Solar Guidebook for New Jersey Municipalities




Powered by SunShot
U.S. Department of Energy

SOLAR OUTREACH PARTNERSHIP

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Introduction. About the SunShot Initiative

The U.S. Department of Energy (DOE) SunShot Initiative seeks to make solar energy cost-competitive with other forms of electricity by the end of the decade. The SunShot Initiative drives research, manufacturing, and market solutions to make the abundant solar energy resources in the United States more affordable and accessible for Americans.

The Solar Outreach Partnership (SolarOPs) is designed to help accelerate solar energy adoption on the local level by providing timely and actionable information to local governments.

Funded by the U.S. Department of Energy (DOE) SunShot Initiative, SolarOPs achieves its goals through a mix of educational workshops, peer-to-peer sharing opportunities, research-based reports, and online resources.

To perform the work of SolarOPs, DOE selected teams led by the International City/County Management Association (ICMA) and ICLEI - Local Governments for Sustainability USA. These organizations and their teams help local governments take a comprehensive approach to solar energy deployment by:

- Conducting outreach and sharing best practices for increasing solar energy use with thousands of local governments across the nation
- Working in partnership with industry experts and national membership associations to enable local governments across the United States to expand their local solar markets
- Providing information in relevant areas, such as solar policies and regulations, financial incentives, workforce training, and utility and community engagement.

Solar Powering Your Community: A Guide for Local Governments serves as the foundation for these outreach efforts and for sections of this Guide.

Chapter 1. About this Guide and the Accompanying Model Ordinance

Background

New Jersey is a national leader in renewable energy and solar in particular, with over 1GW of solar energy capacity installed (only behind California and Arizona) providing cleaner and renewable electricity to residents, businesses, and governments across the state.[1] This is due in part to both federal and state financial incentives and New Jersey state regulatory changes that promote solar development in New Jersey.

Despite this large influx of solar development projects into the state, there is no clear guidance or accepted standard available to municipalities for properly siting these projects. In many cases municipalities have been struggling to deal with requests to accommodate large commercial installations that have the potential to have significant land use, aesthetic, economic, and environmental impacts. In other cases there is fear that municipal ordinances may place unnecessary burdens on new small scale solar projects (for example on individual homes).

State legislation allows for municipal adoption of siting criteria for solar photovoltaic (PV)systems at the local level on issues such as location, size and aesthetics. However, most municipalities do not have ordinances or site design standards in place to assess solar projects and approve, modify, or reject them. Without an ordinance, municipalities must turn to the use-variance process which must be performed on a case-by-case basis with little guidance. Some municipalities have begun adopting ordinances to regulate the solar installations. However, without clear guidance on how to construct solar siting ordinances, many of these efforts can conflict with state laws, may be overly restrictive, fail to address key impacts, and produce other unintended consequences.

This piecemeal approach has a three-fold effect. An inconsistent, unpredictable and inefficient process saps municipal and private sector resources and can retard the growth of the solar industry. Secondly, with no clear guidelines or standards for solar development in communities, any given application may have undesired consequences such as poor aesthetics or improper use of valuable or sensitive land. Thirdly, there can be an inherent conflict between farm and open space preservation efforts and master plans and large land-based solar development when solar is proposed in those types of locations.

Given the continuing demand for solar projects in New Jersey, it is evident that the solar industry and local quality of life are best served, in the absence of statewide rules, if municipal governments proactively develop siting standards. This guidebook and accompanying framework ordinance aim to assist local governments in better understanding and preparing for different kinds of solar installations that balance the need to support renewable energy and preserve local quality of life and are most effective utilized together.

This guidebook provides a comprehensive background for New Jersey municipalities on solar PV systems, state legislation that affects the siting of these systems, and the appropriate tools and methods municipalities can use to incorporate solar PV systems into their community's vision. After

[1]New Jersey's Clean Energy Program: http://www.njcleanenergy.com/renewable-energy/project-activity-reports/installation-summary-technology/installation-summary-technology, and Greentech Solar. Garden State a Solar Eden-New Jersey Hits 1 GW. March 22, 2013. http://www.greentechmedia.com/articles/read/garden-state-a-solar-eden-new-jersey-hits-1-gw

reading the Guidebook, you will be better prepared to consider the benefits and considerations that a solar siting ordinance will bring to your community.

From there, municipalities should utilize the complementary ordinance framework that addresses the full spectrum of solar development options in a community – from residential systems designed to meet the needs of a single household, to utility-scale projects that serve electricity consumers more broadly. Municipalities should utilize the framework and the information in this guidebook as well as their knowledge of their communities to create an ordinance that will work best for their particular situation.

It is recommended that municipalities consider adopting this Ordinance as a stand-alone piece of legislation or as a separate section within their Land Use Ordinance rather than try to fit it into existing Ordinance language. If a municipality already has a Land Use Ordinance adopted that solely addresses the solar PV systems, they may consider reviewing this guidebook and framework ordinance and revising their existing ordinance.

It is important to remember that ordinances must be supported by the municipal master plan. In matters dealing with environmental and aesthetic factors, the master plan depends to a large degree, on the municipal Environmental Resources Inventory (ERI) as well as other planning policies and documents including, but not limited to, open space and agricultural preservation plans. New Jersey's Municipal Land Use law also authorizes three optional elements that should be examined with solar installations in mind. These are the Conservation Element, the Historic Preservation Element and the Sustainability Element. Municipalities should be advised that their ERI and other master plan elements need to be consulted, interpreted and updated to support the accompanying modifications to the master plan and development of a solar siting ordinance.

Chapter 2. Solar Energy Technology Background

2.1 How Does a Photovoltaic System Work?

Solar energy systems (referred to as photovoltaic (PV) systems) convert sunlight directly into electricity. These systems allow electricity consumers (homes, businesses, public buildings, etc.) to generate some or all of their electrical energy demand. The system is generally installed either on a roof or on the ground somewhere near the owner's property.

The majority of solar PV systems are grid-tied, meaning they are directly interconnected to the power grid and do not have battery or other forms of storage. Grid-tied PV systems will generate electrical power to supply part or all of a building's energy usage during the day, but will not produce power during a power outage or at night when the sun isn't shining.

When the solar PV system generates more electricity that is needed by the owner, the excess electricity can be fed back into the electricity grid, in effect spinning the building's electricity meter backwards. The ability to export electricity into the grid and receive compensation from the utility in this way is called net-metering. Utilities generally have a special rate tariff for net-metered PV systems and will install a dedicated utility meter that records the net power coming in from the utility and the surplus power flowing out from the solar PV system. The customer's electricity bill reflects the net amount they used subtracting out the amount generated or exported to the grid.

