/uploads/2011/01/OhioWindSupplyFinal_HQ.pdf 5/1/2011

4. FINANCIAL PROGRAMS AND INCENTIVES

The chief obstacle to the majority of rooftop solar installation is high up-front costs of the equipment and the realization of savings over time. Despite a steady decrease in the cost of solar panels over the last few decades, each kilowatt-hour of solar energy costs roughly two to three times as much as the same amount of electricity produced from fossil fuels. Given the economical challenges facing solar developers, state and federal programs have emerged to provide incentive/subsidy programs and encourage the wider adoption of solar energy production.

4.1. STATE OF OHIO SUPPORT FOR SOLAR ENERGY

Ohio Air Quality Development Authority

The majority of Ohio's renewable energy programs are administered through the Ohio Air Quality Development Authority (OAQDA) which has financed 393 projects totaling more than $7.1 billion since its inception in 1970. The OAQDA is able to support the construction and acquisition of renewable energy projects through issuing bonds, making loans and grants to local governments, and providing loans to businesses.

For large businesses (100+ employees) that are developing renewable energy technologies, OAQDA can provide a 100 percent exemption from the tangible personal property tax (on property purchased as part of a renewable energy project), real property tax (on real property comprising a renewable energy project), a portion of the corporate franchise tax, and sales and use tax (on the personal property purchased specifically for the renewable energy project only) as long as the bond or note issued by OAQDA is outstanding. Additionally, interest income on bonds and notes issued by OAQDA is exempt from state income tax and may be exempt in certain cases from the federal income tax.[10]

Advanced Energy Job Stimulus Fund

The OAQDA administers $84 million through the Advanced Energy Job Stimulus Fund set aside for non-coal-related energy projects. Awards are based on creating new full-time jobs, attracting significant investment and a project's ability to make a major impact on the advanced energy sector in the State of Ohio. This program provides forgivable and non-forgivable loans with awards ranging from $50,000 to $2 million with five percent of the fund targeted toward small awards. Loans can be structured a number of ways including below market rates, subordinate collateralized positions with participating financial institutions, and/or varying principal payments for a specified period of time.

Qualified Energy Property Tax Exemption

This critical State initiative allows for 100 percent exemption of tangible personal property tax and real estate taxes. Originally, a renewable energy facility in Ohio that sold electricity to a third-party was considered a "public utility" for tax purposes and therefore subject to public utility tangible personal property tax and real property taxes. Recently, Ohio has adopted legislation that allows

[10] Ohio Air Quality Development Authority: http://www.ohioairquality.org/oaqda/about_oaqda.asp March 1, 2011

energy facilities with nameplate capacity of 250 kW or less (AC) to receive a complete exemption from public utility tangible personal property tax and real property taxes. Energy facilities are defined as interconnected solar, wind, or other facilities that use renewable energy to generate electricity for the purpose of sale to a third party. This recent legislation includes interconnection equipment, cables, devices, and the land in the exemption.

If the project is 250 kW or greater then it is also provided a 100 percent property tax exemption but a payment in lieu of tax is required. In lieu of taxes, the county where the renewable energy facility is located is entitled to receive the following payments:

- All other qualified facilities employing at least 75 percent Ohio-based employees during construction: $6,000/MW
- All other qualified facilities employing at least 60 percent Ohio-based employees during construction: $7,000/MW
- All other qualified facilities employing at least 50 percent Ohio-based employees during construction: $8,000/MW

If the project is 5MW or larger, the property tax exemption must be approved by local county commissioners. Local county commissioners are allowed to require an additional payment but total payments are not to exceed $9,000/MW. In addition, the law requires that (1) the renewable energy facility meets certain jobs-creation criteria, (2) provides for road repairs (for projects 5MW or more), (3) provides training and equipment to local first responders (for projects 5MW or more), (4) establishes partnerships with universities (for projects 2MW or more), and (5) makes offers to sell the renewable energy credits to Ohio utilities seeking to buy them.[11]

A Renewable Portfolio Standard (RPS)

In 2008, Ohio established an alternative energy portfolio standard (AEPS). The law mandates that by 2025 at least 25 percent of all electricity sold in the State come from alternative energy sources. At least half of the standard, or 12.5 percent of electricity sold, must be generated by renewable sources such as wind, solar (which must account for at least 0.5 percent of electricity use by 2025), hydropower, geothermal, or biomass. In addition, at least half of this renewable energy must be generated in-state. The bill establishes a renewable energy credit (REC) tracking system, where utilities are able to buy, sell, and trade credits to comply with the renewable energy and solar energy requirements. The hope is that by mandating in-state renewable energy consumption and financially penalizing the utilities for not meeting this minimum, the State will create a tool for financing production, namely through the sale of the RECs.

Ohio Advanced Energy Fund and ARRA-Related Programs

The Ohio Department of Development administers the Advanced Energy Fund to support investments in renewable energy projects in the industrial, agricultural, public, and residential sectors. The Fund has provided more than $21 million in incentives to deploy both large and small-scale energy projects and has leveraged a total investment of more than $305 million. The fund was created in 1999 from the proceeds of a 9¢ annual assessment on the utility bills of Ohio

[11] Ohio Department of Development – Business and Industry http://development.ohio.gov/Business/AlternativeEnergyTaxExemption.htm March 1, 2011

consumers. The utility rider was limited to investor-owned utilities and therefore municipal electrics were excluded from participation in the grant program. The Ohio Advanced Energy Fund was allowed to expire at the end of 2010 and re-authorization of the fund is unclear. This program along with various funds like the State Energy Program and those based on American Recovery and Reinvestment Act of 2009 (ARRA) funding have been critical to the recent progress that Ohio has made in attracting renewable energy projects. Their longevity and renewal is in considerable doubt.

Property Assessed Clean Energy (PACE)

PACE is a relatively new financing program that is designed to help mitigate the financial barrier associated with solar energy's high up-front equipment costs. Ohio recently passed legislation that enables cities to establish Special Energy Improvement Districts (SIDs) that allow property owners within the district to borrow money through government loans or bonds at very low interest rates and use the proceeds to invest in renewable energy installations on their property. The loan is repaid through a special assessment on the property's tax bill over a 25-year term. In the event that the property changes ownership, the new owner is responsible for the remainder of the special assessment. In Ohio, only the City of Athens has enacted a PACE program. Nearly all PACE programs are on hold due to objections raised by the Federal Housing Finance Authority's (FHFA). If these programs are re-established they could substantially ease the obstacles to widespread, small scale renewable energy generation.

4.2. FEDERAL SUPPORT FOR SOLAR ENERGY

The majority of federal financial support for renewable energy projects has taken the form of federal tax credits which enables project developers to partner with "tax equity investors" (typically large investment banks and insurance companies) who can take advantage of the federally provided tax credits and accelerated depreciation deductions in exchange for up-front capital to fund the project. The largest renewable energy tax credit programs are the Federal Production Tax Credit (PTC) and the Federal Investment Tax Credit (ITC). [12]

Renewable Energy Incentives (ITC, PTC, REPI, Section 1603, Bonus Depreciation)

Production Tax Credit (PTC)

Section 45 of the Internal Revenue Code provides a 10-year, inflation-adjusted per-kWh tax credit for power generated by certain types of renewable energy projects, including wind, geothermal and solar. The PTC allows a solar project to claim a 2.2¢ per kilowatt-hour (kWh) tax credit on income for 10 years. Unused credits may be carried forward up to 20 years following the year they were generated.

[12] Mark Bolinger et al. *PTC, ITC, or Cash Grant? An Analysis of the Choice Facing Renewable Power Projects in the United States*: Lawrence Berkeley National Laboratory. March 2009. http://eetd.lbl.gov/ea/emp/reports/lbnl-1642e.pdf

Investment Tax Credit (ITC)

While the PTC provides an ongoing subsidy to a solar project, the ITC provides a source of up-front capital. This investment tax credit is equal to 30 percent of the eligible costs of the development, with no maximum credit limit. The ITC is generated at the time the solar project is placed in service. Financial benefit to the tax credit investor is derived from the tax credit and accelerated depreciation.

It is important to note that projects can pursue either the PTC or the ITC, but not both, and the PTC and ITC are available only to businesses that pay federal corporate taxes. The Department of Energy's Renewable Energy Production Incentive (REPI) is the version of the PTC that applies to local governments, municipal electrics or rural electric cooperatives. It is also scaled at 2.2¢ per kWh for solar projects over a 10 year period.

For renewable energy projects that are proposed in the near term and whose construction will begin before December 31, 2011, the ARRA and its recent expansions and extensions provide several important financing tools, namely the Section 1603 grant program and the Modified Accelerated Cost-Recovery System (MACRS) + Bonus.

Essentially the 1603 program allow projects that are eligible for the ITC or the PTC to receive a cash grant of 30 percent of the eligible cost of the project from the U.S. Treasury Department instead of taking the tax credits for new installations. Additionally, solar projects that are eligible for the ITC or PTC also qualify for 100 percent first-year bonus depreciation. After 2011, bonus depreciation is still available, but the allowable deduction reverts from 100 percent to 50 percent of the eligible basis.

Because neither the ITC nor the 1603 grant program requires the project owner to also operate the project-- as required by the PTC-- solar projects replacing the PTC with ITC or 1603 are able to pursue third party ownership models such as lease financing.

Other Federal Tax Credit Incentives

New Markets Tax Credits

Other federal programs, such as New Markets Tax Credits (NMTC), are not specifically targeted at renewable energy projects, but can be used for such if investments are made into qualifying low-income communities. The NMTC is a program run through the U.S. Treasury Department and provides a credit against federal income taxes in exchange for making qualified equity investments in designated Community Development Entities (CDEs), which must make investments in low-income communities. The credit equals 39 percent of the cost of the investment and is claimed over a seven year period. NMTCs can be used successfully as a funding source for renewable energy projects as long as they are located within a qualifying census tract.[13] While credits from any CDE can be used for renewable projects, in 2006, for the first time four CDEs (Midwest Minnesota Community Development Corporation, Detroit Lakes, MN; Rural Development Partners, LLC, Harlontown, IA; Dakotas America, LLC, Sioux Falls, SD; American Community Renewable Energy Fund, LLC, New Orleans, LA) received $232 million in tax credit allocations for the express purpose of directly supporting the financing of renewable energy projects.

