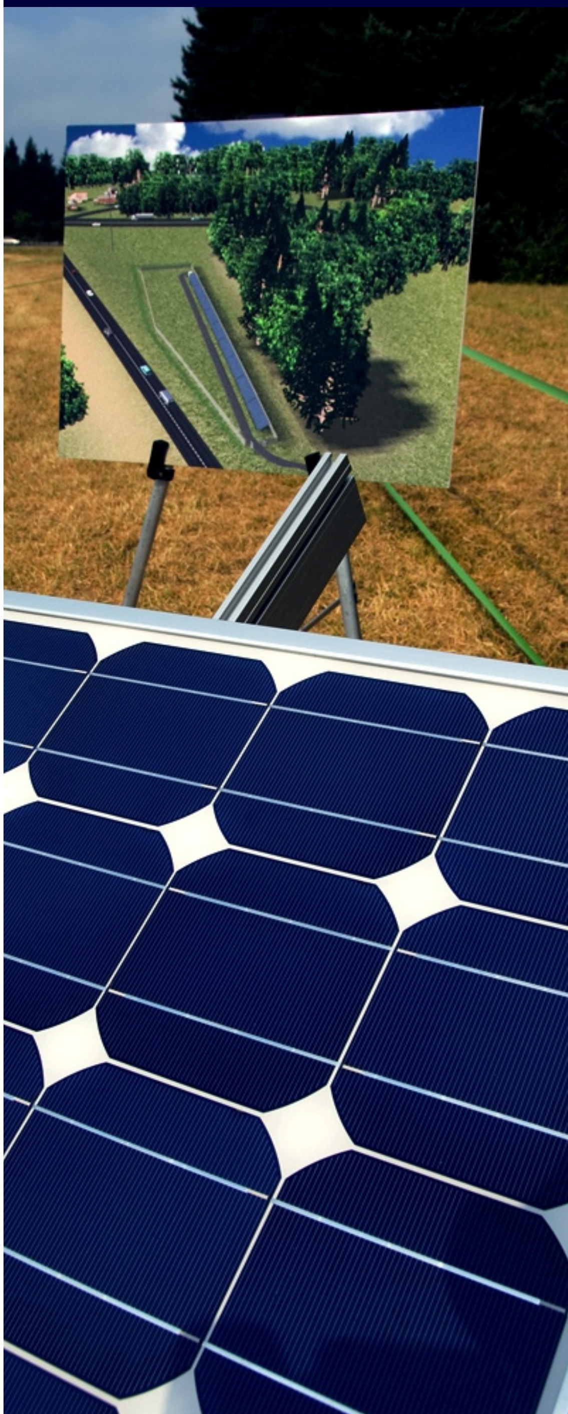

Solar Highway Program: From Concept to Reality

A Guidebook for Departments of Transportation to Develop Solar Photovoltaic Systems in the Highway Right-Of-Way

August 2011

Prepared for the

Oregon Department of Transportation

by

good COMPANY

Acknowledgements

Key contributors

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The Oregon Department of Transportation's Office of Innovative Partnerships and Alternative Funding works to create public-private partnerships benefiting the state transportation system and its citizens.

Five Stars International

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Five Stars International performs management consulting and professional services for the public and private sectors including leadership development, coaching and mentoring; program administration and support services; program and organizational reviews; and building public-private partnerships.

Portland General Electric

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Portland General Electric is Oregon's largest electric utility and is committed to expanding renewable energy production to address climate change and meet the growing needs in the state's energy future.

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Good Company is a strategic sustainability research and consulting firm that provides innovation to the transportation, utilities, renewable energy, low carbon fuels and materials recovery industries. Good Company's work includes market research, technical analysis and strategic positioning for solar facilities, biomass cogeneration plants, anaerobic digester systems and waste to synthetic diesel facilities. Since 2001, Good Company has helped over seventy organizations in the public and private sectors evaluate, plan for and improve their triple bottom line.

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Table of Contents

How to Read This Manual

This guidebook is intended to provide an overview for state Departments of Transportation (DOTs) of the process for developing solar photovoltaic (PV) projects in the highway right-of-way. The goal is to help others navigate the process towards a successful solar PV installation by providing step-by-step information, case studies and additional resources.

The information presented in this guidebook is based on the experience of the Oregon Solar Highway Program as well as industry best practices.

It is important to note that the solar PV industry is a dynamic one. The technologies, business models and incentives that make these types of projects possible are rapidly evolving. It therefore is vital to acknowledge that important lessons and new information will develop over time and that these insights may not be reflected in this document.

As other agencies embark on these types of projects it is hoped that collaboration and peer-to-peer learning will continue. To that end, the Oregon Department of Transportation (ODOT) welcomes feedback and suggestions on how to enhance this guidebook.

Oregon Solar Highway Program Highlight

Look for the story of the Oregon Solar Highway Program told throughout the guidebook in highlighted boxes.

Organization of the guidebook

The guidebook is arranged by the following four topics:

Understanding the context

This section provides an introduction to the experiences of Departments of Transportation with solar PV. An in-depth look at the Oregon Solar Highway Program's demonstration project and an overview of solar energy technologies is also provided.

Solar highway program development

This section discusses the key considerations in developing a Solar Highway Program including the importance of internal agency support and the staffing and resource commitments. A review of policies, funding options, regulatory issues and other considerations that will influence the viability of a particular project are provided.

Developing a solar highway project

This section provides a step-by-step overview of the process of implementing a solar highway project. Core capablities and competencies are detailed for internal and external project partners required for successful project management and implementation. This section also provides direction on how to evaluate candidate project sites and conduct a feasibility study. This section also includes an in-depth discussion of the issues related to the selection of and contracting with a private sector partner and project execution.

Assessing project feasibility

In the appendix is a project feasibility checklist that can help inform a go or no-go decision to proceed further in the project development process.

Understanding the Program Context

Adoption of Solar PV by Departments of Transportation

Oregon Solar Highway Program: From Concept to Reality

Overview of Solar Energy Technologies and Their Uses

This section provides an introduction to the experiences of Departments of Transportation with renewable energy and specifically, with solar photovoltaics or solar PV. An in-depth look at the Oregon Solar Highway Program's demonstration project and an overview of solar energy technologies and their application to highway rights-of-way is provided.

Adoption of Solar PV by Departments of Transportation

Federal, state and local public agencies across the country are deploying renewable energy technologies, like solar PV. The decision to implement clean energy activities is inspired, in part, by a growing awareness of the environmental costs of fossil fuel energy production—including the release of climate changing greenhouse gasses.

Interest in solar PV is also driven by the growing recognition of the tangible economic and social benefits to investing in clean renewable energy—including local job creation and increasing the nation's energy security.

It is not surprising that DOTs are among these public agencies increasingly interested in exploring the opportunity to deploy renewable energy technologies.

Solar PV highway applications

For many years, DOTs have made use of solar PV in a range of highway applications. The ability to electrify signs and signals without the investment of resources to the electric grid or operating a diesel generator has made small-scale highway installations of solar PV a widely accepted practice.

The most common highway applications for this technology include portable variable message signs, traffic signals, flashing beacons, weather information systems and traffic counters.

The decision to use these technologies had little to do with debates about energy policy or environmental protection and was driven primarily by convenience and cost savings.

Medium to large scale solar PV

More recently, DOTs have turned their attention toward medium to large-scale deployments of solar PV.

Like other public agencies, several DOTs across the country have installed solar PV systems on the rooftops of agency facilities. These building-sited systems typically generate electricity to partially displace the purchase of fossil fuel fired electricity from the local utility.