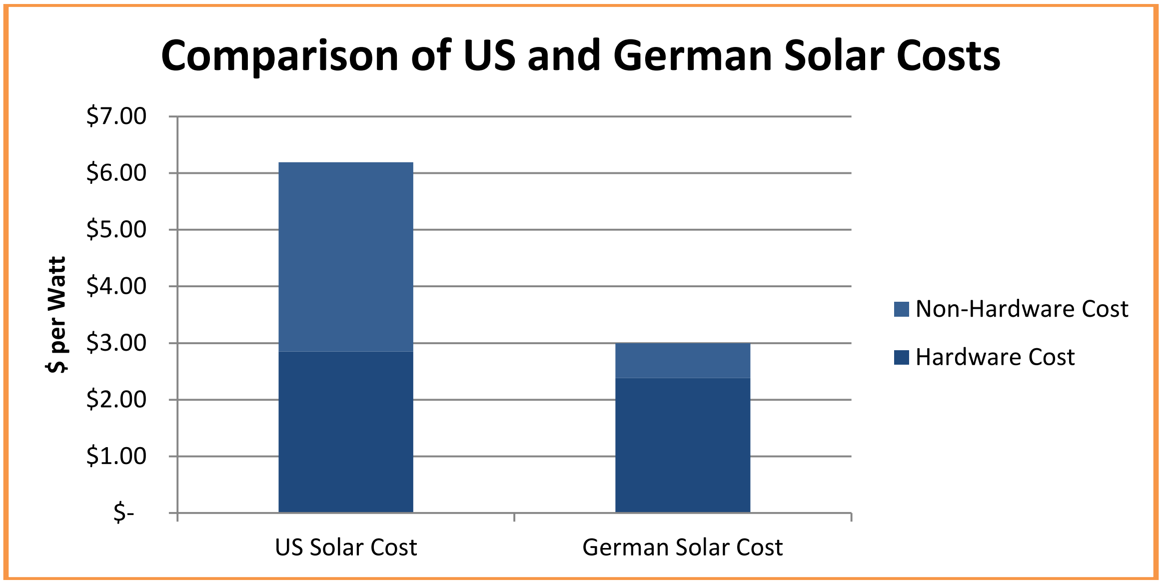
Large utility scale PV systems are not generally net metered and instead sell power directly to the utility or into wholesale electricity markets.

A solar PV system will not operate during a power outage unless the system includes a battery or other forms of backup and most systems do not include backup because batteries tend to increase the installed cost of the system.

The basic components of a PV system include:

- the solar panel, which contains the blue or black colored cells of silicon or other semi-conductor material that converts sunlight to flowing electrons. These panels are affixed to the roof or ground.
- the inverter, which converts the electrons from direct current (DC) to alternating current (AC). The inverter also serves as a safety and monitoring device, preventing power from flowing out from the panels and into the electric grid during a power outage or shutting down the flow of electricity if there is a problem with the system.
- the balance of system components (BOS) that includes racking, wiring, junction boxes and meters.

BOS components make up a significant portion of the overall costs of a PV system.[2]



2.2 Photovoltaic Technologies

Solar PV technologies are broadly categorized into three types of semiconductor technologies, monocrystalline, multicrystalline and thin-film. Each of these technologies has different performance factors, efficiencies, costs and warranties.

Monocrystalline silicon (mono-Si) solar modules are the highest efficiency PV technology commonly available on the market. Monocrystalline modules are comprised of multiple rows of cells characterized by a single, uniform silicon crystal wafer per solar cell.

Multicrystalline silicon (mc-Si) solar modules are typically lower efficiency than monocrystalline silicon modules. Silicon wafers for mc-Si cells are grown in a less uniform fashion, and the non-uniform nature of the silicon crystals results in less efficient solar cells. However, multicrystalline solar cells are also less expensive.

Thin-film solar technologies include a range of different semiconductor types, including Copper Indium Gallium Selenide (CIGS), Copper Indium Selenide (CIS), Cadmium Telluride (CdTe) and amorphous silicon (a-Si). Each of these technologies has their own unique design and performance characteristics; however, in general, thin-film solar modules and cells are lower efficiency than either crystalline silicon technologies. The lower efficiency of thin-film technologies, however, is balanced against lower production and materials costs for thin-film panels. In spite of these lower efficiencies, thin film solar products have been popular with utility-scale and large commercial solar sectors where installation space may be less constrained.

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[2] Ardani, Barbose, Margolis, Wiser, Feldman, and Ong. 2012. Benchmarking Non-Hardware Balance of System (Soft) Costs for U.S. Photovoltaic Systems Using a Data-Driven Analysis from PV Installer Survey Results. National Renewable Energy Laboratory. November.

2.3 Installation Methods

There are a number of methods for affixing PV arrays to buildings or to the ground or in other open spaces. Common PV array mounting methods for residential and commercial systems include:

- Integral roof mounting
- Standoff roof mounting
- Rooftop or ground rack mounting
- Rooftop or ground ballasted mounting
- Ground-based pole mounting

Large-scale flat roof commercial projects are often designed with fully integrated mounting systems, and many systems require no roof penetrations. For these systems, mounting hardware is either secured with "ballast systems" (using rock, pre-cast concrete, or cinder blocks), interlocking or some combination of the two in order to withstand wind speeds as required by local building codes. Non-penetrating ballasted systems require adequate roof structural integrity in order to withstand the additional weight of the ballast. Non-penetrating mounting hardware can be installed on standing seam metal roofs with roof clips. Mounting hardware can also be mechanically attached to the roof and underlying structural roof joists or rafters.

Various PV installation methods clockwise from upper left: ground rack mounting, rooftop standing seam mounting, ground-based pole mounting, rooftop rails system, rooftop ballasted.
Images Courtesy of Home Power Magazine





2.4 The Benefits of Solar

There are numerous public, private and utility benefits of installing solar including:

- Local economic growth - The Solar Energy Industries Association has been tracking the growth of the industry for several years now and found that the solar industry has grown 300% from 2006 to 2010. The solar industry has become the fastest growing energy sector and one of the fastest growing industries in any sector across the U.S.[7]
- Local clean energy jobs - Over 119,000 Americans work in the solar industry as of the end of 2012 and solar employment grew 13.28% between 2011 and 2012.[8]
- Energy independence – Solar provides on-site energy generation avoiding the import of fossil fuels from out-of-state and out-of-country.
- Stabilize price volatility – With no fuel source, solar energy provides a stable energy price throughout the life of the project.
- Added value to utility via distributed generation – Solar energy provides value to the grid including avoided need for additional fossil fuel energy sources, avoided transmission and distribution investments, avoided capacity purchases, avoided fossil fuel price impacts, and energy supplied during summer peak energy use. Solar has been found to add between 10 and 25 cents of value to the utility beyond the market value of the electricity.[9]
- Smart economic investment – Solar can be a smart economic investment saving money on energy bills for homes, businesses and governments. In addition, recent studies have shown that homes with solar power may sell faster and for more money than comparative homes without solar power.[10]

2.5 Common Misconceptions

There are a number of myths and misconceptions relating to solar PV. As a necessary step in developing a solar ordinance or other local planning around solar, local officials must be familiar with some of the more common concerns and responses to these concerns.