[13] For census tract mapping tool, see www.novoco.com/new_markets/resources/ct/

Another encouraging development for the financing of renewable energy projects has been the successful combination or "twinning" of NMTC and ITC/PTC subsidies, as well as the ability to substitute the PTC for the ITC.[14] Through the combination of NMTC and ITC/1603, the City of Denver was able to install 1 MW of solar photovoltaics on the roofs of various City buildings. The City partnered with a solar developer through a power purchase agreement (PPA). The developer was able to take advantage of low-interest loans through a New Markets Tax Credit allocation to purchase and install the PV system. The developer passed these saving on to the City, making the new green energy revenue neutral for the municipality, while also taking advantage of the 1603 Treasury grant and the accelerated depreciation. [15]

Another example of the successful combination of NMTC and ITC subsidies can be found with the Coastal Community Action Program (CCAP) of Aberdeen, Washington, a nonprofit community assistance organization. The CCAP was able to develop the Coastal Energy Project, a 6MW wind development near the Washington coastline in Grayland, Washington. The project was able to bring in $8 million in NMTC through ShoreBank Enterprise Cascadia and $7 million through the 1603 program that allows the project to receive the PTC in cash grant form in lieu of the ongoing tax credit. The Coastal Energy Project was one of the first deals to use the NMTC and the Section 1603 provision that allows ITCs to be claimed for traditional PTC facilities.[16]

Bonds

In addition to extending the 1603 program and allowing the ITC and the PTC to be interchangeable, the ARRA also provided up to $3.2 billion in bonding authority to each state and its local governments to finance renewable energy projects like solar farms and solar rooftop arrays through Qualified Energy Conservation Bonds (QECBs). QECBs allow a state or city to issue bonds and pay back only the principal of the bond, while the bondholder receives federal tax credits in lieu of the traditional bond interest. Moreover recent legislation has provided the option of allowing issuers of QECBs to recoup part of the interest they pay on a qualified bond through a direct subsidy from the Department of Treasury. QECBs differ from more traditional tax-exempt bonds in that the tax credits issued through the program are treated as taxable income for the bondholder. The advantage of either option is that it creates a lower effective interest rate for the issuer because the federal government subsidizes a portion of the interest costs.[17]

Loan Guarantees

One of the significant obstacles to both small and large-scale solar developers is the financing guarantees that are required. In order to leverage private investment through banks and facilitate renewable energy projects, the federal government offers several loan guarantee programs:

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[14] Novogradac Journal of Tax Credits, March 2010, Volume I, Issue III

[15] http://www.nrel.gov/docs/fy10osti/49056.pdf

[16] Novogradac Journal of Tax Credits, April 2010, Volume I, Issue IV

[17] Internal Revenue Service. Internal Revenue Bulletin: 2009-16, April 20, 2009 http://www.irs.gov/irb/2009-16_irb/ar10.html March 1, 2011

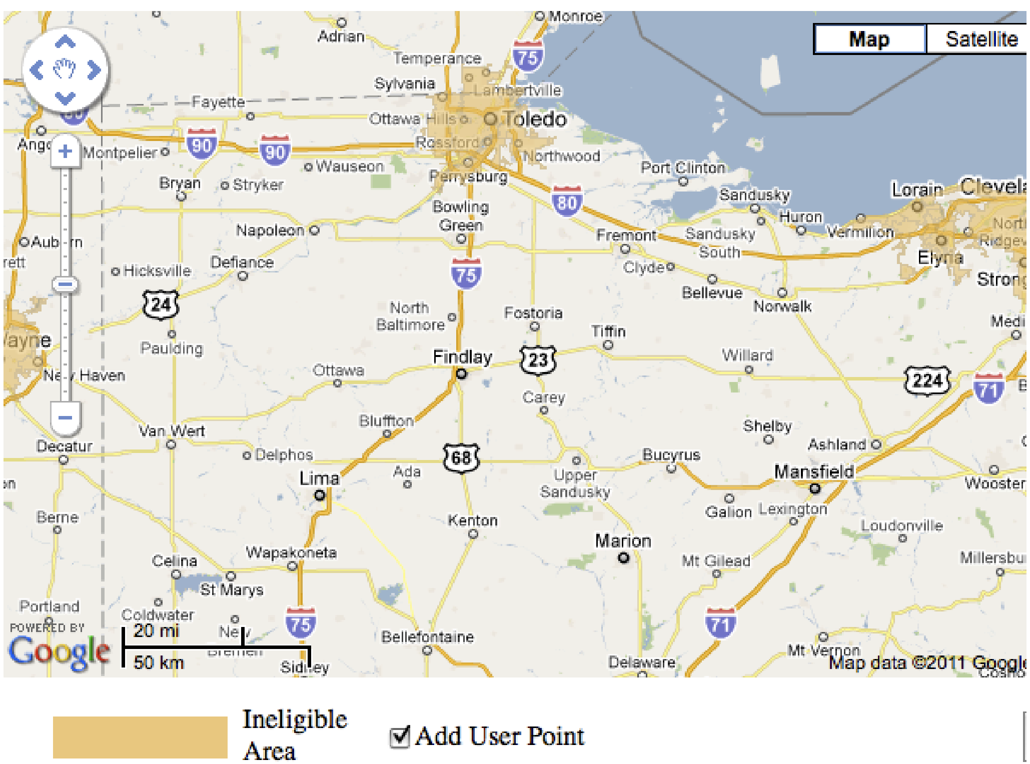
U.S. Department of Energy (DOE) - Loan Guarantee Program

Full repayment is required over a period not to exceed the lesser of 30 years or 90 percent of the projected useful life of the physical asset to be financed. The DOE loan guarantees focus largely on projects that exceed $25 million.

U.S. Department of Agriculture (USDA) Rural Development

As shown in the map below, nearly 80 percent of the land area of the 9th Congressional District is considered "rural" and therefore may be eligible for renewable energy development support through USDA Rural Development programs. The two major sources of funds are the Rural Energy for America Program (REAP) grants and loan guarantees programs and the Business and Industry loan program.

REAP promotes energy efficiency and renewable energy for agricultural producers and rural small businesses through the use of (1) grants and loan guarantees for energy efficiency improvements and renewable energy systems (systems that may be used to produce and sell electricity), and (2) grants for energy audits and renewable energy development assistance. The REAP grants are limited to 25 percent of a proposed project's cost, and a loan guarantee may not exceed $25 million. The combined amount of a grant and loan guarantee may not exceed 75 percent of the project's cost. In general, a minimum of 20 percent of the funds available for these incentives will be dedicated to grants of $20,000 or less.



The map above indicates in gray the areas in Northwest Ohio and the 9th U.S. Congressional District that qualify for business assistance under USDA programs.

Business & Industry Loan Guarantees (B&I)

The B&I program provides loan guarantees for businesses that contribute to the expansion of jobs and the preservation of the environment in rural areas. These guarantees are given to commercial lenders who make credit available to establish or maintain rural businesses. An individual, cooperative or a corporation that seeks to "reduce reliance on nonrenewable energy resources by encouraging the development and construction of solar energy systems and other renewable energy systems" is eligible under the B&I loan program.[18] The B&I program provides guarantees not to exceed 80 percent for loans of $5 million or less, 70 percent for loans between $5 and $10 million, and 60 percent for loans exceeding $10 million.

It is important to note that given the USDA requirement that it lend directly to a project, B&I and REAP loan guarantees cannot be used within the New Markets Tax Credit structure. Both funding sources remain viable tools for solar energy finance on their own but developers must elect to use one or the other.

5. PROJECT STRUCTURING AND OWNERSHIP

There are a variety of ownership and funding models used for larger-scale solar projects. In some instances the host will own the system outright from the beginning of the project and utilize the incentives mentioned above. In this scenario, typically the host will provide the gap financing (i.e., the funds needed for the project after the incentives) and see a return in the long run due to ownership of the system.

In some instances the host can not afford to come up with the gap financing or initial project costs. In these cases the host could seek out investors or developers and utilize a model which allows the hosts sites to enjoy the benefits of solar energy through a power purchase agreement (PPA) or solar equipment lease. These cases would involve developer- or investor-related entities owning the system, and the host purchasing power through a PPA or equipment lease. Below are three funding models currently being used in the solar industry.

5.1. FUNDING MODELS

Sale Leaseback. In this model, the developer develops the solar project using whatever federal and local incentives are available, sells the project to an investor (e.g., a bank), and the bank leases the project back to the developer (typically for a 10-20 year term), who now owes the bank lease payments. The bank determines the lease payments and term based on the expected annual cash flow available from the PPA after operating expenses, the internal rate of return (IRR) it needs to achieve based on the purchase price of the project, and how long it will take to achieve that IRR. The developer enters a PPA with the host site by which the developer provides electricity to the host at a predetermined rate which the developer expects will cover the leases payments and net the developer some profit. At the end of the lease term, the bank remains the owner of the project

[18] US Department of Agriculture. Business and Cooperative Programs. Business and Industry Guaranteed Loans http://www.rurdev.usda.gov/rbs/busp/b&i_gar.htm March 1, 2011

and the developer has no further interest in the project unless there is a purchase option that the developer decides to exercise.

Partnership-Flip Model. In this model, the investor and developer form a company (e.g., an LLC) that is taxed as a partnership. The investor contributes tax equity for the project development, while the developer will bring in various combinations of debt, gap equity, and solar incentives/ rebates to fill the remaining funding gap. The developer also constructs and operates the solar project. The investor initially owns most of the entity so that it can receive the majority of the tax benefits and operating income during the 5 year solar ITC period. After the investor has recovered a pre-determined after-tax rate of return on its tax equity investment (commonly referred to as the "flip point"), but not within the first five years, the developer can enter into a purchase option and become the primary owner and receive most of the income and remaining tax incentives. The partnership will enter into a PPA or equipment lease with the host site.

Example:

- **Step 1: Initial Investment Period**: The investor owns 99 percent of the entity and receives 100 percent of the operating income and 99 percent of the tax benefits. The developer owns 1 percent of the entity, and receives no operating income but gets 1 percent of the tax benefits. During this period, the investor recovers its capital plus a specified return, and receives the tax credits and depreciation deductions from the project.

- **Step 2: The Partnership Flip**. Once the entity generates sufficient income to meet the expected rate of return for the investor, including tax credits and deductions, the ownership is ready to flip. The developer then owns 95 percent of the entity and receives 95 percent of the operating income and tax benefits. The investor owns 5 percent of the entity and receives 5 percent of the operating income and tax benefits.

Inverted/Pass Through Lease. In this model, the investor and developer form two entities; a "Landlord" to own the solar project, and a "Tenant" to operate the project. The Landlord passes the solar ITCs (or the 1603 cash grant) to the Tenant. The investor becomes the majority owner (e.g., 99.99%) of the Tenant and receives the "passed through" solar credits while making a tax equity investment as well. The developer will bring in additional project sources such as debt, gap equity, and solar incentives/rebates to fund the project, and will be responsible for the construction and day-to-day management of the project. The Tenant will enter into a PPA or equipment lease with the host site.

- One type of Pass Through Lease structure "twins" **New Markets Tax Credits (NMTCs) with ITCs**. For projects located in low-income areas as defined by the CDFI Fund, NMTCs can be brought in to the project where an investor will purchase the NMTC in addition to the solar ITCs. Although this twinned structure brings additional complexity and compliance requirements, it provides the developer with one more funding source, reducing the level of funding filled by debt or private equity.

5.2. POWER PURCHASE AGREEMENT (PPA)

A PPA is a contractual arrangement with a third-party solar power developer by which the host site takes advantage of solar energy savings while remaining sheltered from the risks of system ownership. A PPA provides a vehicle by which the host permits a developer to construct a solar power system on the host's property; the host buys power from the developer at a pre-determined rate (per kilowatt-hour), which allows for savings to the host as well as a hedge against escalating energy prices. The developer would be responsible for selecting the equipment and type of solar panel, project design, permitting, finance, and installation. For environmental and financial reasons the host may also want to own the associated RECs; however, this would be a negotiated point with the developer, as the RECs may be needed to finance the project for the developer. The developer would be responsible for operations and maintenance. If problems with the equipment prevent the project from performing as expected, the developer would not have as much power to sell, but the price per kilowatt-hour to the host would remain the same. This type of arrangement is beneficial to the host because it transfers ownership risk away from the host and places it on the developer, while still providing benefits and energy price stability to the host.

6. LOCAL UTILITY REGULATIONS

One of the critical parties in any scenario is the local utility. Local utility regulations and incentive programs can vary widely from utility to utility, in some cases, making a renewable project feasible in one service area but not in another. At the outset of any project, the local regulations and programs should be examined closely. For example, what net metering programs are available? Are there feed-in-tariffs? What requirements exist for connecting to the grid? Does the utility allow for third-party ownership of a facility? For purposes of this paper, we examine the utility that serves Oberlin College, Oberlin Municipal Light and Power Systems (OMLPS).

The local utility would have to approve the installation of any new grid-connected power generation equipment within its service area. Some key provisions follow.

6.1. THIRD PARTY OWNERSHIP

If a third-party ownership structure is employed (e.g., via a PPA model), the utility would need to permit an entity which is not its customer to install and operate the power generation equipment connected to the grid. Traditionally, this role is filled only by the utility company, or by the customer under particular conditions.