Some DOTs have initiated these types of projects as a response to policy mandates established by state legislatures or executive order to acquire renewable energy. Others have pursued these installations as pilot projects to examine project feasibility or as demonstrations of agency leadership and public goodwill.

Solar PV projects in rights-of-ways

Innovative DOTs are now looking at other agency property and assets, including highway

For many years, DOTs have made use of solar PV in a range of highway applications.

rights-of-way and rest areas, for opportunities to develop larger scale renewable energy projects.

ODOT completed construction of the nation's first solar PV system in a highway right-of-way in 2008. The project produces electricity to power the interchange illumination where it is located while reducing the agency's carbon footprint.

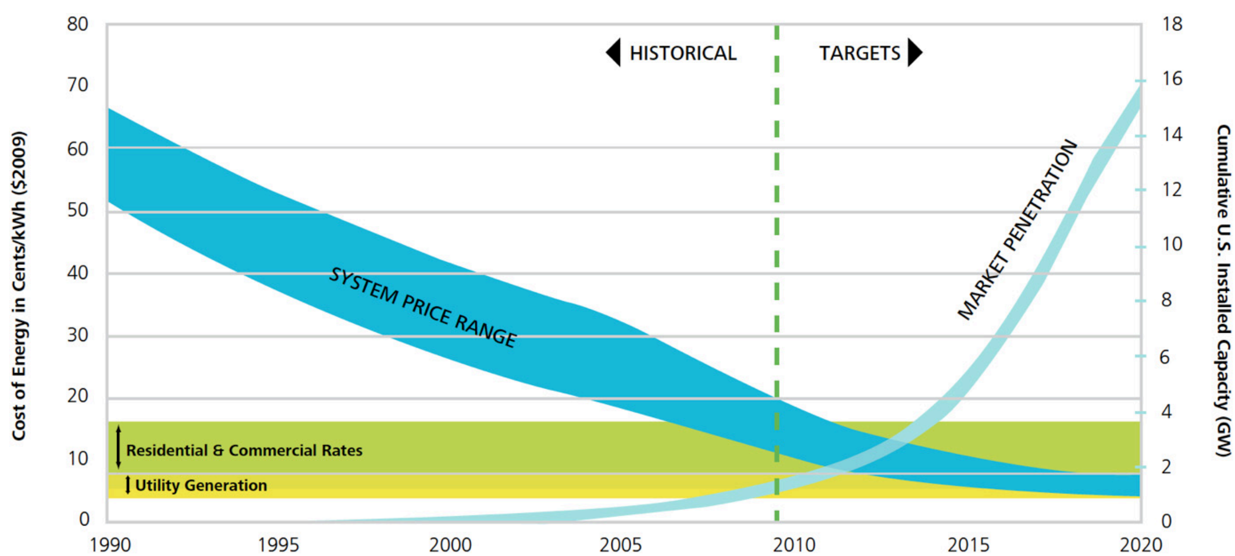
Since the groundbreaking, the ODOT has received inquiries from DOTs, renewable energy developers and academics from 25 states and 12 countries interested in learning more about the feasibility, best management practices and lessons learned for this project.

Transportation and government agencies in California, Ohio and Massachusetts have also explored similar projects. Additionally, the states of Colorado, Florida and Missouri have completed assessments evaluating the potential for renewable energy generation at rest areas, service plazas and along highway rights-of-way.

Solar PV Approaching Price Parity

Interest among DOTs in pursuing solar PV will likely persist as demand for clean energy grows and prices for solar technologies decline. The U.S. Department of Energy has established a goal for solar PV to reach price parity with other forms of electric generation by the year 2015. Meeting this goal will require improvements in the performance efficiency of PV technologies and increases in manufacturing economies of scale.

The solar PV industry is approaching this threshold. In parts of the country with relatively high electricity prices, abundant sunshine and well-established financial incentives, solar has already reached this important threshold. Indeed in parts of the country with these three characteristics, solar has already reached this important threshold.



The U.S. Department of Energy has established a goal for solar PV to reach price parity with other forms of electric generation by the year 2015. http://giffords.house.gov/DOE%20Perspective%20on%20Solar%20Market%20Evolution.pdf

Oregon Solar Highway Program: From Concept to Reality

While roadside solar has operated successfully in Europe for over two decades, it had not been successfully implemented in the United States until ODOT completed construction of the nation's first solar PV system in a highway right-of-way in 2008.

Proof-of-concept project

The Oregon Solar Highway Demonstration Project, a 104 kilowatt system located at the interchange of Interstate 5 and Interstate 205 near Portland, Oregon, was initiated as a proof-of-concept project.

This project demonstrates that renewable energy development in the highway right-of-way can complement traditional transportation activities and functions. Electricity produced by the system feeds into the utility grid during the day. At night, energy flows back from the utility grid to illuminate the interchange.

Several factors figured into the success of the demonstration project but among the most important were a willingness of agency leaders and staff to embrace the inherent uncertainty of exploring a new public-private partnership business model and finding private sector partners with the expertise and capital to bring the project to fruition.

Driven by public-private partnerships

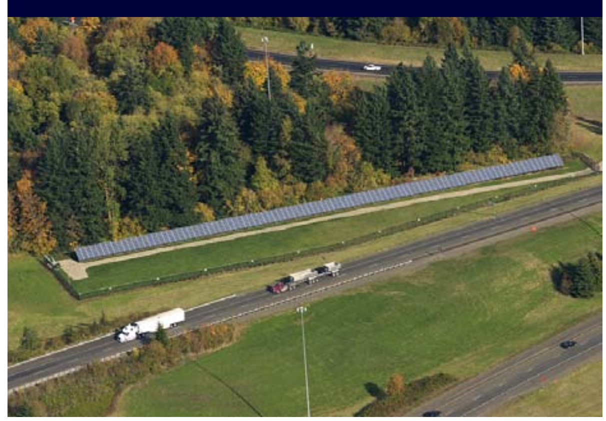
The demonstration project is a public-private partnership between ODOT and Portland General Electric (PGE), Oregon's largest electric utility.

ODOT was responsible for assuring the project site was "shovel ready." ODOT completed a site feasibility study that ruled out potential environmental and transportation system conflicts and addressed standard legal and regulatory requirements.

PGE, through a subsidiary, took responsibility for project financing, ownership and coordinating engineering design, construction, operations and maintenance of the Oregon Solar Highway Demonstration Project over the long term.

The Oregon Solar Highway Demonstration Project has evolved from concept to reality.

This 104 kilowatt ground-mounted solar array is situated at the interchange of Interstate 5 and Interstate 205.



The involvement of PGE as a private sector partner also allowed the project to take advantage of financial incentives otherwise unavailable to ODOT.

Supporting local clean technology

The Oregon Solar Highway Demonstration Project features and supports Oregon's emerging green technology sector. This project supported and created Oregon-based jobs through a local and sustainability-focused procurement process. Oregon-based clean energy manufacturers supplied the materials and equipment to build the system and Oregon-based technical and professional service firms provided the know-how to design, construct and finance the project.

Future of the Solar Highway Program

ODOT is actively seeking to build on the success of the demonstration project with at least three potential planned future projects including:

- An expansion of the Oregon Solar Highway Demonstration Project that will more than double the capacity of the system
- An installation of a 1.75 megawatt solar PV system at the Baldock safety rest area along Interstate 5 between Portland and Salem
- The world's largest roadside solar installation, a 3 megawatt solar PV system at a maintenance and storage facility along Interstate 205 in the City of West Linn, Oregon.

These future projects will help meet ODOT's long-term goal of installing enough roadside solar to supply 100% of the 47 million kilowatt-hours of electricity annually consumed.

For more information
on the program, visit
www.oregonsolarhighway.com

A conceptual layout for the future installation of a 1.75 megawatt system at the Baldock safety rest area along Interstate 5 between Portland and Salem.