Myth: Solar takes up too much land

Fact: There is a large amount of available roof space, capped landfills, and other brownfield space to install significant amounts of solar. Cities and towns across New Jersey have developed solar projects on capped landfills and other unused brownfield sites. In addition, there are opportunities to install solar on abandoned malls and large areas of impervious surfaces that are currently devoted to parking. Municipalities should take care to plan for larger solar arrays and discuss potential competing land uses, like agriculture.

Myth: Solar causes too much glare

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[7] See: SEIA/GTM Research - 2010 Year in Review Report http://www.seia.org/galleries/pdf/SMI-YIR-2010-ES.pdf SEIA/GTM Research- 2009 year in Review Supplemental Charts.

[8] The Solar Foundation, Cornell University ILR School, bw Research Partnership. National Solar Jobs Census 2012: A Review of the U.S. Solar Workforce. November 2012. URL?

[9] See: Perez, Richard, Zweibel, Ken, Hoff, Thomas. Solar Power Generation in the US: Too expensive, or a bargain? Energy Policy 39 (2011), pp. 7290-7297. Available at: http://www.asrc.cestm.albany.edu/perez/2011/solval.pdf

[10] See: Fahar, B.C., Coburn, T..C. A New Market Paradigm for Zero Energy Homes. December 2006. National Renewable Energy Laboratory. http://www.nrel.gov/docs/fy07osti/38304-01.pdf

Fact: As with swimming pools, decks, and garages, the aesthetics of solar panels may raise concerns for some residents, or neighbors. One potential concern is glare. However, solar panels are designed to absorb radiation, not reflect it. Solar PV panels are constructed of dark-colored (usually blue or black) materials and are covered with anti-reflective coatings. Modern solar PV panels reflect as little as 2 percent of incoming sunlight, about the reflectivity as water and less than soil or wood shingles.[11] Projects can be analyzed and adjusted to mitigate potential glare issues and a number of solar installations have been successfully located at or near several U.S. airports (Boston, New York, San Francisco, and Denver). The Federal Aviation Administration delivered a preliminary report showing that glare is not a concern; however, the FAA has not finalized its determination on solar PV panels and glare.[12] When the issue has come up, it is no different than potential glare from office building windows and the effects are only witnessed during a few minutes to hours of the day and can often be mitigated with blinds or awnings. For example, while there has been concern at the Manchester Regional Airport in Manchester New Hampshire over glare, the concern was only during a couple of hours during the day and was not affecting any aircraft either while in flight or during takeoffs or landings.[13]

Myth: It isn't sunny enough in New Jersey for solar to make sense

Fact: While solar irradiation levels vary across the U.S. a New Jersey homeowner can produce a significant portion of their electric load from their roof space (assuming un-shaded, proper tilt, orientation and installation). Germany is the world's leading installer of solar even though it has a similar solar resource to Alaska. Germany has enough solar installed to essentially eliminate the afternoon 'peak' throughout the entire country. A PV system in New Jersey could be expected to produce 90% of the energy that would be created by the same sized system in Florida.[14]

Photovoltaic Solar Resource : Unites States and Germany[15]

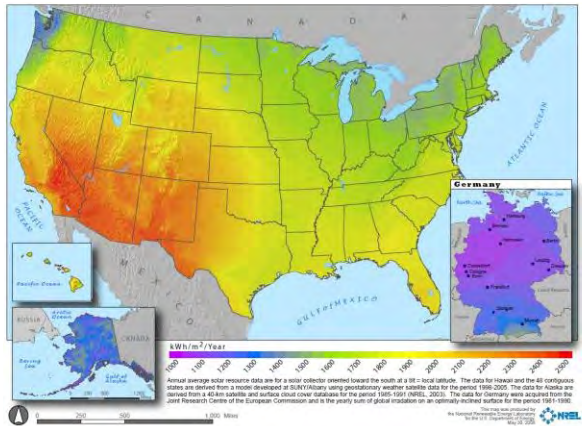
[11] See: APA Solar Briefing Papers, Solar Community Engagement Strategies for Planners Available at http://www.planning.org/research/solar/briefingpapers/pdf/engagementstrategies.pdf and ACRP Synthesis 28, Investigating Safety Impacts of Energy Technologies on Airports and Aviation, A Synthesis of Airport Practice, Transportation Research Board, of the National Academies available at: http://www.dot.ca.gov/hq/planning/aeronaut/documents/InvestigatingSafetyImpactsOfEnergyTechnologiesOnAirportsAndAviation.pdf

[12] Federal Aviation Administration, Office of Airports. 2010. Technical Guidance for Evaluating Selected Solar Technologies on Airports. Washington, D.C.: FAA. Available at www.faa.gov/airports/environmental/policy_guidance/media/airport_solar_guide_print.pdf

[13] Hayward, Mark, "Airport Controllers Complain of Solar Panels' Glare." New Hampshire Union Leader, Aug. 30, 2012.

[14] Analysis using NREL PVWatts calculator available at: http://www.nrel.gov/rredc/pvwatts/

[15] Source: National Renewable Energy Laboratory



Myth: Solar is not compatible with fighting fires[16]

Fact: While solar installations that do not adhere to basic fire safety standards may interfere with fire-fighting procedure, smart regulations can ensure that solar installations are strategically placed such that they do not inhibit firefighters or firefighting operations.[17] A number of reputable organizations have evaluated fire safety issues related to solar PV installations and have developed relevant guidelines including the International Building Code and International Fire Code as well as the National Fire Code published by the National Fire Protection Association (NFPA). These codes address setbacks and pathways for flat and pitched roofs, marking and labeling requirements, the location of wiring and other electrical equipment, and ventilation options. By marking hazardous equipment, ensuring sufficient rooftop access, moving electrical wiring and equipment to safe locations, and creating space for smoke ventilation, firefighters can safely and effectively fight fires with a solar PV installation on site. Educating firefighters on the risks solar technology can pose during a fire and the precautions that can be taken if key. A number of training resources exist to assist Fire Departments in training firefighters, including a NFPA approved lesson plan developed by the State of California.[18]