6.2. NET METERING

Solar power is generated throughout the year by a PV system, but each month is not created equal when it comes to solar energy generation. Summer months will see the greatest production and winter months will see the least. If a customer uses less total power in a given month than it generates, net metering programs allow the customer to "bank" the energy it doesn't use and is given credit for it in future months when it is needed – i.e., when solar production is less than total energy use. Not all utilities have net metering programs, and for those that do, the programs can vary on several dimensions, chief among them: at what price is the excess energy credited, and how long can customer "roll over" credits. Power generated by the system is essentially "used" first in the building, and only if there is a net surplus of power production is it exported onto the grid. Depending on the set-up, the solar generated electricity may pass the meter to the grid and thus become indistinguishable from the "brown" energy supplied by the grid. Either way, the host site is credited for the energy it produces.

But what if the power generated at the site exceeds the building's overall use during the credit or rollover period (e.g., say it's a one year period). If the building can't use the credits during the year, then it simply loses the credit. In such a case, the building's solar system would be oversized because it's producing more energy throughout the year than it can use. This is the reason why an analysis of a building's historical energy use is important prior to sizing a project.

However, there is another spin on net metering – called virtual net metering or remote net metering -- that would allow a building to deploy some or all of its energy credits to another meter. Most jurisdictions do not currently have virtual net metering programs. One example is the California Solar Initiative's MASH (Multi-family Affordable Solar Housing) program that allows host sites to have their low-income tenants credited for solar production even though the tenants' meters are not connected to the solar system.

In general, in remote or virtual net metering, the power generation equipment is not connected to the meter that benefits from the generation, and instead a meter at the generation site records the power exported to the grid and the customer is given a credit for that power on an existing utility account. As with standard net metering, utilities are wary of certain implications of remote net metering and such terms are evolving, including the price at which a kilowatt-hour of green energy is credited to the customer's account, the period for which net metering is allowed to carry over, what happens to any net production (over the customer's use) at the end of the relevant period (e.g., is it a "use it or lose it" scenario, can it allowed to roll-over, or is it paid out to the customer at a pre-determined rate), and whether or not to allow customers to transfer credits, or "sell electricity," to unaffiliated parties across the street or across town. See *Appendix F* for an example of remote net metering legislation (Pennsylvania).

7. OBERLIN CASE STUDY

This section looks at the key issues that every project should evaluate to determine feasibility and desirability, viewed through the lens of a case study project. This section first outlines how some of the financial resources can be utilized in a demonstration project and outlines the other factors that can impact the successful development of roof-mounted solar power. The case study model uses Oberlin, Ohio, a town of less than 10,000 inhabitants that is served by a municipally owned utility and AMP member. Please see *Appendix A* for the case study financial model.

7.1. PROJECT FINANCING

ITC, PTC, and the 1603 Grant Program

Renewable energy facilities face uncertainty regarding the future of existing tax credits. Predictions regarding subsidies that will be available or extended in the future are problematic, and financial assumptions should be attentive to the changing landscape. For the purposes of this report, the project is assumed to be placed in service under the current subsidy regime. (In practice, this would necessitate an accelerated predevelopment and development process.)

The stimulus package of 2009 (ARRA) contained a provision for energy tax credits to be exchanged for a direct cash grant from the U.S. Treasury (Section 1603). This was done to alleviate a temporary lack of tax credit buyers. The program proved popular with the renewable energy industry because the cash benefits, unlike tax credits, were claimed up front instead of being spread over five years and cash was preferable to a credit against taxes.

Section 707 of the Tax Relief, Unemployment Insurance Reauthorization and Job Creation Act of 2010 (that is, the Obama/House Republican tax cut package that passed in late 2010) extends 1603 eligibility to projects that begin construction in 2011. It does not, however, extend the relevant deadline for when a project must be placed in service in order to qualify. Solar projects have until January 1, 2017 to be placed in service. It is possible that an Oberlin solar project could meet the 2011 construction start deadline by moving aggressively. It is also possible that the deadline could be extended or the program re-authorized. For the purposes of this report, the project is assumed to be placed in service under the current subsidy scenario, and elects to take the 1603 grant as opposed to the ITC or PTC.[19]

New Markets Tax Credit

The New Markets Tax Credit (NMTC) is a U.S. Treasury program designed to encourage job creation and investment in low-income areas. In recent years, developers have begun employing the NMTC as part of renewable energy projects. [20]

This case study uses the NMTC structure because we believe it can provide no up-front costs to the host, a stable and predictable price for power via a PPA, and a mechanism for one of the parties to own the project at the end of the NMTC compliance period. This would be a complex, multi-stage process, but would yield significant economic benefit for the project. The process would involve finding an approved CDE (Community Development Entity) with an existing NTMC allocation that is interested in becoming involved in the project. Many existing CDEs serve Ohio. The 2010 NMTC award round gave allocations to eighteen CDEs working in Ohio, with $604 million of total allocation. The allocatees include:

- Cincinnati Development Fund ($28 million)
- Cincinnati New Markets Fund, LLC ($18 million)
- Cleveland New Markets Investment Fund II LLC ($35 million)
- Consortium America, LLC ($35 million)
- Dayton Region New Market Fund, LCC ($11 million)
- DV Community Investment, LLC ($35 million)
- ESIC New Markets Partners LP ($62 million)
- Forest City Community Development Entity ($28 million)
- HEDC New Markets, Inc. ($63 million)
- MBS Urban Initiatives CDE, LLC ($10 million)
- National New Markets Fund, LLC ($42 million)
- National Trust Community Investment Corporation ($28 million)
- Northeast Ohio Development Fund, LLC ($18 million)

[19] In this case, the most advantageous way to bring in the 1603 grant would be to have a bank lend the expected grant amount to the project up front and then repay the bank when the Treasury Department funds the grant. This way, the grant can be included in the leverage loan and counted as part of the basis on which the New Markets Tax Credit is allocated, see below.

[20] (See the *Federal Support* section for more background, and the program website at www.cdfifund.gov/what_we_do/programs_id.asp?programid=5)

- Ohio Community Development Finance Fund ($35 million)
- PNC Community Partners, Inc.($53 million)
- Stonehenge Community Development, LLC ($53 million)
- Telesis CDE Corporation ($11 million)
- Urban Research Park CDE, LLC ($39 million)

Prior year allocations were similar, and multiple CDEs with Ohio in their service areas received awards. A significant portion of prior-year allocations have not been placed with projects, due to both normal project delays and also increased project uncertainty and cancellations due to the recession. This serves to increase the pool of available allocations and CDEs that would be interested in discussing an investment in a project involving a stable institution like Oberlin College.

Private Equity

Even using all of the available subsidies and a creative financing structure, this solar project would likely not be able to be financed on purely commercial terms. A private equity investor could be brought in to fill the gap between project sources and project costs. The returns on this equity position would be below market, but a philanthropically- or environmentally-motivated investor would be able to make an investment that returns their capital over the duration of the 20 year term, and generates a large community impact. An investment of approximately $1.1 million would leverage approximately $4.4 million in renewable energy.

7.2. SITE SELECTION

The prospective rooftops for solar installations in Oberlin must consider several factors. See *Section 2.2, Site Basics,* for a general discussion of site characteristics.

- **Ownership:** We limited our selections to existing Oberlin College-owned property on the assumption that Oberlin College would want the installation on its rooftops for public relations purposes, and also for simplicity in net metering discussions.

- **No shading obstacles:** The site should not have shading obstacles such as tall trees, other large buildings, smokestacks, etc., to the south, east or west.

- **Compatibility with existing uses:** The solar arrays should also be compatible with current roof uses. For instance, portions of Mudd Library roof that are occasionally occupied would not be suitable.

- **Roof type:** While in theory any rooftop could be used, certain types of roofs are more naturally compatible with solar installation. For instance, Oberlin College has many large historic buildings with tile roofs. A solar installation would significantly impact the historic character of a building like Finney Chapel. Flat, membrane roofs are acceptable, subject to condition concerns outlined below. However, care must be taken to maintain roof warranties. The solar panel racking systems, if they are to be physically attached to the structure, should be installed with the cooperation of the roof installer/warrantor in order to maintain the warranty. Alternatively, if the racks are to be held to the roof with ballast, a structural engineer should be engaged to analyze the roof structure and loads. Standing seam metal roofs, such as on the Adam Joseph Lewis Center, are ideal for solar installations because they will generally outlive the solar installation and are more robust than membrane roofs. Asphalt shingle roofs are also attractive due to a slightly longer lifespan than membrane roofs, but are only seen in sloped applications, making orientation a prime factor.

- **Roof condition**: The majority of large usable rooftops in Oberlin are flat, membrane type roofs. Such roofs typically have a 20-30 year lifespan. While it is possible to temporarily remove the solar installation from a building in order to replace the roof, costs for this type of work would need to be factored into the project economics. Ideally, solar installations would go onto new roofs, instead of roofs that are approaching the end of their useful life.

- **NMTC-eligible locations:** The NMTC will play a central role in financing the project, and sites should be located in qualifying census tracts. Lorain County Census Tract 601 qualifies as a low-income, which generally comprises all areas east of Main Street. It is possible to mix some non-qualifying locations with qualifying locations; however the balance between qualifying and non-qualifying buildings would have to be assessed according to NMTC requirements as well as a given CDE's allocation agreements. Many, CDEs, for example, require highly distressed locations, which is a more stringent threshold.

7.3. POTENTIAL SITES FOR OBERLIN COLLEGE

For potential rooftops, we examined buildings with gross usable rooftop area of greater than 3,000 square feet, along with a full year of historical electricity billing for each of those locations. We use this 3,000 square foot size as a cutoff in order to achieve at least modest economies of scale. The balance of the characteristics above leads us to recommend six rooftops for solar installations from this list. The first six rooftops (Firelands dormitory, the Apollo Theatre, Hall Auditorium, the Allen Art Museum, and the East Lorain Street art studios) are all in an NMTC-eligible census tract. Then we also select several non-NMTC qualifying roofs in cases where those could be included as well. Of course, if NMTCs are not used in a funding model, then any of these locations could be assessed without regard to census track location, and therefore, the other criteria would govern.

The overall project, with all rooftops included, should be large enough to have significant purchasing power with suppliers and installers. Within the context of a larger project, smaller arrays typically will have a higher installed price per watt because costs associated with analysis, design, mobilization, electrical integration, etc. will have fewer watts over which to be amortized. The rooftops recommend below are assumed to support an estimated 519kW (DC) in total. Please note that system sizes listed below are rough estimates based on images. For any potential project, an engineering review would be required to determine correct sizing. The case study will assume an aggregate system size of 519kW, however, the campus contains many open spaces where additional capacity can be installed, including parking areas where solar carport canopies can be constructed, providing shaded parking for cars as well as locations for solar panels.

Rooftop 1: Firelands Dormitory

Firelands has several factors to recommend it:

- It is higher than all surrounding buildings and so will not be shaded by other buildings.
- It is not historic.
- It has a flat roof that has no other uses and is easily accessible.
- It is located in an NMTC eligible census tract.

Firelands has the disadvantage of a large cooling tower in the middle of its roof, which renders the middle and northern parts of the roof less than ideal due to shading from the tower. The southern part of the roof also has a stair tower which would shade the areas around it. This rooftop can support a system of approximately 10kW.

Rooftop 2: Apollo Theatre

The Apollo has several factors to recommend it:

- Current renovations include a new roof.
- No other buildings around it are tall enough to shade it.
- The Apollo is already recognized as part of the Green Arts District, which brings a natural programmatic reason for a solar installation.
- It is located in an NMTC eligible census tract.

The Apollo has the disadvantage of a curved, barrel-type roof that will make installation and proper orientation of the panels more complex. Historic factors may impact the approval process. This rooftop can support a system of approximately 37kW.