Two views (an aerial view and a view from the adjacent residential neighborhood located higher up the bluff) of the conceptual layout for the world's largest roadside solar installation, a 3 megawatt system at a maintenance and storage facility along Interstate 205 near the City of West Linn, Oregon.

Overview of Solar Energy Technologies and Their Uses

There are two basic technologies that can harness the energy of the sun to generate electricity—concentrating solar power and solar photovoltaics (PV).

Concentrating solar power

Concentrating solar power (CSP) technologies use mirrors to concentrate the thermal energy of sunlight to make steam and produce electric power using a turbine or heat engine. CSP systems require substantial tracts of land, on a scale of 500 to 1000 acres, in climates with limited cloud cover to be cost effective.

The ideal locations for this type of system are on previously disturbed lands in the deserts of the U.S. Southwest. Generally speaking, this technology is not suitable to highway rights-of-way.

Solar Photovoltaics (PV)

Photovoltaic technologies are solid-state semiconductors that directly convert direct and indirect sunlight into electricity. Solar PV is a distributed electric power generating technology that produces electricity at or near the place where it is used.

As a distributed generation technology, small PV systems are often installed on building roofs—a deployment called rooftop solar PV. PV systems can also be installed directly on mounting structures affixed to either a shallow or deep foundation footing—a deployment called ground mounted solar PV.

Focus on ground mounted solar PV

While transportation agencies have a variety of assets where solar PV systems might be appropriate, this guidebook focuses on ground mounted systems, as this type of system is the most appropriate for the unused highway rights of-way. The following discussion describes the basic solar PV technology components involved in a typical project.

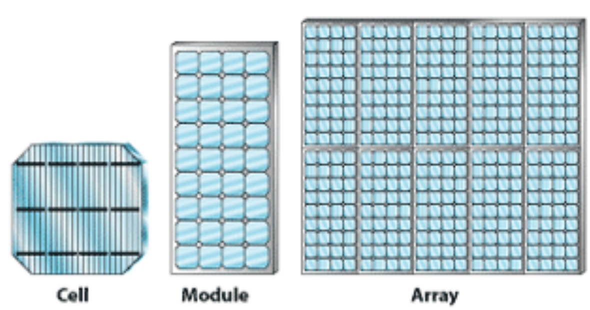
Solar PV cells, modules and arrays

The basic building block of a solar PV system is the solar cell. Solar cells are solid-state, semiconductor devices that convert the energy in sunlight into electricity. A variety of semiconductor materials can be used in the manufacture of solar cells but the most common material in the marketplace is crystalline silicon.

Individually, photovoltaic cells can only produce a small amount of power so they are connected to form a photovoltaic module, or solar panel. To provide electrical insulation and protect against environmental corrosion, the module is encased in a transparent material referred to as an encapsulant.

To provide structural integrity the module is mounted on top of a rigid flat surface or substrate. A transparent cover film, commonly made of glass, further protects these components from the elements.

Diagram showing the basic building blocks of a solar PV system, including a cell, module and array.



Source: solareis.anl.gov

Often a number of modules are interconnected, in electrical series or parallel, to create a string. The whole collection of modules in a system is called an array. An array can be designed, or sized, to meet small or large electric power needs.

In addition to the modules, a solar PV system also includes a number of other components necessary for effective and efficient operation collectively referred to as "balance of system" components. These components include standard electrical supplies as well as equipment unique to photovoltaic systems including a mounting structure and power conditioning units (inverters).

Ground mounted structures

Mounting structures provide structural support for the modules and point them towards the sun at the proper angle. Stationary mounting structures with a constant cardinal orientation and angle of inclination are called fixed mounts.

Mounting structures that can adjust the cardinal orientation, the angle of inclination or both as the sun moves across the sky over the course of the day or year are called "tracking mounts."

Most ground mounted installations consist of steel or aluminum racks or poles anchored to a concrete footing. While tracking mount systems can improve system performance they cost considerably more than fixed mount systems, and they include moving parts—increasing maintenance costs.

Inverters

Power condition units, or power inverters, are specialized pieces of electrical equipment that convert the direct-current electricity produced by the photovoltaic modules into alternating-current electricity that can be placed on the electric grid.

The number of inverters in a solar array will vary depending on the specifications of the equipment involved, but a common configuration is to utilize one inverter for each parallel string.

Once the electricity is converted to alternating current, it can be placed onto the local electricity distribution grid through a grid interconnection.

Interconnection

The term interconnection refers to connecting a photovoltaic system to the electric grid—a procedure managed by the local electric utility. Most electric utilities require that a grid-tied photovoltaic system meets specific interconnection standards.

These standards typically require the installation of disconnect switches—safety equipment that can interrupt the flow of electricity from the photovoltaic system in an emergency. They also ensure that power inverters and other electrical equipment, like meters, meet certain electrical codes or standards.

These requirements are usually detailed in an interconnection agreement signed by the electric utility and the solar PV system owner.

Oregon Solar Highway Program Highlight

The Oregon Solar Highway Demonstration Project is made of 594 high efficiency 175-watt SolarWorld monocrystalline silicon PV modules. Aluminum frames mounted on top of a steel racking system support the modules. The power from the modules is routed through a single 100 kilowatt PV Powered inverter before connecting to the grid. A six-foot security fence hardened with triple-strand barbed wire, razor wire coil and 3-inch barbed security tape encloses the entire site.

Putting it all together

The following shows the process of putting all of these solar energy technology parts together during the Oregon Solar Highway Demonstration Project site construction managed by Moyano Leadership Group and Aadland Evans Constructors, Inc. and installed by Advanced Energy Systems .

Site preparation including grading and construction of the solar PV array footings.

Installation of the security fence.

The rest of the guidebook will outline the considerations and steps for developing your own Solar Highway Program and implementing a similar project in the highway right-of-way.

Installation of the steel racking system, aluminum framing and solar PV modules.

Solar Highway Program Development

Gaining Agency Support and Structure for the Program

Finding Program Funding: Financial Incentives for Solar PV

Navigating State-Specific Regulatory Issues

Understanding Federal Highway Administration Policy

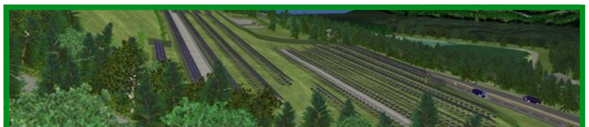
This section discusses the key considerations in developing a Solar Highway Program including the importance of internal agency support and the staffing and resource commitments required to effectively implement a project. A review of policies, funding options, regulatory issues and other considerations that will influence the viability of a particular project are provided.

Gaining Agency Support and Structure for the Program

Transportation officials considering the development of a Solar Highway Program should first confirm that the program concept is consistent with the overall goals and objectives of the transportation agency and that other agency members have a clear understanding of how the proposed program is compatible with the agency's mission.

Relevant agency policy and planning

Identifying existing policy frameworks that explicitly justify pursuit of a program is important in providing the policy rationale and legal justification for the agency to act.



Oregon Solar Highway Program Highlight

When considering whether to proceed with the demonstration project, staff at ODOT discovered language supporting the project concept in a number of policy frameworks.

While it was clear that the spirit and letter of these frameworks would justify pursuit of the project concept, agency staff deliberately sought out the specific endorsement of the Oregon Transportation Commission prior to proceeding. This endorsement served two purposes.

First, the endorsement confirmed support for the project concept from the leading policy body and provided part of the legal justification for proceeding.

Second, the endorsement served to crystallize agency leadership support for the project concept.

Moreover, seeking authorization from agency and political leaders provides these decision-makers the opportunity to exercise their proper management and oversight functions.