Myth: Solar energy is only an option because of lavish subsidies

Fact: Every energy technology takes advantage of subsidies. Fossil fuel and nuclear power receive numerous federal subsidies – including loan guarantees, accelerated depreciation, tax credits, caps on producer liability, bankruptcy protection, and avoidance of paying for externalities.[19] The

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[16] See: More Solar Energy Myths, SunShot Solar Outreach Partnership, Meister Consultants Group, Inc. Available at: http://solaroutreach.org/wp-content/uploads/2013/10/Solar-Myth-II-_-Final.pdf

[17] See: Paiss, Matthew, "PV Safety and Firefighting." Home Power Magazine. June/July 2009. Available at http://www.homepower.com/articles/solar-electricity/equipment-products/pv-safety-and-firefighting

[18] California Department of Forestry and Fire Protection Office of the State Fire Marshall. "Solar Photovoltaic Installation Guideline". August 22, 2008Available at: http://osfm.fire.ca.gov/training/pdf/photovoltaics/solarphotovoltaicguideline.pdf and Brooks Engineering. "Understanding the Cal Fire Solar Photovoltaic Installation Guideline". August 2010. http://www.fsec.ucf.edu/en/education/southeast_training_network/Background%20on%20CA%20PV%20Installation%20Guide.pdf

[19] Keith, Geoff, Jackson, Sarah, Napoleon, Alice, Comings, Tyler, and Rame, Jean Ann. 2012. The Hidden Costs of Electricity: Comparing the Hidden Costs of Power Generation Fuels. Synapse Energy Economics, Inc., Prepared for the Civil Society Institute. September. 2012. Available at: http://www.civilsocietyinstitute.org/media/pdfs/091912%20Hidden%20Costs%20of%20Electricity%20report%20FINAL2.pdf

subsidies available for renewable technologies have only been around recently and have gone through various stop and start cycles.[20] For example, the federal wind production tax credit was extended for only one-year as of 2013 and federal solar tax credits are set to expire in 2016. In contrast, the majority of fossil fuel and nuclear subsidies have been uninterrupted for up to a century and many of these subsidies are permanently written into the Federal Tax Code.[21] It is important to reiterate that all technologies are subsidized and therefore these subsidies and their implications should be considered when comparing the costs of various technologies.

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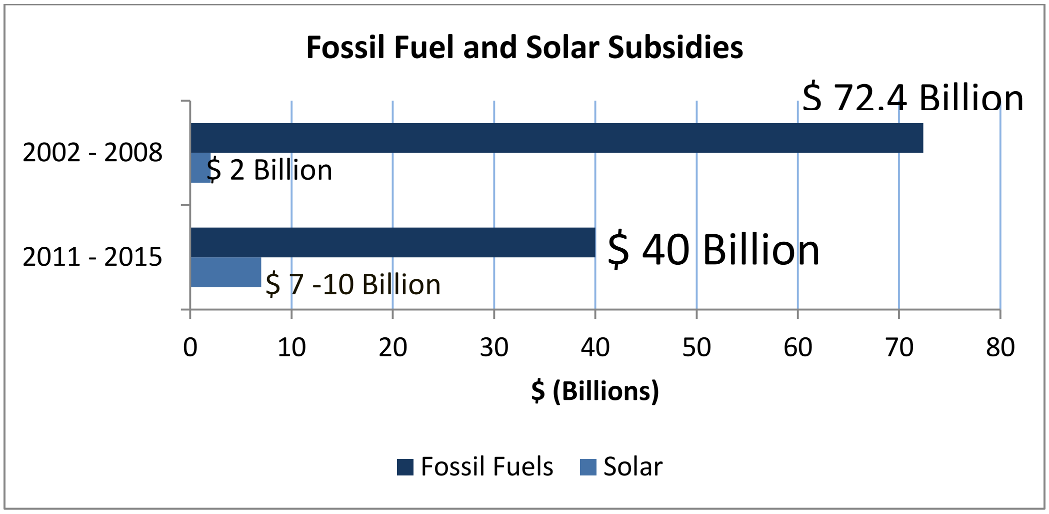
[20] Pfund, Nancy, and Ben Healey. 2011. What Would Jefferson Do? The Historical Role of Federal Subsidies in Shaping America's Energy Future. San Francisco: DBL Investors. September. Available at www.dblinvestors.com/documents/What-WouldJefferson-Do-Final-Version.pdf.

[21] Id.

Fossil Fuel and Solar Subsidies[22]



Myth: Solar is too expensive

Fact: While solar power isn't free, global solar industry growth has reduced costs steadily and rapidly in recent years. Current analyses that compare the cost of various energy technologies show that PV is already cost competitive with new nuclear plants and gas peaking plants, and, given declining costs, will be cost competitive with other technologies in the near term.[23] The cost of solar has fallen dramatically in recent years with installed costs falling by 11-14% in 2011 and an additional 6-14% in 2012.[24] The cost of solar power has fallen by 99% since 1977.[25]

Myth: Solar doesn't create jobs and we can't compete with China

Fact: Over 119,000 Americans work in the solar industry as of the end of 2012 and solar employment grew 13.28% between 2011 and 2012.[26] By way of comparison, 79,500 Americans work in iron & steel manufacturing and 84,000 work in coal mining.[27] Solar creates seven times more jobs per MW than coal.[28] Most solar jobs are in the sales and installation of solar energy systems—jobs that cannot be out-sourced.

Myth: Solar technology is new and will quickly become outdated

Fact: Basic solar photovoltaic technologies have been around for more than 40 years. While efficiencies have increased and costs have decreased, solar PV systems built in the 1970s still produce the same product (kWhs of electricity) as any modern solar PV system. The solar industry

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[22] Sources: Environmental Law Institute, SEIA, U.S. Treasury

[23] Lazard Levelized Cost of Energy Analysis Version 5.0

[24] Galen Barbose, Naïm Darghouth, Samantha Weaver, and Ryan Wiser. Tracking the Sun VI: An Historical Summary of the Installed Price of Photovoltaics in the United States from 1998 to 2012. July 2013. Available at: http://emp.lbl.gov/sites/all/files/LBNL-5919e-REPORT.pdf.

[25] Bloomberg New Energy Finance. Sustainable Energy in America 2013 Factbook. January 2013. Available at: https://www.**bnef**.com/InsightDownload/7320/pdf/

[26] The Solar Foundation, Cornell University ILR School, bw Research Partnership. National Solar Jobs Census 2012: A Review of the U.S. Solar Workforce. November 2012.

[27] Id.

[28] Id.

like other electricity generating industries does not evolve in the same way that the electronics or computer industries have. If solar makes financial sense today, then there is no reason to wait to take advantage of solar power's benefits.