Rooftop 3: Hall Auditorium and Annex

The main Hall roof is complicated by its slope. The annex has a flat roof with no obstacles and will be relatively straightforward. The main factors weighing in favor of this location are NMTC eligibility and the relatively large size. These rooftops can support a system of approximately 100kW.

Rooftop 4: Art Library and Allen Art Museum

While the main roof of the Allen Art Museum is tile, and historic considerations would prevent the installation of solar panels, the Art Library building and several smaller flat roof areas of the museum present an opportunity. These rooftops can support a system of approximately 152kW.

Rooftop 5: Lorain Street Art Studios

Oberlin College owns a small complex of old industrial buildings on East Lorain Street currently used as art studios, behind the Laundromat on the corner of Park Street. This area qualifies for NMTC, and the industrial/art aesthetic presents an interesting programmatic tie-in and the chance to redefine the space. It would be recommended that the roofs be replaced prior to solar panel installation, and some structural assessments of the roof supports performed. Assuming that this work is done, the rooftops can support a system of approximately 20kW.

One characteristic of these buildings, unique among the sites recommended, is that due to their relatively low intensity of use (only 7,500 kWh in the 08-09 academic year) and relatively high ratio of usable rooftop area to floor area, these structures would likely be able to produce more electricity than they consume.

Rooftop 6: Robert Kahn Dormitory

While Kahn dormitory is not in a NMTC-qualified census tract, it is a compelling location because of the existing infrastructure and planning that is already in place for eventual solar panel installation. This rooftop can support a system of approximately 30kW.

Rooftop 7: Science Center

The new Science Center has ample space, and panels could be installed both on the flat roof portions and on the south-facing sloped sections. The panels would fit well with the modern aesthetic of the building, and the roofs are new. It is assumed that this rooftop can support a system of approximately 170kW.

Alternate Rooftops: There are many other rooftops in non-NMTC qualifying areas that would be acceptable. Many dormitories like North, South, Dascomb, or Barrows have large areas of flat roofs that could be used.

7.4. INPUTS AND KEY FACTORS

The examination of the model for the demonstration solar project follows, taken from the perspective of the project host. Below is a discussion of the key variables and assumptions used in that model.

Project Factor 1: Ownership Structure

For purposes of this report, we are recommending PPA structure as it would relieve Oberlin College of the responsibility of operating and maintaining the systems, along with any operational risk and asset management/monitoring costs, while still providing some of the benefits of the financing structure outlined here. If the host desires to own the project, then installation costs, discussed below in *Project Factor 4*, become critical to the analysis.

Project Factor 2: Regulatory Involvement and OMLPS

OMLPS will need to approve the installation of any new grid-connected power generation equipment within its service area. OMLPS has permitted customer-owned, behind-the-meter generation systems in the past, under a net metering regime.[21] A third party-owned system would need OMLPS approval.

[21] *Appendix C*: OC/OMLPS net metering contract for AJLC array; *Appendix D*: OMLPS net metering regulation; *Appendix E*: Ohio net metering regulation

We also assume for the case study model that OMLPS would offer a credit equal to the Commercial Generation Charge, which is $0.073 per kWh for 2011. See *Appendix B* for a discussion of OMLPS cost structure and pricing.

Project Factor 3: PPA Terms

Pricing

For purposes of the case study model, we assume that the price charged to Oberlin College in the PPA would be equal to the credit given by OMLPS ($0.073 per kWh), plus a premium to reflect the "greenness" of the power, and the consideration that a large solar rooftop project would add value to Oberlin College's narrative and mission. Placing a dollar value on that premium is difficult, since it is highly subjective, but it is assumed here that the PPA price is $0.13 per kWh. This is approximately the minimum price necessary to achieve any return on the equity invested in the model.

Duration

The length of the PPA contract for a solar project should not be longer than the expected useful life of the panels. Most solar panels have a 20-30 year design life, with a 20-year warranty (although some balance-of-system components such as inverters have a shorter design life, the panels represent such a large portion of the investment that they drive the payback calculations.) A 15 to 20-year PPA is common, and gives the host customer long-term price stability, and gives the developer sufficient time to recoup the investment. A shorter time period might not allow the developer to recoup the initial investment unless the price is raised. A 20-year PPA is assumed for this model.

Escalation

One of the benefits of a long-term PPA is the ability of the host customer to lock in an escalation rate for the entire term. Electricity prices are highly variable, and difficult to predict. See *Appendix B* for a discussion of Oberlin's historical and predicted wholesale power rates. From this information, it would be possible to draw a 7-year trend from 2003 to 2010 showing a 7.32 percent annual increase in prices, or a 5.90 percent annual increase if the trend is followed out to OMLPS predictions on 2015 rates. (A full assessment of future electricity prices is outside of the scope of this report, and there is no shortage of qualified forecasters predicting lower rates of increase, or higher rates of increase and the end of cheap energy.) We assume that the PPA would have a 4 percent annual rate of increase for its entire term. This number provides significant potential long-term cost savings to the host customer, and allows the developer to keep up with operations and maintenance costs, which we assume to rise at 3 percent annually.

Assets at End of Term

This model assumes that at the end of the PPA term, the developer will, at its cost, disassemble and remove the project from the host's site. (Other arrangements are sometimes used such as a purchase option by the host at fair market value, or an extension of the PPA on negotiated terms.) There is also often a residual value to the assets at the end of their service life. This model assumes these two values are equal, and the asset/liability at the end of the PPA term nets to zero.

Renewable Energy Credits

For environmental reasons, Oberlin College may want to control the RECs associated with the green energy, and rather than selling the RECs, the College would keep them off the market, thereby reducing the overall global energy footprint. Unfortunately, due to the challenging economics of a rooftop solar project in Ohio, the sale of the RECs would be a critical factor in financing the project, and the RECs would need to be monetized for project development. For the purposes of this model, we assume that the value of the Solar RECs tracks the value of the Ohio Annual Compliance payment, with a 10 percent annual discount.

Project Factor 4: Project Installation Costs

By far the most expensive factor in the pricing of a complete installation is the equipment itself. Racking systems and electrical installation make up the balance of the hard costs. Pricing for the complete installation is assumed to be $5.80 per Watt, equal to the April 2011 Solarbuzz Commercial Index, plus a 10 percent markup for rooftop installation.

Note that if a PPA structure is employed for a given project, then installation costs are borne by the developer, and would not impact the host, although only projects that make economic sense to the developer will be constructed.

Project Factor 5: Project Operations Costs

Project operational costs are shown, for modeling purposes, as levelized costs with an annual inflation factor of 3 percent applied. Most operational costs such as scheduled cleaning and maintenance will remain relatively stable over the project lifetime.

Insurance

Insurance is one of the largest operational costs, and has several components:

- Property Insurance: Replacement in the event of damage due to lightning strikes, wind-driven debris, vandalism, etc.
- Income Interruption: Insurance to replace the lost income during system downtime due to events listed above to ensure that operational and financing expenses are met.
- General Liability: Insures the system owner, operator, and host/customer (as additional insured) against liability associated with system operations and any third-party claims.

Insurance is estimated at 0.625 percent of installed costs annually.

Note that if a PPA structure is employed for a given project, then operations costs are borne by the developer, and would not impact the host. In some cases the host is required to cover the property insurance under their existing insurance policy, which would reduce these assumed costs.

Maintenance/Operations

This model assumes that all maintenance and operations costs are borne by the developer.[22] Inspection and semi-annual cleaning costs, usually estimated at $10 per Watt annually, are increased by a factor of 1.25 to account for multiple rooftops and the associated logistics.

Taxes

Solar installations are exempt from Ohio personal property taxes but the owner/generator must make a Payment In Lieu of Taxes (PILOT) to the State instead of paying real estate taxes directly, as discussed in *Section 4.1. State of Ohio Support for Solar Energy*.[23] The PILOT for solar power facilities is $7,000 per MW of installed nameplate capacity per year. The County is also able to levy an additional payment up to a maximum of $9,000 per MW per year. For the purposes of this model we assume $9,000 per MW.

Other Operating Costs

In a third-party ownership model, the developer will incur other operating expenses such as annual tax returns and financing expense to the tax credit investor and other financing parties.

Project Factor 6: System Output

A 519kW system is assumed in the model with a fixed-tilt installation at 41.4°. Power generation is assumed to be 617,610kWh annually, or 1190kWh/kW. Also, the direct current to alternating current de-rate factor (power losses due to transformers) is assumed to be 20 percent.

Project Factor 7: Financing Assumptions

It is assumed that low-interest financing is available to the project in recognition of its community impact and sustainability goals. Interest rates are assumed to be 2 percent for the life of the project, with favorable fee structures and debt coverage ratios permitted. . It is assumed in the case study model that NMTCs will be used on this project. Given the overhead costs of the financial transaction, it may be advisable to increase the overall size of the projects. As mentioned above, additional locations, most specifically parking areas, can accommodate system capacity increases.

8. OHIO CASE STUDIES & OTHER AMP COMMUNITIES

The College of Wooster in Wayne County took advantage of current renovations of its student recreation center to add solar to the roof of the facility. In September 2010 Wooster signed a PPA

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[22] Operating costs in this assumption include insurance. This is a negotiated item in a PPA and should not necessarily be assumed for purposes outside of this model.

[23] Database of State Incentives for Renewable Energy (DSIRE). Qualified Energy Property Tax Exemption for Projects over 250 kW (Payment in Lieu).
http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=OH60F&re=1&ee=1 March 1, 2011

with Carbon Vision LLC to install a 20,000 square foot solar recreation center, which is due to open in 2012. The solar roof will generate over 271,000 kWh of electricity and will be the largest solar roof at any college in the country, making the College of Wooster a frontrunner of green technology. The PPA is structured so that it will not cost Wooster any upfront capital and Wooster will have full ownership of the roof in ten years.

A more complicated and larger project can be found in Cincinnati where the Cincinnati Zoo is constructing parking canopies with solar on the canopy roofs. When complete in mid-April this will be one of the largest public urban displays of solar in the country. The project consists of 6,400 panels assembled on more than 100 metal arrays, 15 to 18 feet high. They cover about 800 of the 1,000 parking spaces at the zoo's main entrance. The project is designed to generate 1.56 megawatts of electricity at peak production, about 20 percent of the zoo's annual need and enough to power 200 homes. The panels were produced by German-based Solar World and manufactured in Oregon. The project relies on financing through a combination of federal New Market Tax Credits and federal energy tax credits through PNC Bank. It relies on cash from the tax credits, sales of electricity over the next seven years to the zoo and selling the renewal energy credits generated by the investment to Akron-based First Energy. The project allows the zoo to lock in the price for about 20 percent of its electricity at about 9 cents a kilowatt-hour. The agreement gives the zoo the option to buy the system in the eighth year if it chooses.

Many of the AMP communities in the 9th District could develop a similar type of structured finance project as evidenced in the Oberlin case study to bring about roof mounted solar project(s). For example, many solar developers are working with local school districts. 9th District public schools can follow the lead of Tallmadge, Ohio, whose Board of Education recently entered into a PPA to put solar on the roof of its auditorium. The electricity created by the system will be sold to Tallmadge City Schools at a contracted rate that begins at 9 cents a kilowatt hour over a ten year period. Tallmadge's only upfront costs were $9,500. Ongoing maintenance of the panels will be performed by the PPA provider and are not the responsibility of the school district.

In addition to public school districts, medical institutions in the 9th district may want to consider working with solar developers to add panels to the roofs of their facilities. For example the Cleveland Clinic has already entered into a solar PPA on its Cleveland Campus and might want to engage in such a project in the 9th District in an effort to increase its renewable energy profile. With larger entities such as the Clinic, it is possible that the agreed upon price for solar energy is high enough so that Federal NMTC are not essential to making a project financially viable.