Potential policy and planning frameworks that may validate agency support for a solar highway program include:

- State transportation plan
- Agency or state sustainability plans
- Executive Orders on energy or sustainability
- State climate action plans or greenhouse gas emissions reduction targets
- Legislative mandates on renewable energy or sustainable economic development

Agency capacity and commitment

Project champion and manager

Developing a program requires the substantial investment of staff time from a skilled project manager who can also serve as a project champion. As with all transportation improvements, there are multiple tasks and processes that must be simultaneously managed to bring a solar highway project to fruition.

The project manager, Allison Hamilton, provides tours of the solar highway demonstration project.

This individual must be capable of managing the logistics and details of the project including controlling the project budget and if necessary, seeking out funding through grants or private sector partnerships, monitoring the project schedule and coordinating agency experts, consultants, partners and stakeholders.

While other agency staff and consultants may provide support and technical expertise, it is the project manager that is the point person responsible for overseeing and integrating these disparate tasks. The project manager should have enough authority in the organizational hierarchy that they can direct this work.

In addition to these basic skills, this individual must have outstanding leadership and entrepreneurial skills. Since it is unlikely that many of the questions that this type of project raises have been addressed by the agency before, the project manager must be comfortable with a certain level of uncertainty and ambiguity and be capable of innovative and creative problem solving.

This person should be able to maintain a positive attitude even in the face of these difficulties and obstacles—this ability to remain enthusiastically persistent can not be overstated. The project manager must act as a champion, articulating a compelling vision to generate and maintain support within the agency and among stakeholders.

Leadership buy-in

Beyond the frontline project manager, it is critical to have the explicit and implicit support of agency leadership.

Securing the full backing of agency leadership is crucial. Without this endorsement it is easier for others to deprioritize the project and discount the requests of the project manager.

With a stamp of approval the project manager will be able to hold others accountable, reconcile divergent opinions and points of view on trivial and inconsequential matters and call on top-level agency leadership when appropriate to keep the project on track.

Project timeline

It is difficult to predict the amount of time that it may take to advance a project from concept to reality, as circumstances will inevitably vary from agency to agency.

At a minimum, prospective project managers should expect to spend from six to twelve months assessing their state-specific political

Oregon Solar Highway Program Highlight

The Oregon Solar Highway Program is a labor of love for its program manager, Allison Hamilton. Hamiliton, a 25-year veteran of ODOT, conceived of the project after watching a television documentary showing solar panels mounted on top of a sound barrier along the German autobahn.

Inspired by what she saw, Hamilton approached her manager, who encouraged her to pursue the idea with agency leadership. While open to the concept, top-level management made it clear that funding was not available for this project.

Undeterred, Hamilton continued to look for a way forward and came across examples of other public agencies using public-private partnerships to finance and develop renewable energy projects. With this key piece of insight, Hamilton was then able to start seeking private sector partners to involve in the project.

While not the only hurdle encountered along the way, this example highlights the entrepreneurial spirit and creative problem solving skills necessary in a project manager and project champion.

context, evaluating available incentives and business models, assembling a project team, identifying suitable project sites and selecting a solar developer.

Governor Ted Kulongoski demonstrated strong public and government support for the Oregon Solar Highway Demonstration Project during the groundbreaking ceremony. His leadership was vital in moving the project forward.

U.S. Senator Jeff Merkley on a tour of the Solar Highway Demonstration Project with program manager, Allison Hamilton. His support at the national level was crucial in moving this project and follow-on projects forward.

This timeline, of course, can be delayed by complications with permitting. Once these initial steps are completed and project agreements are executed, construction and project commissioning can typically happen in less than six months, depending on the complexities involved with the site development.

Program costs

While innovative public-private partnerships may allow an agency to avoid the upfront capital cost of the solar PV system, there will likely be some programmatic costs the agency must fund.

Some of these costs are associated with internal agency staff time, while others may be costs for external consulting services such as external legal counsel and professional or technical services.

It may be possible to absorb these costs within existing programmatic budgets but it may also be necessary to secure funding from other sources such as federal grants or programmatic requests.

Finding Program Funding: Financial Incentives for Solar PV

The policy landscape for renewable energy incentives is constantly changing. What may be true one year may no longer be true the next.

It is therefore important for DOTs to conduct their own research and analysis to assess the availability and applicability of financial incentives and other funding opportunities.

The leading resource for conducting this research is the Database of State Incentives for Renewables & Efficiency maintained by the North Carolina Solar Center and the Interstate Renewable Energy Council.

That said, this guidebook highlights some of the associated high-level challenges and describes some of the more important incentives-based issues to consider when funding a solar highway project.

The availability and extent of financial incentives designed to help defray the large upfront capital costs associated with a photovoltaic system are a key variable in determining a project's cost effectiveness.

In order to encourage the deployment of renewable energy and solar PV in particular, both the states and the federal government have devised a number of financial incentives designed to make deployment cost effective.

In most cases, as of 2011, without substantial financial incentives, pursuing a project simply does not make good financial sense, even if it does make good environmental sense.

Federal Funding Incentives

The federal government administers a number of programs and tax policies intended to facilitate the development of renewable energy projects. The most valuable of these incentives are the business investment tax credit (ITC) and modified accelerated cost-recovery system (MACRS).

Investment Tax Credit

The Investment Tax Credit (ITC) provides a tax credit to taxpayers equal to 30% of qualified expenditures for investments in solar PV systems. Qualified expenditures include both equipment costs as well as direct costs such as labor and indirect installation costs such as design fees. To qualify for the ITC, the system must be placed in service, installed and ready to use prior to December 31, 2016. Determination of ineligible use of the property within five years of claiming the credit may result in recapture by the Internal Revenue Service.

Since 2009, taxpayers have had the option of choosing between the ITC or a 30% cash grant in lieu of the ITC. These grants are often referred to as Section 1603 grants after the section of the American Recovery and Reinvestment Act (ARRA) in which it is found. To qualify for the cash grant, the project must begin construction by December 31, 2011 and be placed in service by the end of 2016. Qualified expenditures for the Section 1603 grant are the same as the regular ITC. Notably, the Treasury Department pays the grant within 60 days of receiving a valid application by the taxpayer.

MACRS accelerated depreciation

Modified Accelerated Cost-Recovery System (MACRS) is the method for calculating federal accelerated depreciation of business equipment. Under MACRS, a taxpayer can recover their capital investments through annual depreciation deductions over a specified number of years.

Different business equipment types, or asset classes, have different depreciation schedules.

Solar PV systems have a five-year MACRS depreciation schedule. In an effort to spur investment, the federal government has temporarily modified the depreciation schedule for solar PV systems allowing taxpayers to take 100% of the depreciation deduction in the first year through 2011.

For 2012, the bonus depreciation declines to a 50% depreciation deduction in the first year. Importantly, the utilization of the ITC or the Section 1603 grant will impact the depreciable basis of the asset.

These federal tax benefits are not available to tax-exempt entities, like state, local or federal public agencies and 501 (c) not-for-profit organizations.