Myth: Most solar panels contain toxic metals that can pollute the environment

Most solar panels are constructed of silicon (glass), aluminum and copper (for wiring), and do not usually contain heavy metals or other potentially toxic substances. At least 90 percent of a PV module can be recycled and a number of manufacturers offer voluntary panel take-back programs.[29] Like all manufactured products, the production of solar panels does cost energy — however, studies show that the panels' energy production more than pays off the energy cost of their manufacture, with energy-cost paybacks of less than two years.[30] Thin-film solar modules may contain heavy metals such as cadmium. However, numerous studies show that there is little to no evidence of toxic leaching from these types of solar modules, and a robust recycling program exists to reclaim such modules at the end of their useful lives.

Myth: Solar is only for environmentalists or advocates

Fact: Solar is for everyone. Everyone from firefighters, the US military and NASCAR racetracks have adopted and are using solar power. In addition, large companies like Google, Wal-Mart, Toys R Us, Staples and others have installed large amounts of solar to power their operations. In Kearny, New Jersey Public Service Electric and Gas (PSE&G) is leasing 13 acres of land atop a capped landfill from the New Jersey Meadowlands Commission to operate a 3 megawatt solar PV installation. Similar installations have been developed on brownfields in Edison, Hackensack, Linden, and Trenton, New Jersey.

2.6 Technological Capabilities and Limitations

Solar power is only produced during daylight hours thus limiting the total amount of time the system is generating electricity and is available to supply power. Fortunately, this is when electricity is in greatest demand. Nevertheless, solar-powered facilities must still be connected to the electricity grid or have on-site electricity storage to supply power during those hours when the sun is down. That said, there are numerous studies looking at the potential of solar to power the grid. These studies indicate that solar could realistically supply up to 30% of our national energy needs.[31] Experience in other countries also shows that even relatively small amounts of solar power can make a huge difference. For example, Germany receives about 4% of its total energy from solar, however, during sunny summer afternoons that correspond to peak demand upwards of 50% of Germany's electricity is supplied by these solar systems.[32] The result has been a reduction in peak demand and peak pricing for electricity.

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[29] Sniderman, Debbie. 2012. "Life After Death." Solar Builder, May 14. Available at www.solarbuildermag.com/featured/life-after-death/#.UAmgPGFfGVo

[30] Sanchez, Justine. 2008. "PV Energy Payback." HomePower Magazine, October/November. Available at http://204.12.63.66/view/?file=HP127_pg32_Sanchez.

[31] Perez, Richard, Zweibel, Ken, Hoff, Thomas. Solar Power Generation in the US: Too expensive, or a bargain? Energy Policy 39 (2011), pp. 7290-7297.

[32] Kirschbaum, Erik, "Germany sets new solar power record, institute says." Rueters. May 26, 2012.

2.7 Additional Reading Material and Resources

Myths and Facts of Solar Power
This PowerPoint presentation delves into some of the most common misconceptions about solar power and systematically debunks each one, providing evidence as to why each is false.

Photovoltaic (PV) Tutorial
This PowerPoint presentation discusses the composition of PV systems as well as methods for installing them on residential properties. It also includes a primer on inverter models and some issues that may revolve around them.

Analysis of Web-Based Solar Photovoltaic Mapping Tools
This report identifies the commercially available solar mapping tools and gives a thorough summary of the source data type and resolution, the visualization software program used, user inputs, calculation methodology and algorithms, map outputs, and development costs for each map.

A Homebuilder's Guide to Going Solar
This guide assists homebuilders who are contemplating solar-ready or solar homes. It helps them decide whether to install solar energy systems on homes or to make homes solar ready, and helps quantify the benefits for home buyers.

Solar-Ready Buildings Planning Guide
This guide identifies the important aspects of building design and construction to enable installation of solar systems after the building is constructed. It discusses important system requirements for PV, SWH, and SVP systems. Attention to these guidelines when developing building codes or any building- or community-related regulations, as well as during building design, could significantly improve the performance and minimize the cost of solar systems.

Chapter 3. The Solar Market in NJ

3.1 State of the Market

New Jersey is the third-largest solar market in the U.S. behind California and Arizona with over 1 GW of installed solar PV capacity, including a particularly robust nonresidential market (governments, businesses, and non-profits).[33] New Jersey's current solar incentive program is structured as a solar carve-out requirement that makes up part of the state's renewable portfolio standard (RPS). The RPS is a state law that requires New Jersey's utilities (both third party electricity suppliers and basic service suppliers) to purchase a set amount of solar energy. The utilities "purchase" solar power by purchasing Solar Renewable Energy Credits (SRECs) in quantities sufficient to meet their solar RPS obligations measured as a percentage of the utilities total electricity supply. The price of SRECs is driven by the market and the penalty payment (called an alternative compliance payment) that the utilities pay if they do not acquire enough SRECs to meet their obligation. SREC market prices have been high enough in value to rapidly promote the development of large amounts of solar PV in a relatively short period of time. However, in 2011 these relatively high SREC prices pushed an overrun of development as compared to the amount of solar the utilities were required to purchase, in essence creating an over-supply of SRECs. The over-supply threatened to cause the prices of SRECs to fall so fast as to stop solar development in the State. In 2012, the state legislature passed a bill to maintain growth in the solar market by increasing the solar carve-out requirements and thus correcting the over-supply of SRECs in turn bringing market prices for SRECs back to levels that support additional solar development.

3.2 Emerging Issues in Solar

The last year has proven to be somewhat turbulent for the solar industry. An oversupply of solar panels from foreign manufacturers significantly undercut many domestic manufacturers, forcing reductions in workforces and shuttering of plants. Installations, however, have benefitted from these very low prices. Places like New Jersey have seen installations skyrocket as a result (among other factors already discussed). Although some beneficial Federal tax incentives expired at the end of 2011, other financing models have emerged to help push the market forward. Third-party financing, where customers pay little to no up-front cost to go solar is proving to be a major force in the residential and small-commercial solar market. In addition, financing community-based solar, where neighbors pool their funds to by one, large solar installation, and using "crowd funding" is becoming increasingly easier. For example, Solar Mosaic launched a crowd funding solar investment option to residents of California and New York in early 2013. Solarize programs are also proving to significantly cut customer acquisition costs, lowering prices further and providing community education and engagement around solar PV.

3.3 Federal and State Incentives

The main federal incentive is the Residential Personal Tax Credit of 30% of the system cost, the Business Energy Investment Tax Credit (ITC) of 30% of the system cost, and the Modified Accelerated Cost-Recovery System (MACRS) + Bonus Depreciation (for systems installed between 2008 and 2013). There is no maximum credit amount. Under the current policy program, PV systems must be placed in service on or before December 31, 2016 in order to receive the credit.