9. POLICY

9.1. LOCAL AND COUNTY

Cities in the 9th District should begin to educate their communities, especially owners of larger commercial or institutional buildings, on the value their roof now has to solar developers. Where appropriate, cities may want to begin engaging its planning, design review and historic preservation commissions to begin to better understand how to integrate more solar rooftops into the energy portfolio and balance the desire for historic preservation and reducing carbon emissions.

9.2. STATE

Extend net metering -- Ohio should extend its net metering legislation to include virtual met metering. This would allow for energy credits to be applied against all meters located on a customer's property or within a certain distance of the generation facility. Currently Pennsylvania's net metering laws allow meter aggregation for all related meters within two miles of the generation facility (see Pennsylvania Code Sections 75.11-14)[24]. Similar legislation exists in Oregon, Washington and Rhode Island. In another example of virtual net meeting under the Neighborhood Net Metering measures in its 2008 Green Communities Act, Massachusetts placed into law a rule that allows ten or more individuals to invest in a single renewable energy facility and receive net metering credits as if it had a single owner. Similar programs exist in Vermont and Maine. In California, virtual net metering can be used in a program targeting multifamily affordable housing. The benefits of solar power generation, in terms of utility bill offsets, can be distributed to units as a percentage of the total credit. If Ohio were to adopt a hybrid of what these states have done it would open the door to more renewable energy projects by expanding the interest level in energy generation from strictly developers to different entities such as universities and non-profits. It would also expand the number of geographical areas where renewable energy projects would be considered viable.

Extend and protect the Advanced Renewable Portfolio Standards – Ohio political leadership must vigorously defend the integrity of the renewable portfolio standards legislation. The law mandates that by 2025, at least 25 percent of all electricity sold in the state come from alternative energy resources. At least half of the standard, or 12.5 percent of electricity sold, must be generated by renewable sources such as wind, solar (which must account for at least 0.5 percent of electricity use by 2025), hydropower, geothermal, or biomass. At least half of this renewable energy must be generated in state. The bill also creates a renewable energy credit (REC) tracking system, which allows utilities to buy, sell, and trade credits to comply with the renewable energy and solar energy requirements. Additionally, electric utilities will be required to achieve energy savings of 22.5 percent by the end of 2025 through energy efficiency programs. Any changes to this legislation, either in the percentages of required renewable or the requirement that this energy be generated in Ohio will erode the growing alternative energy market and create a regulatory uncertainly. Any uncertainty will lead to a decline in REC pricing and a backing off of alternative energy investment by the private sector.

Renew the Ohio Advanced Energy Fund (OAEF) – Prior to 2011, the Ohio Department of Development's Advanced Energy Fund had made more than $41.9 million in investment in nearly 400 advanced energy projects. The fund was eligible to Ohio projects in the service territories of one of the four participating electricity distribution companies: AEP-Ohio, Dayton Power & Light, Duke Energy, and FirstEnergy, and it helped solar projects receive capital boosts all over Ohio. As of 2011 the State has stopped taking new requests for funds and Governor Kasich's budget does not have future investments being made into the OAEF. This funding should be renewed immediately in order to continue to stimulate alternative energy investments.

[24] State of Pennsylvania Code Sections 75.11-14
www.pacode.com/secure/data/052/chapter75/subchapBtoc.html

9.3. FEDERAL

Continue and increase the New Markets Tax Credit. The New Markets Tax Credit is an important tool for developers when building a financial model that support solar development.

Continue the Section 1603 cash in lieu of tax credits program for more than one year at a time. The 1603 program is voted on as extender legislation at the end of each year, which is a problem for projects in the pipeline, because investors banks do not want to commit until they know for sure the program will remain in place. This has the effect of decreasing the number of projects that commence in the fourth quarter of the year since banks do not need the tax credits and the project economics make it such that the cash is necessary to move the project forward.

10. APPENDICES

- Appendix A: Case Study Financial Model
- Appendix B: OMLPS Background
- Appendix C: OMLPS/OC Net Metering Contract for AJLC
- Appendix D: OMLPS Net Metering Regulation
- Appendix E: Ohio Net Metering Regulation
- Appendix F: Sample Remote Net Metering Legislation (Pennsylvania)

Appendix A:

Case Study Financial Model

Sources & Uses of Funds

System Size (Watts)		519,000	

Uses of Funds

Hard Costs		**Total**	**Cost/W**
Equipment and Installation (EPC Contract)		3,010,200	5.80
Hard Costs Contingency	2.50%	75,255	0.15
SUBTOTAL: HARD COSTS		**3,085,455**	5.95
SOFT COSTS			
Planning & Feasibility Study		20,000	0.04
Legal & Accounting		350,000	0.67
Soft Costs Contingency	5.6%	76,000	0.15
Property Taxes (Construction Period)		4,671	0.01
Interest Costs (Construction Period)	2.00%	10,000	0.02
Loan Fees	1.00%	10,000	0.02
Developer Fee	15.00%	519,019	1.00
NMTC Fees	6.00%	266,400	0.51
Reserves		100,000	0.19
SUBTOTAL: SOFT COSTS		**1,356,090**	2.61
TOTAL PROJECT COSTS		**4,441,545**	8.56

Sources of Funds

1603 Cash Grant	1,124,920	25%
NMTC Equity	1,229,436	28%
Leverage Loan: Non-Commercial Debt	1,000,000	23%
Leverage Loan: Private Equity	1,087,188	24%
Total Sources	**4,441,545**	**100%**

Sample Project Budget and Operations

Oberlin Rooftop Solar Project

Inputs	
System Size (KW DC)	519
DC to AC conversion	80.0%
System Size (KW AC)	415
Annual KWh/KW DC	1,190
AC KWh/year	617,610
Annual Degradation Factor	0.50%
Annual O&M Expense $/Watt DC	12.5
Annual Insurance Expense	0.625%
Annual PILOT/MW	9000
PPA Price $/KWh	0.1300

	Annual Compliance Payment ($/MWh)	350	350	300	300	250	250	200	200	150	150	100	100	50	50	50	50	50	50	50	50
90%	REC Value ($/kWh)	0.315	0.315	0.270	0.270	0.225	0.225	0.180	0.180	0.135	0.135	0.090	0.090	0.045	0.045	0.045	0.045	0.045	0.045	0.045	0.045
	PPA Price ($/kWh)	0.130	0.135	0.141	0.146	0.152	0.158	0.164	0.171	0.178	0.185	0.192	0.200	0.208	0.216	0.225	0.234	0.243	0.253	0.263	0.274
	DC kWh Generated	617,610	614,522	611,449	608,392	605,350	602,323	599,312	596,315	593,334	590,367	587,415	584,478	581,556	578,648	575,755	572,876	570,011	567,161	564,326	561,504

	Annual Operating Budget	Operations Year 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
	Income																				
4%	Power Sales	80,289	83,083	85,975	88,967	92,063	95,266	98,582	102,012	105,562	109,236	113,037	116,971	121,042	125,254	129,613	134,123	138,791	143,621	148,619	153,791
	REC Sales	194,547	193,574	165,091	164,266	136,204	135,523	107,876	107,337	80,100	79,700	52,867	52,603	26,170	26,039	25,909	25,779	25,651	25,522	25,395	25,268
3%	Other Income	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total Income	**274,836**	**276,658**	**251,066**	**253,232**	**228,266**	**230,789**	**206,458**	**209,349**	**185,662**	**188,935**	**165,905**	**169,574**	**147,212**	**151,293**	**155,522**	**159,903**	**164,441**	**169,143**	**174,013**	**179,058**
	Expenses																				
3%	Operations and Maintenance	6,488	6,747	7,017	7,298	7,589	7,893	8,209	8,537	8,879	9,234	9,603	9,987	10,387	10,802	11,234	11,684	12,151	12,637	13,142	13,668
3%	Insurance	19,284	20,055	20,858	21,692	22,560	23,462	24,401	25,377	26,392	27,447	28,545	29,687	30,874	32,109	33,394	34,730	36,119	37,563	39,066	40,629
3%	Taxes (or PILOT)	4,671	4,858	5,052	5,254	5,464	5,683	5,910	6,147	6,393	6,648	6,914	7,191	7,478	7,778	8,089	8,412	8,749	9,099	9,463	9,841
3%	Accounting/Audit	25,000	26,000	27,040	28,122	29,246	30,416	31,633	32,898	34,214	35,583	37,006	38,486	40,026	41,627	43,292	45,024	46,825	48,698	50,645	52,671
	Total Expenses	**55,443**	**57,660**	**59,967**	**62,365**	**64,860**	**67,454**	**70,153**	**72,959**	**75,877**	**78,912**	**82,069**	**85,351**	**88,765**	**92,316**	**96,009**	**99,849**	**103,843**	**107,997**	**112,317**	**116,809**
	Net Operating Income	219,394	218,997	191,099	190,867	163,406	163,335	136,305	136,390	109,785	110,023	83,836	84,223	58,446	58,977	59,513	60,054	60,598	61,146	61,697	62,249
	Financing Expense	111,327	111,327	111,327	111,327	111,327	111,327	111,327	48,557	48,557	48,557	48,557	48,557	48,557	48,557						
	Cash Flow	108,067	107,671	79,773	79,541	52,080	52,008	24,979	87,833	61,228	61,466	35,279	35,665	9,889	10,420	59,513	60,054	60,598	61,146	61,697	62,249
	Debt Coverage Ratio	197%	197%	172%	171%	147%	147%	122%	281%	226%	227%	173%	173%	120%	121%						
	Return on Equity Calculations	(979,121)	107,671	79,773	79,541	52,080	52,008	24,979	87,833	61,228	61,466	35,279	35,665	9,889	10,420	59,513	60,054	60,598	61,146	61,697	62,249
	IRR on Equity Position	0.91%																			

Tax Credit and Debt Assumptions: Oberlin Rooftop Solar Project

Debt Assumptions: Years 1-7	
Size	1,000,000
Term (years)	7
Amortization (years)	10
Interest Rate	2.0%
Constant	11.1%
Minimum DCR	122%
Fees	1.00%
Annual PMT	111,327

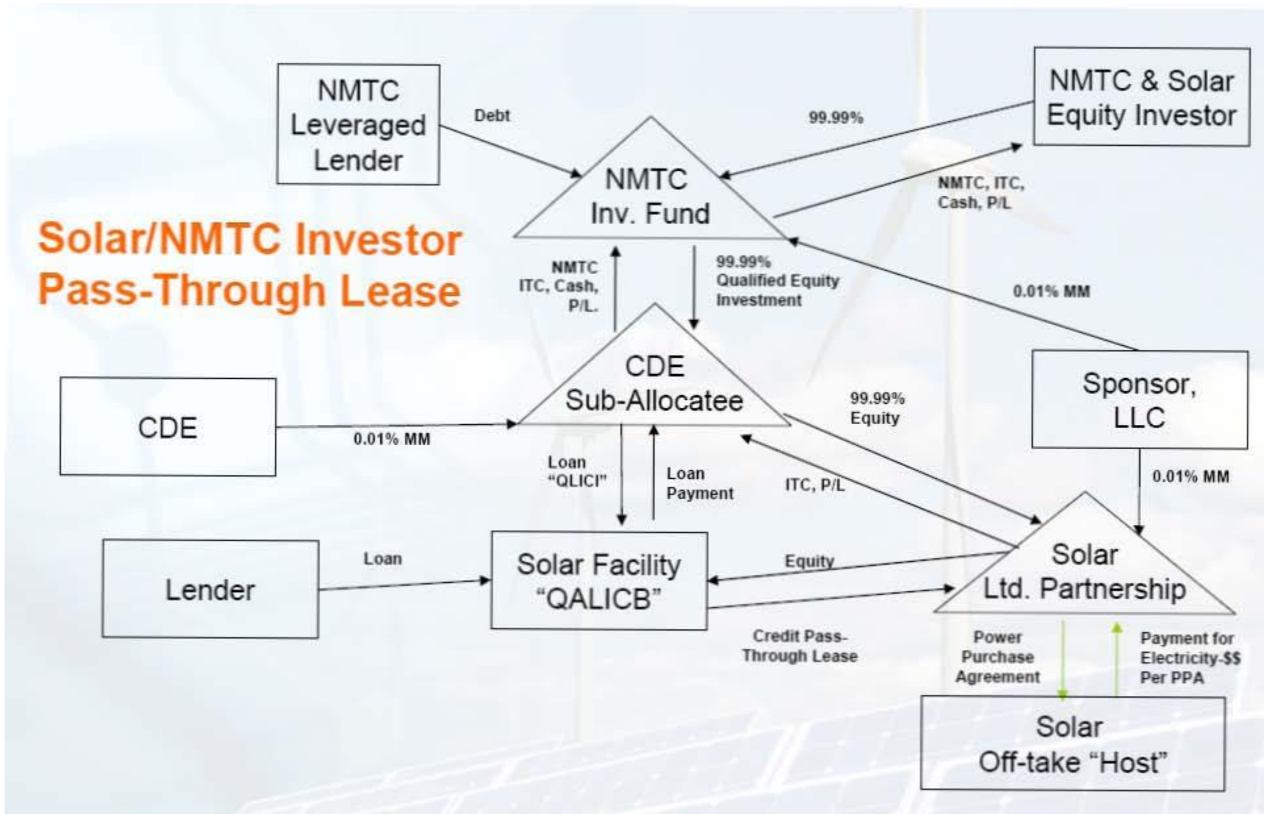
Debt Assumptions: Years 8-15	
Size	314,263
Term (years)	7
Amortization (years)	7
Interest Rate	2.0%
Constant	15.5%
Minimum DCR	120%
Fees	1.00%
Annual PMT	48,557