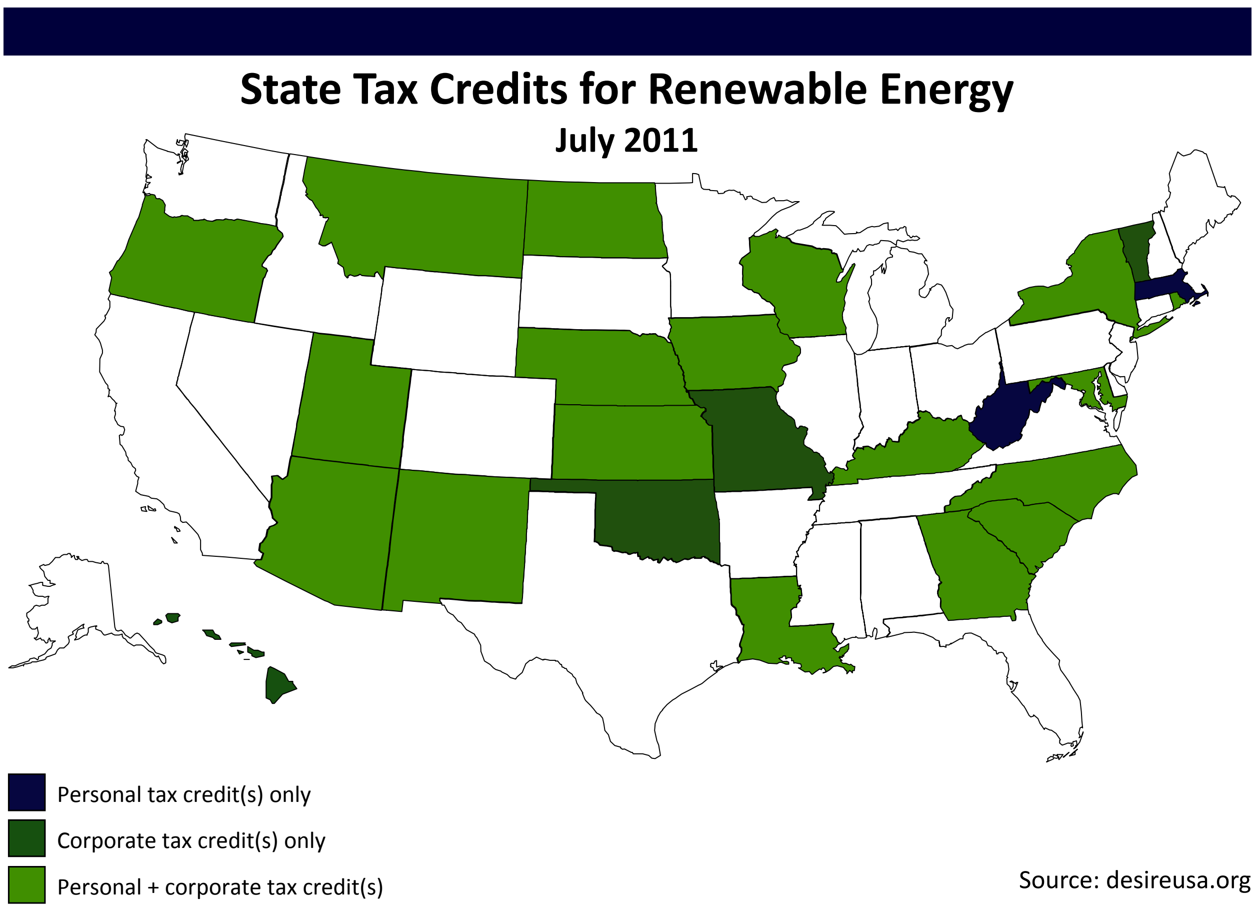
Since public agencies cannot take advantage of these incentives themselves, it has become increasingly common for public agencies to partner with a private sector partner who can through a public-private partnership..

State funding incentives

Various states make use of a range of financial incentives to encourage renewable energy development. The specific nature of available incentives depends on the policies enacted by a particular state but in most cases, state-level financial incentives consist of tax credits, rebates and grant programs, and sales or property tax exemptions.

State tax credits

More than twenty states offer tax credits (see the map below) to offset taxpayer investments in residential or commercial photovoltaic systems. The value of the tax credits differs among states but ranges between 10% and 50% of project cost, with maximum limits for commercial systems up to $10 million. Project and taxpayer eligibility criteria, equipment and installer requirements, claim processes and



funding availability also vary widely among the states.

As with the federal tax incentives, tax-exempt entities cannot take advantage of these state tax credits without a private sector partner with state tax liability.

As an alternative to a project cost incentive based on a percentage of project cost, some states offer a tax credit as either a capacity-based incentive or a production-based incentive. Capacity-based incentives provide the taxpayer a fixed subsidy for each DC watt ($/DC watt) in a photovoltaic system. Production-based incentives provide the taxpayer a variable subsidy, typically at a fixed rate, for each kilowatt-hour ($/kWh) of electricity the system produces.

State rebate and grant programs

More than a dozen states offer rebate programs that provide direct cash incentives to purchasers of photovoltaic systems. Most states offer these subsidies as a capacity-based incentive with a range of $0.50 per DC watt to $6.00 per DC watt.

Programs typically cap the size of the subsidy through a limit on allowable system size, total project cost or percentage of project costs eligible for the subsidy.

Increasingly states are exploring methods to reward system performance over total capacity. As a result, most states now have specific criteria for determining project eligibility including siting, equipment, and installer standards or requirements.

State rebate programs are typically funded through a systems benefit charge, a small surcharge added to a customer's electric utility bill. The amount of the surcharge is typically a fraction of a penny for every kilowatt-hour of electricity consumed by the customer.

The funds generated by the surcharge, also called a Public Benefits Fund, are either administered by a state agency or a third-party organization on behalf of the state government, although in some instances, the electric utilities administer the funds themselves. Other funding sources include legislative appropriations and federal grants.

An advantage of a state rebate program is that the funds are available regardless of the equipment purchaser's tax status. In fact, some states offer more generous subsidies to public agencies or tax-exempt entities to compensate for the fact that the entity is otherwise unable to take advantage of tax incentives.

Sales and property tax exemptions

More than 20 states, not including states without a sales tax, exempt the purchase of solar equipment from state sales taxes. While a sales tax exemption lowers the overall cost of solar PV systems, these savings alone are unlikely to be a deciding factor in determining the economic feasibility of a project.

More than 30 states provide photovoltaic system owners relief from property taxes. Most often this relief comes in the form of a statewide exclusion of the added value of customer-sited solar PV system equipment to property value assessment. These exemptions can result in a non-trivial benefit to the equipment property owner.

Oregon Solar Highway Program Highlight

The private sector partners involved in the Solar Highway Demonstration Project leveraged federal, state and ratepayer funded incentives to help finance the project. The federal incentives included both the accelerated equipment depreciation and investment tax credit. The project also made use of Oregon's Business Energy Tax Credit and a ratepayer funded grant through the Energy Trust of Oregon.

Navigating State-Specific Regulatory Issues

In addition to offering voluntary financial incentives, states may also use their authority to regulate the business practices of electric utilities to encourage the development of renewable energy.

It is important to note that not all electric utilities are subject to the state regulatory frameworks. Investor owned utilities are owned by private shareholders and are typically subject to the oversight of a statewide regulatory commission that sets rules that govern the utility's operations, including their treatment of renewable energy facilities.

On the other hand, the states typically vest the governance authority of consumer-owned utilities, rural electric cooperatives and municipal-owned utilities with a locally elected or appointed board. As a result, different utilities in a given state will often have different rules for renewable energy projects.