[33] Greentech Solar. "Garden State a Solar Eden-New Jersey Hits 1 GW". March 22, 2013. http://www.greentechmedia.com/articles/read/garden-state-a-solar-eden-new-jersey-hits-1-gw

The state incentives include the aforementioned SREC program. The state also has a property tax exemption that applies to all customer sited PV installation.

New Jersey has a sales tax exemption, applicable to all taxpayers, for all solar energy equipment. The language of the exemption also includes equipment used for passive solar design.

3.4 Solar Industry Needs and Process

Local permitting and inspection processes can account for upwards of one-third the cost of a solar PV system. Industry analysis attributes these costs (which are 40% higher than in Germany) to variation in local approval, permitting and zoning practices. The solar industry has indicated that a standardized and streamlined process along with fair and transparent permitting fees is desired. For example, the Solar America Board for Codes and Standards found that roughly 80% of residential rooftop solar systems are practically identical in design and could benefit from an expedited permitting process.

While New Jersey has a uniform building code, municipalities play a key role in the solar market as local jurisdictions have control over construction processes via discretionary building and zoning codes. In this respect, solar is different from other large-scale power plant construction processes where local control is preempted by state or even federal approval processes. Therefore, the solar industry is subject to numerous individual permitting and market dynamics even within a single state like New Jersey. In turn this can lead to large variation in local solar adoption levels. Some communities may promote solar in unexpected ways while other may unintentionally prohibit solar development. A more consistent, transparent and uniform approach benefits the solar industry. Local governments should be aware of the impact of their local permitting processes and adapt their approaches to meet local solar development and planning goals.

3.5 Additional Reading Material and Resources

New Jersey's Clean Energy Program: Solar Market FAQs
This site provides a list of questions and answers regarding NJ's solar market.

New Jersey Incentives/Policies for Renewables and Efficiency
This is a list of incentives for renewable energy in NJ. It includes NJ's solar tax exemption, information on SRECs and solar loans, as well as other incentives to pursue solar installation in the state.

New Jersey Solar Industry Fact Sheet
This slideshow details the current state of the solar industry in NJ and projects its impacts into the future.

Solar Photovoltaic Financing: Residential Sector Deployment
This report presents the information that homeowners and policy makers need to facilitate PV financing at the residential level. It covers the full range of cash payments, bill savings, tax incentives, and potentially available solar attribute payments.

Chapter 4. Solar Installation Issues

4.1 Municipal Perspective

From the municipal perspective, solar offers many benefits, especially if the municipality has a clear idea of what its goals and expectations with regard to solar development are. Solar energy is proving to be a successful strategy for reducing the energy costs of the municipalities, local businesses and residents. Solar energy development can also intersect with other local government interests related to sustainability, economic development, siting and land use planning. When the local government has clearly laid out its goals in terms of balancing economic development and land use, the process of siting solar facilities can go more smoothly. Land Use Boards can base their decisions on planning documents that help in weighing the benefits of solar energy development against other public interests like preserving particular community character, be it rural, agricultural or historic. For example, the Planning Board of Branchburg Township, NJ decided by one vote to allow the development of a 29-acre solar project on the property of a large industrial employer. The site was mostly undeveloped woodland, but, despite that loss, members of the Board were swayed by the fact that development of a solar installation would avoid the potential of a large warehouse being constructed, preserve 5 acres of the tract as woodland, and that the energy savings from the solar installation would help to keep the large employer located in the town. In this instance, without an Ordinance on solar development to guide it, the Board balanced the economic needs of the Township with two of the Township's land use goals of preserving the rural character while providing for a diversity of non-residential uses to provide a balance of land uses within the township. Municipalities need to translate their land use goals into clear ordinance standards and development procedures in order to help expedite solar installation for both local residents and developers.

4.2 Solar Developer Perspective

While many solar developers have enjoyed the rapidly expanding solar market in New Jersey, more and more of these companies have recognized that a sustainable market requires that they engage local stakeholders. Solar projects can accommodate many siting concerns, but these concerns must be understood at the early stages of project development in order to keep the project economical for the developer. Installation requirements, such as set-backs, height restrictions, minimum lot sizes, and impervious surface restrictions can be implemented in ways that are reasonable for most solar projects. As more local jurisdictions begin to include solar considerations in their planning and siting documents, it is imperative that local ordinances allow the process of installing solar to be as efficient as possible both for developers and the municipality while still respecting other community values.

4.3 Public perspective

More than 7-in-10 Americans want the U.S. to put more emphasis on producing domestic solar energy sources.[34] Given the level of solar development in New Jersey, supported by state policy goals, programs and incentives, it is evident that many within the state also strongly support solar. Nevertheless, the public is torn on certain types of solar development, particularly on rural land.

[34] Gallup Poll, March 7-10, 2013. http://www.gallup.com/poll/161519/americans-emphasis-solar-wind-natural-gas.aspx?utm_source=alert&utm_medium=email&utm_campaign=syndication&utm_content=morelink&utm_term=Energy

While siting requirements such as set-backs and height restrictions may avoid the most disagreeable rooftop solar installations, such requirements do not as easily settle disagreements over land use issues. It can be difficult for planning boards to manage concerns regarding wildlife habitats, preserved open space, and contiguous forests. Despite these difficulties, clear standards, and early public engagement can satisfy many of the public's concerns regarding the impact of the various effects of solar development.

4.4 Historic Districts

Historic sites and structures typically have very specific federal, state and local building codes and standards associated with any new construction or site improvements. Owners of historic properties may feel discouraged from pursuing adding solar energy to their property if they feel the process is too complex. Indeed, this may be the case if municipalities haven't taken steps to create an application process and provide a set of clear standards for adding solar energy to historic sites.
The first step in making historic property owners feel more confident in pursuing the installation of solar energy is to delineate which properties are in designated historic districts versus conservation districts. The different categories require different levels of municipal review from the relevant landmark and planning commissions. Solar projects in conservation districts can often be permitted on an expedited basis given they comply with established community design standards. Projects in designated historic districts or on designated historic landmarks will most often require additional local, state or federal review.

Local jurisdictions can aide property owners through the review process by establishing web sites to help property owners navigate any additional statutes, view design guidelines, and track their applications. Municipalities can also establish mechanisms for administrative review of certain solar energy systems on historic properties, thereby saving property owners both the time and money associated with a formal planning commission review. Administrative review, clear design guidelines, and a serviceable web site would make the process of installing solar energy on historic properties more transparent.

Solar installation on an historic building in Michigan.[35]

[35] Photo courtesy of Kim Kooles

4.5 Proposed and Adopted State Regulations

- Inherently beneficial use S1303/A3062 (2009) Classifies solar technology as "inherently beneficial use."