1603 Assumptions	
Total Project Costs	4,441,545
Less Ineligible Costs	(691,810)
Eligible Basis	3,749,735
ITC Credit	30%
1603 Grant	**1,124,920**

NMTC Assumptions	
Total Project Costs	4,440,000
Less Ineligible Costs	0
Eligible Basis	4,440,000
NMTC Credit	39%
Credit Pricing	0.71
NMTC Equity	**1,229,436**
CDE Fees	6%
Fee Amount	266,400

Notes regarding New Markets Tax Credits

The NMTC investment structure with pass-through lease is shown below.



In this flowchart, four sources of funds are first collected in the Investment Fund (the Investor for NMTC purposes).

1. The NMTC equity investor (the entity ultimately receiving the NMTC benefit) invests based on the value of future tax credits that it will receive. Tax credit pricing is assumed to be 71 cents on the dollar, representing both the discount rate and project/compliance risk.
2. The Solar Equity Investor invests in anticipation of the 1603 grant (or for the Solar ITC) and depreciation/losses.
3. The Leverage Lender is assumed to contain two sources of funds: a non-commercial lender who will be repaid from PPA revenue; and the private equity investor who will be paid cash flow over the term of the PPA, with returns subject to project performance.[25]

[25] Leverage Loan Terms: In this scenario we assume two sources (a non-commercial loan and private equity) brought in to the leverage loan. The actual structuring would be more complex than this, due to NMTC compliance requirements. Most likely the non-commercial "loan" portion would be structured as a 7-year term and a 10-year amortization, with a balloon payment at the end of the NMTC compliance period. A new loan for the balance of the service life of the project could then be made directly to the project. There is some difficulty in repaying principal during the NMTC compliance period, but given that only a small amount of principal would be in question, recapture risk can be avoided by using the combination of escrowed funds at the QALICB level (up to 5 percent of total assets), the return of moderate amounts of principal to the CDE, up to the "substantially all" threshold, and escrowing funds with third party guarantors if necessary. We assume the "private equity" portion of the leverage loan would be repaid with available cash flow after the loan was repaid.

4. The flowchart also shows a Lender (in addition to a Leverage Lender) lending directly to the QALICB. This would be typical of a commercial loan that wants a collateral assignment of the solar equipment and PPA agreements that are owned by the QALICB. This scenario assumes no commercial loan.

Once the sources are received by the Investment Fund, it then makes the Qualifying Equity Investment (QEI) into the Community Development Entity (CDE.) The amount of tax credits received is based on this QEI.

The CDE then makes its Qualified Low Income Community Investment (QLICI) into the Qualifying Active Low Income Community Business (QALICB.) The QALICB would be the entity that actually owns the project, and leases the project to the operator (the Solar Limited Partnership in the chart above) which enters into the PPA with the host.

While the NMTC structure is complicated, it brings in important subsidy that would be hard to replace. The financial model shows $1.2 million of NMTC equity introduced through the structure. One tradeoff that should be noted is that a leveraged NMTC structure as shown here would not be compatible with several (otherwise promising) funding mechanisms listed above in the *Federal Support* and *State Support* sections. Loan guarantees through UDSA, or low-interest loans through a Port Authority or OAQDA, would not be compatible because the loans would have to be made directly to the project instead of through the leveraged structure.

CDEs charge fees to the projects they invest in to support the CDEs operations and the costs associated with NMTC compliance. CDE fees of six percent of the allocation amount are assumed for this model.

Appendix B:

OMLPS Background

Oberlin Municipal Light and Power Systems (OMLPS) is a municipally-owned utility that operates on a not-for-profit basis. That is, it sets its rates to cover its costs and provide the lowest possible prices to its customers, as opposed to trying to provide a maximum rate of return to investors. OMLPS costs can be thought of in two general categories: generation/transmission, and operations/maintenance. Generation and transmission costs are directly variable based on the amount of power purchased. Operations and maintenance costs are less variable based on the amount of power purchased. These costs include staff devoted to maintenance and repair, staff devoted to billing and recordkeeping, equipment maintenance, etc. OMLPS is essentially a retailer of electricity. It buys the product wholesale (the generation/transmission costs), and then marks it up from wholesale to retail prices to cover its retail operations (the operations/maintenance costs.) OMLPS also owns and operates a 20-megawatt natural gas and diesel-fired power plant, but that is not directly related to the discussion here.

OMLPS Pricing Structure

OMLPS has two price structures for its customers. The first is residential, which is also used for small commercial. In this pricing structure, the customer pays a minimum charge of $2.50 per month, and then a flat charge of $0.109 per kWh thereafter (2011 rates). The second pricing structure is commercial, in which the customer pays a flat "Generation Charge" of $0.073 per kWh, and then a "Demand Charge" which is equal to $8.69 multiplied by the customer's peak kilowatt consumption for a 15-minute period during the month. This commercial structure helps to incentivize "smoother" consumption by customers.

The residential rate of $0.109/kWh is made up of the Generation Charge of $0.073, a Distribution Charge of $0.032 cents, and a $0.004 tax. The Generation Charge is essentially the wholesale purchase of power, and the Distribution Charge is essentially the markup OMLPS places on the power to fund their operations and maintenance.

In the existing commercial net metering contract (such as with Oberlin College,) OMLPS gives its customer a credit on its monthly bill for each kWh of power produced by the customer's generating equipment. The credit is equal to the Generation Charge. In this way, OMLPS (approximately) recovers its operations costs, even if the customer produces as much electricity as it consumes.

OMLPS Power Sources

OMLPS Wholesale Power Costs 2003-2015 (Predicted; per OMLPS Director Steve Dupee in a public presentation to City Council 2010).

Year	Avg. Wholesale Cost	% Change	Implied Trend
2003	43.41		
2004	46.46	7.03%	7.03%
2005	59.06	27.12%	17.07%
2006	52.89	-10.45%	7.90%
2007	52.64	-0.47%	5.81%
2008	56.35	7.05%	6.05%
2009	68.69	21.90%	8.70%
2010	68.07	-0.90%	7.32%
2011	66.70	-2.01%	6.16%
2012	64.97	-2.59%	5.18%
2013	74.05	13.98%	6.06%
2014	77.48	4.63%	5.93%
2015	81.79	5.56%	5.90%

Appendix C:

OMLPS/OC Net Metering Contract for AJLC

NET METERING AGREEMENT

This Net Metering Agreement (the "Agreement"), is made as of SEPT. 18, 2001, by and between Oberlin College, an Ohio not-for-profit corporation, whose address is 70 N. Professor St. (the "College") and the City of Oberlin, an Ohio municipal corporation whose address is 85 S. Main, Oberlin, OH (the "City").

WHEREAS, Oberlin Municipal Light & Power System ("OMLPS"), a department of the City, operates a municipal electric power system for the generation, purchase, transmission, distribution and sale of electric power and energy; and

WHEREAS, the College intends to install and operate photovoltaic generating equipment to generate electric power to supply certain College buildings, which shall be connected to the load side of the OMPLS billing meter; and

WHEREAS, the College desires to return any excess generation capability to OMLPS to reduce the College's energy costs.

NOW, THEREFORE, in consideration of the mutual promises contained herein, the College and the City agree as follows:

1. DEFINITIONS

"Net Metering" means an arrangement by which the College's PV Equipment is connected to the load site of the OMLPS billing meter. The resultant electric power generated by the PV Equipment is permitted to run in synchronism with the OMLPS 60 cycle, alternating current electric power and carry all or part of the load of the building in which it is installed. Generated energy which is in excess of that required by the building load is permitted to flow in a reverse direction through the billing meter. Such electric power (measured in kilowatt-hours) is either subtracted from the meter's kilowatt-hour register or accounted for in a separate "Kilowatt-hours Received" register and used to set-off "Kilowatt-hours Delivered" for billing purposes.

"Photovoltaic Generating Equipment" or "PV Equipment" means the College's equipment used for generating electricity directly from the sun's rays and converting such energy to 60 cycle, alternating current including solar panels, DC to AC inverter, safety and disconnect devices and excluding energy storage devices.

2. PV EQUIPMENT INSTALLATION

The City authorizes the College to connect and operate Photovoltaic Generating Equipment subject to the terms and conditions of this Agreement. The College's installation shall comply with IEEE Standard 929-2000 for "Recommended Practice for Utility Interface of Photovoltaic (PV) Systems" (the "IEEE Standard") as the same may be amended or supplemented from time to time. The College agrees to use good industry practice and shall not operate the PV Equipment in a manner that jeopardizes the health and safety of City or OMLPS employees. The College also agrees to repair or replace damaged City Equipment (defined below) which is directly caused by the negligent installation or operation of the Photovoltaic Generating Equipment; provided however, the College shall assume no responsibility, financial or otherwise for losses to City Equipment caused by Force Majeure (defined below) or other failures which are beyond the College's control. The College agrees to provide a standard dial-up phone line at its expense at each meter location where PV Equipment is installed. The College agrees to notify and submit plans to OMLPS before installing and operating PV Equipment. OMLPS will review and approve plans with regard to compliance with this Agreement and good industry practice, including but not limited to the IEEE Standard and will conduct an inspection of the installation of the PV Equipment before the College places the PV Equipment into operation.

3. INDEMNIFICATION

Each party hereto shall defend, hold harmless and indemnify the other party from and against any and all claims, liabilities, costs and expenses, including without limitation attorney's fees, due to proprietary right infringement, personal injury or death of any person(s) or damage to property to the extent said personal injury, death or property damage is caused by the negligent acts or omissions of such party, its officers, agents, employees, contractors or subcontractors.

4. PROPRIETARY RIGHTS

All materials of the College used in generating electricity with the PV Equipment, including but not limited to solar panels, hardware, software, written materials, art work, labels, marks, calculations, and methods of calculations and any upgrades thereto ("Proprietary Material") shall remain the property of the College. The City Equipment shall remain the property of the City.