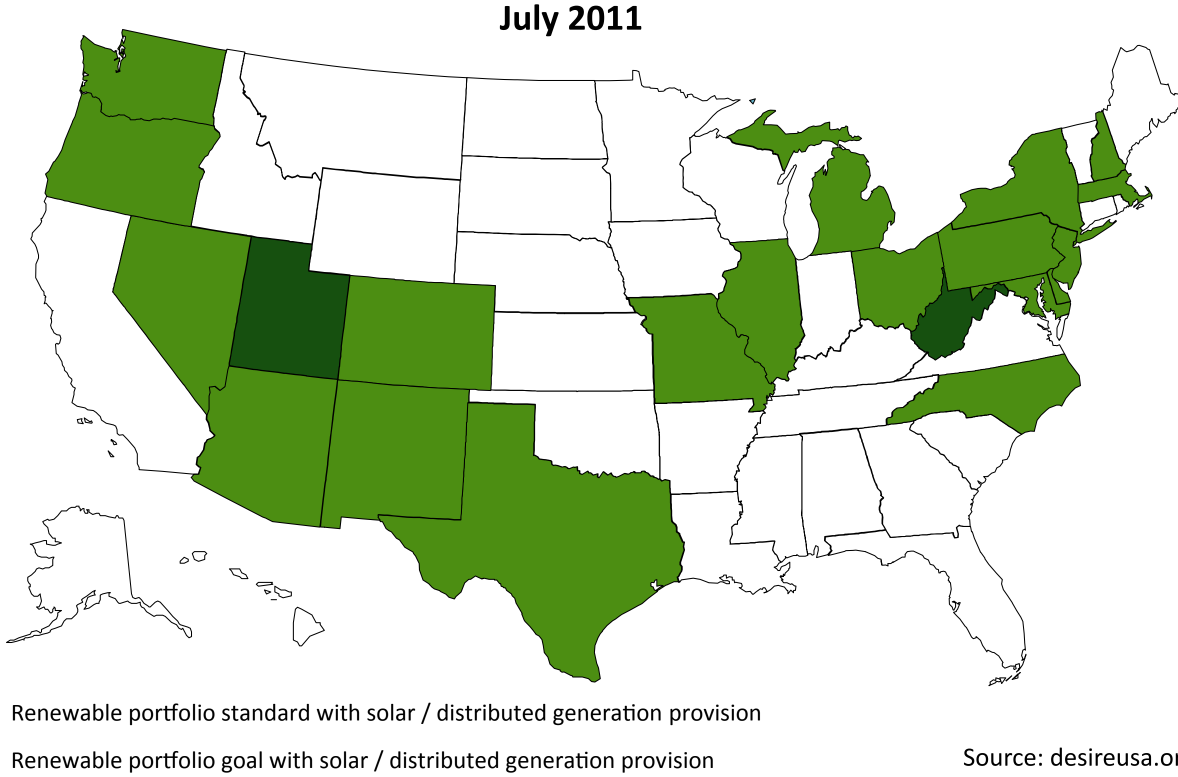
Regardless of the type, it is important to consult with the utility early on concerning proposed projects as they will play a critical role in determining the success or failure of a project.

Renewable portfolio standards

A Renewable Portfolio Standard (RPS) is a requirement that electric utilities include a minimum percentage of renewable resources among the power resources serving their

RPS Policies with Solar or Distributed Generation Provisions

July 2011



customers. It is the primary policy mechanism that states have adopted to encourage renewable energy adoption.

At least sixteen states (see the map on page 20) have included provisions in their RPS requirements specifically aimed at encouraging the development of solar resources. The solar-specific provisions include credit multipliers or set-asides. A credit multiplier allows a utility to earn additional credit toward compliance. A set-aside requires the utility to meet a certain percentage of the RPS with solar resources.

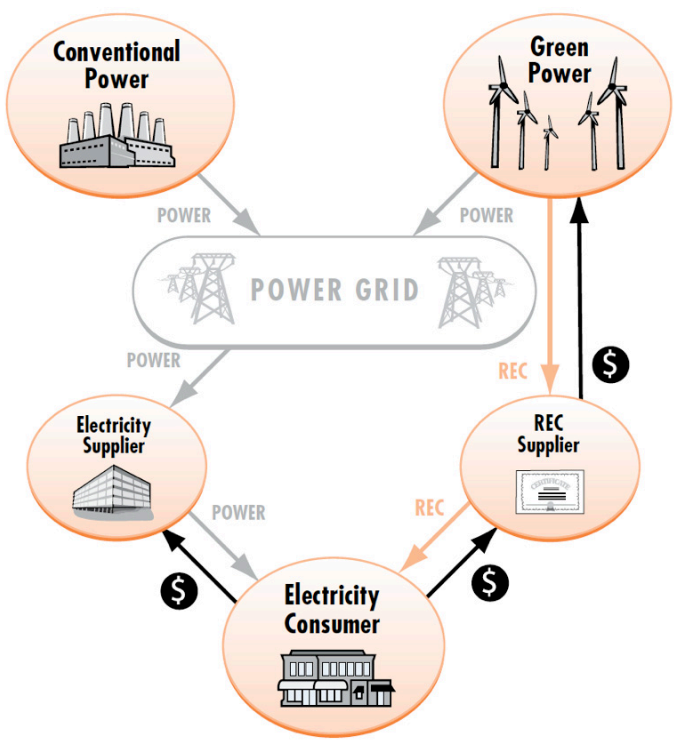
Renewable energy certificates

Most state RPS policies allow utilities to demonstrate compliance with these requirements by acquiring renewable energy certificates (RECs). RECs are tradable environmental commodities that represent the renewable attributes associated with the generation of electricity from renewable energy resources. One REC typically represents one megawatt-hour of renewable electricity. Private parties can also voluntarily acquire RECs to offset their purchases of conventional electricity.

In some states with special RPS provisions for solar PV or other distributed generation a marketplace for a special subset of RECs known as solar RECs or SRECs has been created.

In some markets, the sale of RECs, or SRECs, can be a significant source of revenue used to offset project costs. However, if a REC is sold or transferred separately from the underlying electricity, then that electricity is no longer considered "renewable." In that circumstance, a system host purchasing electricity can no longer claim that they are using renewable electricity—only the ultimate purchaser of the REC can make that claim. Draft guidelines from the

Renewable Energy Certificates



Renewable Energy Certificates (RECS) represent the renewable attributes associated with the generation of electricity from renewable energy resources.

When a REC is sold separately from the underlying electricity, then that electricity is no longer considered "renewable."

Only the ultimate purchasers of the REC can make the claim that they are using renewable electricity.

Courtesy: U.S. EPA

Federal Trade Commission go even further, saying that entities that do not retain RECs cannot even claim to "host a renewable power facility" without also disclosing that the RECs are sold to another party.

Net metering

Forty-three states (see the map below) have adopted rules that require electric utilities to provide a utility bill credit for electricity generated by a grid-tied system in surplus of a customer's on-site consumption.

These net metering rules vary widely by state and utility service territory but those variations generally affect: the rate or price at which the utility will purchase excess generation, the length of time and period for which credits are valid, and the maximum allowable system size.