- Use By Right A2550/S1299 (2009) Permits renewable energy facilities in industrial zones as a use by right on, "parcels of land comprising 20 or more contiguous acres that are owned by the same person or entity." The definition of "contiguous as recently interpreted by BPU in Bedminster raises concerns. The site for the 55ac. array is in Bedminster, Twp. in the R-10 zoning district the destination (behind the meter system) is in Bridgewater Twp, separated by the I-287 right of way. The distance between the two properties is 1500'. Bpu has ruled that this is a "contiguous" project. Thus, a "contiguous" project in one municipality intrudes on the zoning of an adjoining municipality.

- Impervious Surface Exemption S921/A2289 (2010) Exempts solar panels from calculations of impervious surface cover.

- Right to Farm S1538/A2859 (2009) Extends protections of the Right to Farm Act to the generation of solar energy on commercial farms within certain standards.

- All electric utility companies regulated by the NJBPU (PSE&G, JCP&L, Atlantic City Electric, and Rockland Electric) and electric suppliers or providers must offer net metering to retail customers that generate electricity through a solar PV system. To be eligible for net metering, the generating capacity of a system cannot exceed the customer's annual electric needs.

- N.J. 46:3-24 (1978) Solar easements to ensure proper sunlight extends over real property. Precludes construction or placement of structure that would block sunlight to solar panels on adjacent property. Negotiations required. Granting of easement not mandated.[36]

- Municipal Land Use Law 40:55D-66.11/A.B. 2550 (2010) Solar and wind facilities permitted in Municipal Industrial Zones with condition that the property be comprised of 20 or more acres and under common ownership.[37]

- N.J. 45:22A-48.2 (2007) "Solar Rights Law" Prevents homeowner associations from prohibiting solar collectors.[38]

- NJBPU Order (2010) Net metering rules applies to all residential, commercial, industrial customers. Limited to meeting on-site electricity demand.[39]

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[36] See Joseph S. Augustyn, PP, AICP. Medford Environmental Commission Solar Town Workshop. Solar Systems as a Land Use: The Municipal Perspective. March 14, 2011.
[37] See Joseph S. Augustyn, PP, AICP. Medford Environmental Commission Solar Town Workshop. Solar Systems as a Land Use: The Municipal Perspective. March 14, 2011.
[38] Id.
[39] Id.

- Senate Bill S 2160 MLUL amended to allow as permitted uses of Solar and Wind Energy projects on sites of former landfills, quarries and other extractive industries. Environmentally sensitive areas remain subject to regulation. Particularly welcome in the Pinelands where there are over 80 old landfills in towns. Funds are to be made available to cap these landfills (Gibbons/Lottinville/7/26/10).[40]

- Municipal Land Use Laws/S 1202 Solar/Photovoltaic/Wind Inherently Beneficial by definition in the MLUL. The use is universally considered of value to the community because it fundamentally serves the public good and promotes the general welfare. Positive criteria and negative criteria are less stringent when a solar project application requires a Use Variance. The positive criteria is presumptively satisfied and the negative criteria is resolve by balancing the project against any detriments, and imposing seasonal conditions to reduce any negative impacts.[41]

- Senate Bill S-921 Exempts solar panels from being classified as impervious. Affects stormwater management calculations and some municipal zoning ordinances.[42]

- Assembly Bill A 1084 Requires solar panels to be included in the design and construction of all new public schools across New Jersey.[43]

- Senate Bill S-1538 Allows for solar, biomass and wind energy generation on preserved farms, with area limits. Maximum 110% of base energy demand of 1% of entire farm area.[44]

- Local Lands and Building Act: N.J.A 40A-12-1. Rules for lands of solar projects regarding terms of lease or sale, and facility closure for municipal and county owned projects.[45]

4.6 Environmental Impact Considerations

All types of energy generating technologies have some type of environmental impact. However, as an emission free and fuel free renewable energy source, solar PV is generally regarded as one of the more benign technologies in existence today. The environmental impacts are generally confined to siting, aesthetics and land use considerations.

Environmental impacts from solar energy development vary significantly based on the type of installation. Residential rooftop installations have little to no impacts (rain water sheeting may occur if installations aren't sufficiently set back from roof edges to allow gutters to channel water). Commercial rooftop and other uses on developed land, such as parking shade structures, do not have any environmental impacts. In fact, solar installations over dark structures like black rooftops may help alleviate the heat-island effect. Photovoltaic solar installations are solid-state systems with no emissions, even large, ground-mounted can be built in a way so as to produce minimal environmental impacts. The impacts that do occur, and should be considered by local planning organizations, are the result of the construction process (e.g., removal of vegetation, site grading, heavy vehicle traffic, etc.), or are due to the presence of the structure itself. Mounting structure

[40] Id.
[41] Id.
[42] Id.
[43] Id.
[44] Id.
[45] Id.

footings can degrade the top soil. Grading and other installation components can obstruct natural drainage flows. Large ground-mounted installations could reduce or degrade wildlife habitat if proposed in these areas of land. In addition, the solar structure could affect valuable scenic vistas. These impacts and corresponding mitigation strategies should be weighed against the environmental benefits of clean energy and other benefits derived from solar energy when considering solar development planning efforts.

4.7 Additional Reading Material and Resources

Balancing Solar Energy Use with Potential Competing Interests
This briefing paper discusses the various concerns local jurisdictions should consider as they begin to include solar energy in the local planning process.

A Comprehensive Review of Solar Access Law in the United States: Suggested Standards for a Model Statute and Ordinance
This comprehensive review of solar access law across the United States suggests standards for a model statute and ordinance.

A Step by Step Tool Kit for Local Governments to Go Solar
The tool kit contains an array of strategies and options that local governments can implement to help encourage solar developments. It discusses incentive and rebate options, focusing on streamlined permitting and permit fee reductions or waivers for solar energy installations, and also includes a model ordinance for a permit fee waiver for residential solar installations.

Chapter 5. Solar and the Planning Process

As communities look to solar energy to help meet energy and sustainability goals, planning should play an important role. Community leaders can initiate and facilitate conversations with community members and stakeholders about solar energy prior to applications for solar development in order to be comfortable with their community's needs and desires as they analyze proposals. Feedback from these conversations should be incorporated into the Municipal Master Plan's mandatory statement of principles.

The master plan is a logical point to introduce solar energy goals and objectives in the context of the wider local policy framework since all Zoning Ordinances should be consistent with the intent of the Master Plan's Land Use Element. The Master Plan's clear intention to support solar development can encourage and facilitate both private and public solar energy systems for the benefit of the municipality and its citizens.