5. METER INSTALLATION/MODIFICATION

The City agrees to use Net Metering on those College facilities with PV Equipment. The College agrees to purchase power and energy from the City at the rates established by Oberlin City Council. The City shall maintain its equipment installed at the College, including, but not limited to, metering equipment, test devices, cabling, switches, fuse boxes, circuit breakers and the like (the "City Equipment") in good operating condition and in accordance with all applicable safety procedures and good industry practice. The City shall promptly repair any defects or malfunctions in the City Equipment in accordance with standard industry practice and insure the uninterrupted supply of electric power to the buildings serviced. In addition to the billing meter(s), the College agrees to allow the City, at it's option, to install metering equipment to measure the power output of the PV equipment for engineering and survey purposes. The City agrees to make all measured load data available to the College at a reasonable cost.

6. ADMINISTRATION OF AGREEMENT

Each party hereby designates the employee identified below as its administrator for this Agreement. The administrator shall be responsible for representing their respective employers in contractual and commercial matters relative to the administration of this Agreement. Each party may change its administrator by giving not less than ten (10) days prior written notice of its new administrator to the other party.

College

Name: Andrew Brown
Title: VICE PRESIDENT FOR FINANCE
Address: OBERLIN COLLEGE
OBERLIN, OH 44074
Telephone: 440-775-8460
Fax: 440-775-8462

City

Name: Vic Ofttering
Title: Tech Service Supt
Address: 289 S. Professor, Oberlin, OH

Telephone: (440) 775-7265
Fax: (440) 775-1546

7. TERMINATION

Either party shall have the right to terminate this Agreement with or without cause and for any reason whatsoever upon thirty (30) days written notice to the other party. The College shall reimburse the City for the electric power and other services provided by the City to the date of such termination. Either party may terminate this Agreement immediately upon notice if the other party is adjudicated bankrupt or makes a general assignment for the benefit of creditors or otherwise, or takes the benefit of any insolvency, reorganization or other relief act, or if a receiver or trustee is appointed for its property.

8. ORDERLY TERMINATION

Except as provided otherwise in this Agreement, upon the termination or expiration of this Agreement, each party shall return to the other all papers, materials and property of the other held by such party in connection with the performance of this Agreement. In addition, each party shall assist the other in the orderly termination of this Agreement and the transfer of all aspects hereof, both tangible and intangible, as may be necessary for the orderly continuation of the business of each party.

9. OTHER CHARGES, TAXES AND FEES

Any taxes, fees, assessments or other charges at the federal, state, municipal, or local level resulting from the purchase of electric power by the College shall be the sole responsibility of College. However, no taxes shall be charged if the College provides evidence of exemption from such taxes, fees, assessments or other charges.

10. PAYMENT TERMS

Invoices will be submitted monthly by the City and shall be due and payable thirty (30) calendar days after the invoice date.

11. APPLICABLE LAW

This Agreement shall be construed solely in accordance with the laws of the State of Ohio.

12. FORCE MAJEURE

Neither party shall be deemed to be in default of any provision of this Agreement, or for failures in performance, resulting from acts or events beyond the reasonable control of such party. Such acts shall include but not be limited to acts of God including weather, civil or military authority, civil disturbance, war, strikes, fires, other catastrophes, or other events beyond the parties' reasonable control (collectively, "Force Majeure").

13. MISCELLANEOUS

If any term, provision or restriction of this Agreement is determined to be invalid, void or unenforceable in any way in any jurisdiction, all remaining provisions shall continue to be valid and enforceable. It is hereby stipulated and declared to be the intention of the parties that they would have executed the Agreement if it contained the remaining terms, provision, covenants and restrictions without including any of such which might be hereafter declared invalid, void or unenforceable.

This Agreement shall supersede and replace any previous agreements, both oral and written, between the College and the City and represents the entire Agreement. Any changes to this Agreement shall be made in writing by the parties and evidenced by their respective approvals in writing.

This Agreement may be executed in two or more counterparts and when so executed shall have the same force and effect as though all signatures appeared on one document.

IN WITNESS WHEREOF, each of the parties have caused this Agreement to be executed by a duly authorized representative on the respective dates entered above.

OBERLIN COLLEGE

By: [signature]

Name: ANDREW B. EVANS

Title: VICE PRES. FOR FINANCE

CITY OF OBERLIN, OHIO

By: [signature]

Name: Robert DiSpirito

Title: CITY MANAGER

Appendix D:

OMLPS Net Metering Regulation

913.04 SERVICE RULES AND REGULATIONS.

The following electric service standard rules and regulations shall apply to all sections of this chapter.

(a) Applications and Contracts.

(1) Service application.

An application accepted by the City or other form of contract between the City and the consumer will be required from a consumer for each class of service requested before the service is supplied. This requirement shall apply to new installations, or where service is to be re-established, or a change in the class of service or a change of consumer. This shall not be construed as releasing the property owner from liability for payment.

(2) Service contract. The service contract shall constitute the entire agreement between the consumer and the City and no promise, agreement or representation of any agent, representative or employee of the City shall be binding upon it unless the same shall be incorporated in the service contract.

(3) Large capacity agreements. Consumers now served who seek to increase their present capacity requirements to more than 500 KVA and new consumers who seek to purchase capacities of more than 500 KVA shall negotiate agreements with the City looking towards an equitable arrangement both as to the term of contract and other conditions requiring special consideration as such capacities may require changes in area facilities or rearrangement of facilities owned by the City and/or the consumer. (Ord. 1106AC CMS. Passed 4-21-75.)

(b) Character of Service.

(1) Type. Electric service supplied by the City will be 60 hertz alternating current delivered at the standard voltages available adjacent to the premises where the consumer is located.

(2) Continuity. The City will endeavor, but does not guarantee, to furnish a continuous supply of electric energy and to maintain voltage and frequency.

(3) **Net Metering**. **Net metering** (an interactive interconnection between the City's utility system and the consumer's electric service panel using a standard kilowatt hour **meter** capable of registering the flow of electricity in both directions) is allowed when on-site generating capacity does not exceed 10 KW (kilowatts) and is derived from solar power. In cases where capacity exceeds 10 KW, both the customer and utility must sign a **net metering** agreement before connecting to the utility.

(c) Billing.

(1) Bills for electric service will be rendered monthly.

(2) The electricity used by the same person, firm or corporation, but delivered and **metered** separately or at different locations, will not be combined for billing purposes.

(3) The City will make available upon the request of a residential customer a plan for uniform monthly payments for electric service over specified periods.

(4) For **net metering** purposes, if the current **meter** reading is less than or equal

to the highest previous meter reading, there are no billable kilowatt-hours for the current month. However, the appropriate customer charge will still apply and continue to be billed monthly. Otherwise, the difference between the current meter reading and the highest previous meter reading is the billable kilowatt-hours. (Ord. 03-70AC. Passed 10-6-03.)

(d) Connection and Meter Requirements.

(1) The City will furnish one meter or one unified set of meters for each service contract. The consumer shall bring his/her service wires from his/her building in such a manner as to be readily accessible from the City's lines.

(2) All equipment furnished by the City shall remain its exclusive property and the City shall have the right to remove the same after termination of service for any reason whatsoever.

(3) The consumer shall permit only authorized agents of the City, or persons otherwise lawfully authorized, to inspect, test or remove City equipment located on the consumer's premises. If this equipment is damaged or destroyed due to the negligence of the consumer, the cost of repairs or replacement shall be paid by the consumer.

(4) The meter or meters shall be located to the approval of the Director of the Municipal Light and Power Department.

(e) Consumer's Wiring and Equipment; Installation. The consumer shall supply all wiring on the consumer's side from the point of attachment as designated by the City. All consumer's wiring and electrical equipment shall be installed and maintained by the consumer to meet the provisions of the City Electrical Code.

(Ord. 1106 AC CMS. Passed 4-21-75.)

(f) Discontinuance and Reconnection of Service.

(1) A consumer may order service discontinued at any time unless there is a provision to the contrary in the service contract or applicable rate schedule, but the consumer is responsible for any use of the electric service until the City has had a reasonable time to secure a final reading or to remove the meter. Service will be disconnected in accordance with Chapter 919.

(2) Service may be discontinued by the City in case the consumer is in arrears in the payment of bills or fails to comply with the terms of the service contract. Service will be disconnected in accordance with Chapter 919.

(3) Additionally, the City may discontinue service upon discovery that the consumer has made misrepresentation of a material fact to the City regarding the use of electric service, or has in any other manner fraudulently entered into the service contract. Upon discovery, the City shall post notice of disconnection seven days prior to the termination of service.

(4) The City may also discontinue service in case the meter or wiring on the consumer’s premises is tampered with in any manner to permit the use of unmetered electric energy. In case of discontinuance of service for this reason, the City shall restore service only after the consumer has paid for the metered and estimated unmetered energy used and has made at his/her expense such changes in the wiring and service entrance as the City may specify. Prior to disconnection, the City shall post a notice of disconnection

seven days prior to the termination of service.
(Ord. 95-70 AC. Passed 9-19-95.)

Appendix E:

Ohio Net Metering Statute

Ohio Revised Code

4901:1-10-28 Net metering.

(A) Standard net metering.

(A)(1) Each EDU electric utility shall develop a tariff for net metering. Such tariff shall be made available to qualifying customer generators upon request.

(a) A qualifying customer generator is one whose generating facilities are:

(i) Fueled by solar, wind, biomass, landfill gas, or hydropower, or use a microturbine or a fuel cell.

(ii) Located on a customer generator's premises.

(iii) Operated in parallel with the electric utility's transmission and distribution facilities.

(iv) Intended primarily to offset part or all of the customer generator's electricity requirements.

(b) Net-metering arrangements shall be made available regardless of the date the customer's generating facility was installed.

(2) The electric utility's tariff for net metering shall be identical in rate structure, all retail rate components, and any monthly charges, to the tariff to which the same customer would be assigned if that customer were not a customer generator. Such terms shall not change simply because a customer becomes a customer generator.

(3) No electric utility's tariff for net metering shall require customer generators to:

(a) Comply with any additional safety or performance standards beyond those established by rules in Chapter 4901:1-22 of the Administrative Code, and the "National Electrical Code," the "Institute of Electrical and Electronics Engineers," and "Underwriters Laboratories," in effect as set forth in rule 4901:1-22-03 of the Administrative Code.

(b) Perform or pay for additional tests beyond those required by paragraph (A)(3)(a) of this rule.

(c) Purchase additional liability insurance beyond that required by paragraph (A)(3)(a) of this rule.

(4) Net metering shall be accomplished using a single meter capable of registering the flow of electricity in each direction. A customer's existing single-register meter that is capable of registering the flow of electricity in both directions satisfies this requirement. If the customer's existing electrical meter is not capable of measuring the flow of electricity in two directions, the electric utility, upon written request from the customer, shall install at the customer's expense a meter that is capable of measuring electricity flow in two directions.

(5) The electric utility, at its own expense and with the written consent of the customer generator, may install one or more additional meters to monitor the flow of electricity in each direction. No electric utility shall impose, without commission approval, any additional interconnection requirement or additional charges on customer generators refusing to give such consent.

(6) The measurement of net electricity supplied or generated shall be calculated in the following manner:

(a) The electric utility shall measure the net electricity produced or consumed during the billing period, in accordance with normal metering practices.

(b) If the electric utility supplies more electricity than the customer generator feeds back to the system in a given billing period, the customer generator shall be billed for the net electricity that the electric utility supplied, as measured in accordance with normal metering practices.

(c) If the customer generator feeds more electricity back to the system than the electric utility supplies to the customer generator, only the excess generation component shall be allowed to accumulate as a credit until netted against the customer generator’s bill, or until the customer generator requests in writing a refund that amounts to, but is no greater than, an annual true-up of accumulated credits over a twelve-month period.

(7) In no event shall the electric utility impose on the customer generator any charges that relate to the electricity the customer generator feeds back to the system.

(B) Hospital net metering.

(1) Each electric utility shall develop a separate tariff providing for net metering for hospitals. Such tariff shall be made available to qualifying hospital customers upon request.