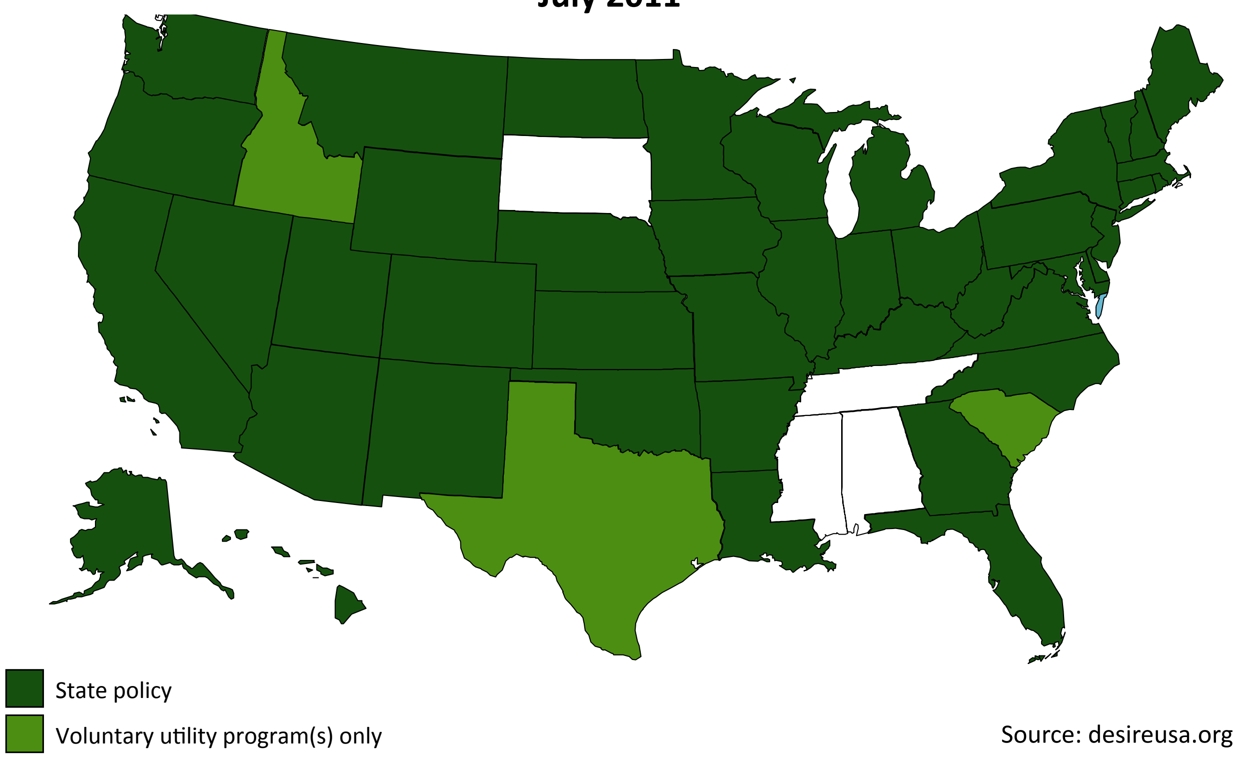
In most states, net metering rules only allow a solar PV system to accrue bill credits against the electric service meter through which it is interconnected. Some states and utilities, however, allow a customer to aggregate multiple meters and thereby offset their electricity consumption at several locations.

Often meter aggregation is limited to properties contiguous to the site where the solar PV system is installed and is always limited to properties within the utility's service territory. Meter aggregation provisions usually cap the size of the solar PV system.

The rate a utility agrees to pay for excess generation will typically be the regular retail rate, the utility's avoided cost rate or the utility's wholesale generation rate. The utility's avoided cost rate is the price the utility would otherwise have to pay to acquire new generation resources. The utility's wholesale generation rate is the price the utility pays for existing generation. Of these, the regular retail rate

Net Metering Policies by State

July 2011



Source: desireusa.org

typically offers the customer the most advantageous pricing while the wholesale generation rate is typically the least advantageous.

Often bill credits can only offset the part of the monthly electric bill associated with power consumption. So even if a solar PV system provided all of the electricity needed by the customer, the customer will continue to receive a bill from the utility for basic service charges.

Net metering rules also often restrict how long a customer can maintain a balance of bill credits. A common arrangement is to allow a customer to carry forward unused credits to the next billing cycle for up to 12 months, after which the unused credits are forfeited. Forfeited credits are often directed toward low-income utility assistance programs.

Finally, net metering rules can limit the size measured as system generating capacity of a solar PV installation. These system limits can either be a fixed cap (e.g. a commercial system cannot exceed 500 kW) or a variable cap based on the customer's electricity consumption (e.g. the output of a system cannot exceed annual on-site consumption).

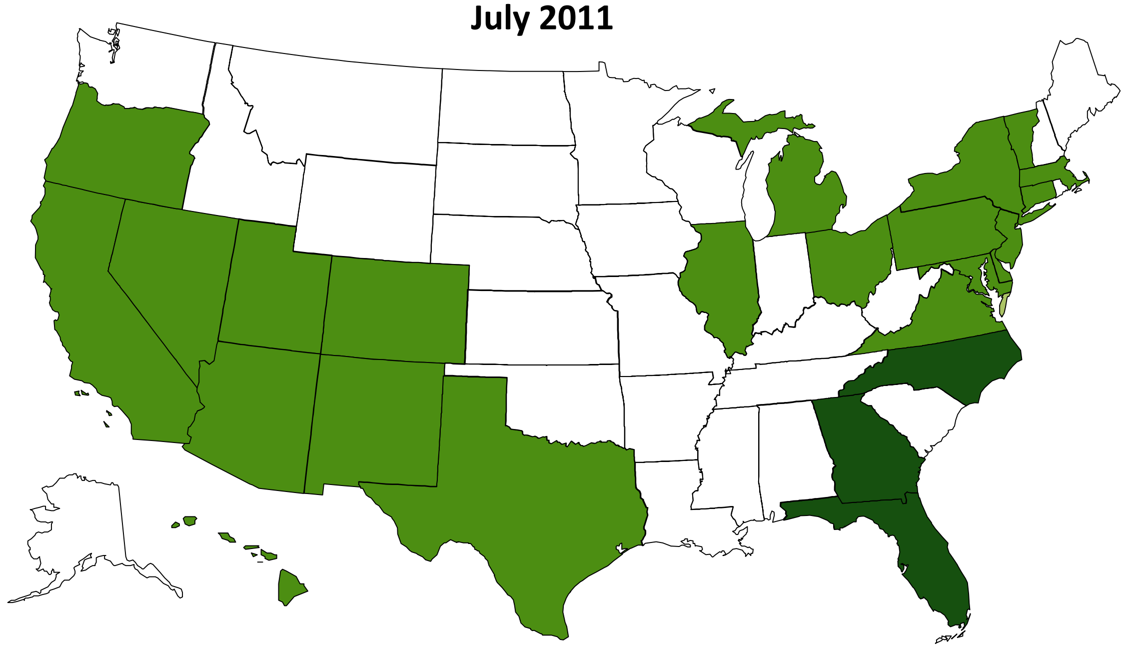
Power purchase agreements

Since public agencies – having no tax burden – cannot take advantage of the tax-related financial incentives available for investments in photovoltaic energy systems, it has become increasingly common for public agencies interested in such projects to partner with a private sector partner who can.

Under such an arrangement, the agency enters into an agreement with a private sector partner to design, finance, install, own and operate a solar PV system on the agency's property.

Permissibility of Third-party Power Purchase Agreements

July 2011



Authorized by state or otherwise currently in use, at least in certain jurisdictions within in the state

Apparently disallowed by state or otherwise restricted by legal barriers

Status unclear or unknown

Source: desireusa.org

In addition to agreeing to host the solar PV system, the agency also agrees to purchase the electricity generated by the system by signing a long-term power purchase agreement (PPA).

This financing model is commonly referred to as the third-party PPA model because it also often involves a silent partner that provides capital in exchange for the large majority of the tax benefits.

The host agency benefits from this financing structure by avoiding upfront capital investment and ongoing operating and maintenance responsibilities while securing a long-term, predictable price for electricity, often initially at a price lower than current utility rates.

The private sector partner or partners benefit by receiving revenue from electricity sales to the host agency and by capturing the tax benefits and financial incentives made available from developing the project.

Because the private sector system owner sells electricity to the host agency it may be considered an electric utility. Treatment of the system owner as an electric utility can preclude utilization of this model as most states have granted incumbent utilities a monopoly right to sell electricity to retail customers.

While some states have specifically authorized third-party PPAs (see the map on page 23) that authorization may not apply in every utility service territory in the state. In other states the permissibility of the model is either unresolved or not permitted. In any event, agencies considering the third-party PPA approach should consult with legal counsel before entering into binding agreements.