When establishing a policy on solar development in the municipality, community leaders should take the time to explore and educate their residents on, how solar energy works and the types of solar which can be installed on different uses. Without a clear idea of the types, benefits and impacts of various solar installations, the community cannot establish a policy which fits their local character. There are various methods for installing solar from integrating it into rooftops to having stand-alone systems on the ground. In addition solar can be placed in nearly any un-shaded location, from rooftops, to parking lots. Furthermore, solar can take advantage of the myriad unused spaces such as brownfields, capped landfills, and parking lots.

Communities should do a self-analysis when considering how to formulate their policy on solar energy. While solar energy is clearly a beneficial use, the municipality should consider its particular character when studying how to gain the greatest benefit from solar installations. Small, dense communities may need to ask different questions about where and how to best place solar than sprawling suburban or rural municipalities. Cities with large numbers of flat roofed commercial buildings should investigate their great potential for solar installation. Agricultural communities need to be aware of State law with regard to solar installations on farmland and they need to weigh any potential loss of open land with the benefits of solar. There are a host of questions to consider as a solar policy is formulated. These questions should be asked and answered at the community level, where the local situation is best understood.

The ERI should inform master plan changes with adequate objective information. For example, spatial and narrative information on wildlife habitats, water resources including streams, water bodies and wetlands, steep slopes, (or other municipally defined "critical areas"), forests, soils (especially agricultural potential) and cultural resources including both below ground resources (archeology)and above ground resources (e.g. historic structures).

5.1 Developing an Ordinance

Once a municipality has a clear policy on solar energy in the Master Plan, it can consider how to best enable citizens and developers to efficiently install solar systems. While the Master Plan establishes policy, the Zoning Ordinance must specify what type, where and how systems will be built. Consistency with the Master Plan is usually determined by the planning board and environmental commission may review proposed ordinances. Whether the Ordinance language comes out of the governing body, is developed by the Planning Board or by a citizens' committee, it should reflect the intent of the Master Plan and be consistent with State law.

Ordinance drafters should consider the importance of clarity and simplicity in the Ordinance. The process to obtain permits or to apply for Site Plan approval should be laid out clearly so citizens will be comfortable with the requirements. Regulations, such as height and setbacks and types of installation, should be reasonable and reality based. Setting arbitrary standards, based on fear of the unknown, will discourage applications for installations and may result in unnecessary and expensive litigation against the municipality.

The following chapter presents some examples of solar ordinances around the nation and in New Jersey. The Solar Ordinance Framework developed as part of this project presents draft language and issues for considerations which a municipality can utilize in framing an ordinance for its particular circumstances.

5.2 Additional Reading Material and Resources

Association of New Jersey Environmental Commissions (ANJEC) White Paper, Solar Siting and Sustainable Land Use
ANJEC also has several power point presentations and resources available at their website under "Workshop Materials" including the following:

"Utility Scale Solar: Preparing your Municipality" by David Peifer, Association of N.J. Environmental Commissions
http://www.anjec.org/pdfs/WorkshopPresentation5312UtilityScaleSolarDPeifer.pdf

"On-Farm Solar Energy Generation" by Susan E. Payne, Executive Director, State Agriculture Development Committee
http://www.anjec.org/pdfs/WorkshopPresentation5312OnFarmSolarEnergyGenSPayne.pdf

"Solar Energy Facilities: Challenges for New Jersey Municipalities by Clarke Caton Hintz
http://www.anjec.org/pdfs/WorkshopPresentation5312SolarEnergyFacilitiesCCHintz.pdfAmerican Planning Association, Planners Energy and Climate Database
This database contains examples of communities that have integrated energy and climate change issues into planning, and states that have addressed climate change issues in plans or policies.

Developing an Effective State Clean Energy Program: Renewable Energy Incentives
This paper summarizes innovative approaches and practices that have worked effectively for providing small renewable project incentives at the state level.

Integrating Solar Energy into Local Development Regulations
This briefing paper provides planners, public officials, and engaged citizens with an overview of three aspects of integrating solar energy into local development regulations — removing barriers, creating incentives, and enacting standards — and offers examples from communities across the country that are taking steps to supporting local solar market growth.

Integrating Solar Energy into Local Plans
This paper provides planners, public officials, and engaged citizens with an overview of common practices that can be used to integrate references to solar energy into local plans.

PAS Essential Info Packets
"[These] Essential Info Packet[s] provide an extensive collection of sample ordinances on solar access, solar siting, and solar energy systems large and small, along with background articles and examples of how communities are adding solar provisions to their comprehensive plans."

Solar Mapping
This paper "provides an overview of common questions community members may raise about solar energy use and discusses various engagement techniques available to help planners raise public awareness and solicit feedback about local policies and regulations that affect solar energy use."

Chapter 6. Examples

6.1 New Jersey Examples

In spring 2012, Montgomery Township in New Jersey adopted a solar ordinance meant to streamline the approval process for new solar projects and preserve the qualities of the township that residents value. Roof mounted solar installations have very clear and simple requirements, namely height restrictions. Larger, ground-mounted systems are encouraged on large commercial, landfill and brownfield sites, and are discouraged, not prohibited as in other jurisdictions, from development on preserved farmland and open space. By clearly encoding the land use values of the township in this ordinance, Montgomery balances the restrictions placed on certain solar developers with some additional planning certainty.[46]

In 2011, Hamilton, NJ introduced an ordinance that limits solar projects to rooftops, industrial zones, and some commercial zones, but not on the ground in residential areas. The rules were aimed at restricting projects from encroaching on farmland and residential neighborhoods.

Other examples include Bedminster (currently pending) and Burlington Township in Burlington County.

6.2 Additional Reading Material and Resources

Developing an Effective State Clean Energy Program: Renewable Energy Incentives
This paper summarizes innovative approaches and practices that have worked effectively for providing small renewable project incentives at the state level.

Freeing the Grid: Best and Worst Practices in State Net-Metering Policies and Interconnection Procedures, 2010 Edition
This report outlines the best and worst practices in state net-metering and interconnection policies.

Photovoltaic Power Systems and the 2005 National Electrical Code: Suggested Practices
This manual examines the requirements of the 2005 National Electrical Code as they apply to PV power systems. It includes the design requirements for the balance-of-system components in a PV system, including conductor selection and sizing, over current protection device rating and location, and disconnect rating and location. Stand-alone, hybrid, and utility-interactive PV systems are covered.

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[46] See: Township of Montgomery Ordinance No. 12-1418 available at:
http://www.montgomery.nj.us/depts/landuse/Ord%2012-1418%20-%20LDO%20-%20FINAL%20WIND%20SOLAR%20%20PHOTOVOLTAIC%20ENERGY%20SYSTEMS.pdf

Additional References

Solar Powering Your Community: A Guide for Local Governments

Solar Boston Permitting Guide: A resource for building owners and solar installers

New York City's Solar Energy Future: 2011 Update