(a) As defined in section 3701.01 of the Revised Code, “hospital” includes public health centers and general, mental, chronic disease, and other types of hospitals, and related facilities, such as laboratories, outpatient departments, nurses’ home facilities, extended care facilities, self-care units, and central service facilities operated in connection with hospitals, and also includes education and training facilities for health professions personnel operated as an integral part of a hospital, but does not include any hospital furnishing primarily domiciliary care.

(b) A qualifying hospital customer generator is one whose generating facilities are:

(i) Located on a customer generator’s premises.

(ii) Operated in parallel with the electric utility’s transmission and distribution facilities.

(2) Net-metering arrangements shall be made available regardless of the date the hospital’s generating facility was installed.

(3) The tariff shall be based both upon the rate structure, rate components, and any charges to which the hospital would otherwise be assigned if the hospital were not taking service under this rule and upon the market value of the customer-generated electricity at the time it is generated. For purposes of this rule, market value means the locational marginal price of energy determined by a regional transmission organization’s operational market at the time the customer-generated electricity is generated.

(4) For hospital customer generators, net metering shall be accomplished using either two meters or a single meter with two registers that are capable of separately measuring the flow of electricity in both directions. One meter or register shall be capable of measuring the electricity generated by the hospital at the time it is generated. If the hospital’s existing electrical meter is not capable of separately measuring electricity the hospital generates at the time it is generated, the electric utility, upon written request from the hospital, shall install at the hospital’s expense a meter that is capable of such measurement.

(5) The tariff shall allow the hospital customer-generator to operate its electric generating facilities individually or collectively without any wattage limitation on size.

(6) The hospital customer generator’s net metering service shall be calculated as follows:

(a) All electricity flowing from the electric utility to the hospital shall be charged as it would have been if the hospital were not taking service under this rule.

(b) All electricity generated by the hospital shall be credited at the market value as of the time the hospital generated the electricity.

(c) Each monthly bill shall reflect the net of paragraphs (B)(6)(a) and (B)(6)(b) of this rule. If the resulting bill indicates a net credit dollar amount, the credit shall be netted against the hospital customer generator’s bill until the hospital requests in writing a refund that amounts to, but is no greater than, an annual true-up of accumulated credits over a twelve-month period.

(7) No electric utility’s tariff for net metering shall require hospital customer generators to:

(a) Comply with any additional safety or performance standards beyond those established by rules in Chapter 4901:1-22 of the Administrative Code, and the National Electrical Code, the institute of electrical and electronics engineers, and underwriters laboratories, in effect as set forth in rule 4901:1-22-03 of the Administrative Code.

(b) Perform or pay for additional tests beyond those required by paragraph (B)(7)(a) of this rule.

(c) Purchase additional liability insurance beyond that required by paragraph (B)(7)(a) of this rule.

(8) In no event shall the electric utility impose on the hospital customer generator any charges that relate to the electricity the customer generator feeds back to the system.

Effective: 06/29/2009

R.C. 119.032 review dates: 11/26/2008 and 09/30/2012

Promulgated Under: 111.15

Statutory Authority: 4928.06, 4928.11, 4905.28, 4928.67

Rule Amplifies: 4928.67, 4928.11, 4905.28

Prior Effective Dates: 9/18/00, 1/1/04, 10/22/07

Appendix F:

Sample Remote Net Metering Legislation

State of Pennsylvania Code
Subchapter B

NET METERING

Sec.

§ 75.11. Scope.

This subchapter sets forth net metering requirements that apply to EGSs and EDCs which have customer-generators intending to pursue net metering opportunities in accordance with the act.

§ 75.12. Definitions.

The following words and terms, when used in this subchapter, have the following meanings unless the context clearly indicates otherwise: *Base year*—For customer-generators who initiated self generation on or after January 1, 1999, the base year will be the immediate prior calendar year; for all other customer generators, the base year will be 1996. *Billing month*—The term has the same meaning as set forth in § 56.2 (relating to definitions). *Customer-generator facility*—The equipment used by a customer-generator to generate, manage, monitor and deliver electricity to the EDC. *Electric distribution system*—That portion of an electric system which delivers electricity from transformation points on the transmission system to points of connection at a customer's premises. *Meter aggregation*—The combination of readings from and billing for all meters regardless of rate class on properties owned or leased and operated by a customer-generator for properties located within the service territory of a single EDC. Meter aggregation may be completed through physical or virtual meter aggregation. *Net metering*—The means of measuring the difference between the electricity supplied by an electric utility or EGS and the electricity generated by a customer-generator when any portion of the electricity generated by the alternative energy generating system is used to offset part or all of the customer-generator's requirements for electricity. *Physical meter aggregation*—The physical rewiring of all meters regardless of rate class on properties owned or leased and operated by a customer-generator to provide a single point of contact for a single meter to measure electric service for that customer-generator. *Virtual meter aggregation*—The combination of readings and billing for all meters regardless of rate class on properties owned or leased and operated by a customer-generator by means of the EDC's billing process, rather than through physical rewiring of the customer-generator's property for a physical, single point of contact. Virtual meter aggregation on properties owned or leased and operated by a customer-generator and located within 2 miles of the boundaries of the customer-generator's property and within a single electric distribution company's service territory shall be eligible for net metering. *Year and yearly*—Planning year as determined by the PJM Interconnection, LLC regional transmission organization.

Authority

The provisions of this § 75.12 amended under 66 Pa.C.S. § § 501 and 1501.

Source

The provisions of this § 75.12 amended November 28, 2008, effective November 29, 2008, 38 Pa.B. 6473. Immediately preceding text appears at serial pages (324588) to (324589).

§ 75.13. General provisions.

(a) EDCs shall offer net metering to customer-generators that generate electricity on the customer-generator's side of the meter using Tier I or Tier II alternative energy sources, on a first come, first served basis. EGSs may offer net metering to customer-generators, on a first come, first served basis, under the terms and conditions as are set forth in agreements between EGSs and customer-generators taking service from EGSs.

(b) An EDC shall file a tariff with the Commission that provides for net metering consistent with this chapter. An EDC shall file a tariff providing net metering protocols that enable EGSs to offer net metering to customer-generators taking service from EGSs. To the extent that an EGS offers net metering service, the EGS shall prepare information about net metering consistent with this chapter and provide that information with the disclosure information required in § 54.5 (relating to disclosure statement for residential and small business customers).

(c) The EDC shall credit a customer-generator at the full retail rate, which shall include generation, transmission and distribution charges, for each kilowatt-hour produced by a Tier I or Tier II resource installed on the customer-generator's side of the electric revenue meter, up to the total amount of electricity used by that customer during the billing period. If a customer generator supplies more electricity to the electric distribution system than the EDC delivers to the customer-generator in a given billing period, the excess kilowatt hours shall be carried forward and credited against the customer-generator's usage in subsequent billing periods at the full retail rate. Any excess kilowatt hours shall continue to accumulate until the end of the year. For customer-generators involved in virtual meter aggregation programs, a credit shall be applied first to the meter through which the generating facility supplies electricity to the distribution system, then through the remaining meters for the customer-generator's account equally at each meter's designated rate.

(d) At the end of each year, the EDC shall compensate the customer-generator for any excess kilowatt-hours generated by the customer-generator over the amount of kilowatt hours delivered by the EDC during the same year at the EDC's price to compare.

(e) The credit or compensation terms for excess electricity produced by customer-generators who are customers of EGSs shall be stated in the service agreement between the customer-generator and the EGS.

(f) If a customer-generator switches electricity suppliers, the EDC shall treat the end of the service period as if it were the end of the year.

(g) An EDC and EGS which offer net metering shall submit an annual net metering report to the Commission. The report shall be submitted by July 30 of each year, and include the following information for the reporting period ending May 31 of that year:

(1) The total number of customer-generator facilities.

(2) The total estimated rated generating capacity of its net metering customer-generators.

(h) A customer-generator that is eligible for net metering owns the alternative energy credits of the electricity it generates, unless there is a contract with an express provision that assigns ownership of the alternative energy credits to another entity or the customer-generator expressly rejects any ownership interest in alternative energy credits under § 75.14(d) (relating to meters and metering).

(i) An EDC shall provide net metering at nondiscriminatory rates identical with respect to rate structure, retail rate components and any monthly charges to the rates charged to other customers that are not customer-generators. An EDC may use a special load profile for the customer-generator which incorporates the customer-generator's real time generation if the special load profile is approved by the Commission.

(j) An EDC may not charge a customer-generator a fee or other type of charge unless the fee or charge would apply to other customers that are not customer-generators. The EDC may not require additional equipment or insurance or impose any other requirement unless the additional equipment, insurance or other requirement is specifically authorized under this chapter or by order of the Commission.

(k) Nothing in this subchapter abrogates a person's obligation to comply with other applicable law.

Authority

The provisions of this § 75.13 amended 66 Pa.C.S. § § 501 and 1501.

Source

The provisions of this § 75.13 amended November 28, 2008, effective November 29, 2008, 38 Pa.B. 6437. Immediately preceding text appears at serial pages (324589) to (324590).

§ 75.14. Meters and metering.

(a) A customer-generator facility used for net metering must be equipped with a single bidirectional meter that can measure and record the flow of electricity in both directions at the same rate. If the customer-generator agrees, a dual meter arrangement may be substituted for a single bidirectional meter.

(b) If the customer-generator's existing electric metering equipment does not meet the requirements in subsection (a), the EDC shall install new metering equipment for the customer-generator at the EDC's expense. Any subsequent metering equipment change necessitated by the customer-generator shall be paid for by the customer-generator.

(c) When the customer-generator intends to take title or transfer title to any alternative energy credits which may be produced by the customer-generator's facility, the customer-generator shall bear the cost of additional net metering equipment required to qualify the alternative energy credits in accordance with the act.

(d) When the customer-generator expressly rejects ownership of alternative energy credits produced by the customer-generator's facility, the EDC may supply additional metering equipment required to qualify the alternative energy credit at the EDC's expense. In those circumstances, the EDC shall take title to any alternative energy credit produced. An EDC shall, prior to taking title to any alternative energy credits produced by a customer-generator, fully inform the customer-generator of the potential value of the alternative energy credits and other options available to the customer-generator for the disposition of those credits. A customer-generator is not prohibited from having a qualified meter service provider install metering equipment for the measurement of generation, or from selling alternative energy credits to a third party other than an EDC.

(e) Virtual meter aggregation on properties owned or leased and operated by a customer-generator shall be allowed for purposes of net metering. Virtual meter aggregation shall be limited to meters located on properties owned or leased and operated within 2 miles of the boundaries of the customer-generator's property and within a single EDC's service territory. Physical meter aggregation shall be at the customer-generator's expense. The EDC shall provide the necessary equipment to complete physical aggregation. If the customer-generator requests virtual meter aggregation, it shall be provided by the EDC at the customer-generator's expense. The customer-generator shall be responsible only for any incremental expense entailed in processing his account on a virtual meter aggregation basis.

Authority

The provisions of this § 75.13 amended 66 Pa.C.S. § § 501 and 1501.

Source

The provisions of this § 75.14 amended November 28, 2008, effective November 29, 2008, 38 Pa.B. 6437. Immediately preceding text appears at serial pages (324590) to (324591).

Cross References

This section cited in 52 Pa. Code § 75.13 (relating to general provisions).

§ 75.15. Treatment of stranded costs.

If a net metering small commercial, commercial or industrial customer's self-generation results in a 10% or more reduction in the customer's purchase of electricity through the EDC's transmission and distribution network for an annualized period when compared to the prior annualized period, the net metering small commercial, commercial or industrial customer shall be responsible for its share of stranded costs to prevent interclass or intraclass cost shifting under 66 Pa.C.S. § 2808(a) (relating to competitive transition charge). The net metering small commercial, commercial or industrial customer's stranded cost obligation shall be calculated based upon the applicable ''base year'' as defined in this chapter.