Oregon Solar Highway Program Highlight

For the Solar Highway Demonstration Project, ODOT entered into a third-party PPA agreement with a subsidiary of Portland General Electric (PGE) to finance, build, operate and maintain the project. In exchange, ODOT agreed to purchase the electricity generated by the system with options to renew after a period of 25 years.

In addition to demonstrating community leadership, PGE also benefits from the project by retaining a portion of the RECs generated by the project and counting them toward its statutory requirements under Oregon's RPS law.

For more information

on state-specific regulatory issues, visit www.dsireusa.org

Understanding Federal Highway Administration Policy

Guidance on right-of-way usage

Projects sited within the right-of-way of the interstate highway system must conform to applicable federal regulations and standards. The Federal Highway Administration (FHWA) issued written guidance on the utilization of interstate right-of-way for the installation of renewable energy facilities.

The guidance makes clear that federal regulations allow for the accommodation of renewable energy facilities within the right-of-way only when the facility does not impede the safe and efficient operation of the highway. If this can be achieved, the guidance spells out two policy options under which such projects can proceed: utility accommodation and airspace lease.

Utility accommodation

The FHWA's guidance provides a two-part test to determine if the renewable energy facility can be sited using utility accommodation—the provisions laid out at 23 CFR 645 Subpart B that requires states to develop policies and standards for the siting of utility facilities in the highway right-of-way. The test is designed to check if the facility meets the regulatory definition of a "utility" set forth at 23 CFR 645.207.

Part one of the test asks if the facility meets the description of technologies listed in the definition. According to the guidance, since renewable energy facilities and therefore solar PV facilities produce electricity, they satisfy the first part of the test.

The second part of the test asks if the facility meets the public service criteria specified in the definition. According to the guidance, a facility satisfies this test when it provides service to the general public or when it is dedicated to a transportation agency for its own use.

While most grid-connected renewable energy facilities are likely to satisfy this test, the facility must still conform to the specific policies and standards detailed in the state-specific Utility Accommodation Plan—the programmatic agreement between the transportation agency and FHWA addressing if, to what extent and under what conditions the state allows the siting of utilities in the right-of-way.

Notably, these plans likely do not explicitly consider the siting of renewable energy facilities and project managers should work with the agency's right-of-way office to review the relevance of and interpret current policies and practices.

If the transportation agency determines that a renewable energy facility meets the terms and conditions outlined in the FHWA approved Utility Accommodation Plan then it may issue a permit for the project without referral to FHWA. However, it is advised that, as a courtesy, program managers consult with the state-level FHWA division office to ensure all parties understand the appropriateness of siting the facility using the utility accommodation framework.

U.S. Department of Transportation
Federal Highway Administration

For more information
on FHWA's guidance, visit www.fhwa.dot.gov/realestate/guidutil_a.htm

Air space lease

If a facility cannot be sited under a state's Utility Accommodation Plan it may still be possible to site the facility under an air space lease—the provisions spelled out at 23 CFR 710 that regulate the use of highway right-of-way by public or private entities for non-highway uses other than public utilities, railroads, bikeways and pedestrian walkways. The transportation agency's policies and procedures for executing airspace leases are a required part of each state's FHWA approved right-of-way operations manual.

In general, airspace leases are permitted when the alternative use is not in conflict with the continued operation, maintenance and safety of the highway facility. All air space lease agreements are subject to final approval by FHWA.

Under the airspace lease rules, transportation agencies are required to charge a fair market value lease rate for use of the property and the federal pro-rata share of the proceeds must be directed toward Title 23 eligible activities.

FHWA's guidance points out however that under certain circumstances a transportation agency may seek FHWA approval to charge below market lease rates for the use of the property if it can be shown that such an exception is in the overall public interest for social, environmental or economic purposes. The guidance further suggests that renewable energy facilities and other projects that positively address climate change or contribute to improvements in air quality may be an appropriate activity for this type of exception.

When utilizing an air space lease to site a renewable energy facility it is advised that the state transportation agency consult with the state-level FHWA division office at the earliest opportunity as the specific terms and conditions of the lease will influence the other project agreements.

Oregon Solar Highway Program Highlight

Through review by ODOT and the Oregon Department of Justice it was determined that since the solar highway demonstration project supplies electricity for ODOT's own use, it met the conditions detailed in ODOT's FHWA approved utility accommodation plan.

While ODOT District offices issue and manage these types of permits as a normal course of business, due to the prototypical nature of the solar installation, FHWA requested and completed review of the permit before it was issued.

Developing a Solar Highway Project

Assemble a Project Team

Identify and Prioritize Candidate Sites

Assess Candidate Site Feasibility

Public Involvement and Communication

Evaluate Business Models

Identify and Select a Solar Developer

Project Delivery and Implementation

This section provides a step-by-step overview of the process of implementing a solar highway project. Core capablities and competencies are detailed for internal and external project partners required for successful project management and implementation. It also provides direction on how to evaluate candidate project sites and conduct a feasibility study. T An in-depth discussion of the issues related to the selection of and contracting with a private sector partner and project execution is also included.

Assemble a Project Team

Because the planning, design, financing, construction and operation of renewable energy projects are complex tasks, most agencies are unlikely to possess all of the technical expertise necessary to bring a project to fruition.

Most program managers will benefit from the advice and expertise of others within the agency as well as external discipline-specific experts.

As a first step in program development, it is important to assess the agency's technical assistance needs and begin networking and partnering with other state and federal agencies and private sector firms to fill knowledge gaps. These partners can help navigate project elements specific to renewable energy development and add value to the project.

Core capabilities and competencies

Below is a brief discussion of the core technical competencies that will likely be required for successful program development and some suggestions for where to start networking and building relationships and partnerships.

Context sensitive site selection

Identifying and prioritizing potential project sites is a multidisciplinary effort that will likely involve both internal and external experts and stakeholders.

In order to narrow the list of potential sites to a manageable list suitable for solar energy development, project managers must consider a number of physical attributes such as the site's

Core Capabilities and Competencies	Internal and External Sources of Expertise
Context sensitive site selection	DOT Right-Of-Way Office; DOT District/Regional Office; State Energy Office; Transportation planners; Solar developers
Environmental impact analysis	DOT Environmental Section; State Natural Resource and Environmental Agencies; U.S. Army Corp of Engineers; Private sector consultants
Utility policy and regulation	State Energy Office; Public Utility/Service Commission; Electric utilities; DOT Utility Relocation Office; DOT Maintenance Office
Solar PV design and engineering	Solar developers; State Energy Office
Incentives and financing structures	Solar developers and business support agencies; State Department of Administrative Services; State Energy Office
Legal issues	State Attorney General's Office ; Outside counsel
Contracting and procurement expertise	State Department of Administrative Services; DOT Procurement Office
Public involvement and marketing	DOT Public Affairs; Public Relations firms
Right-of-way	DOT Right-Of-Way Office; FHWA Division Office; FHWA Office of Planning, Environment, and Realty

solar energy generation potential, land limitations, competing uses and access to the electrical grid. Short-listing of potential sites should also consider a site's natural, economic, cultural and community attributes. This high-level context sensitive screening will help ensure a project fits with the surrounding natural and built environments and can serve as the basis for building community support and acceptance. This analysis should consider aspects such as land use compatibility, major natural features and adjacent community and economic activities.

Expertise related to site selection likely to be found within the agency includes property management knowledge found in Right-Of-Way (ROW) offices. These offices are often the repository for real property inventories, plats, maps and other geographic information systems (GIS) data sets that can serve as the starting point for identifying potential project sites. Regional maintenance offices are an invaluable source of information related to actual site conditions and field staff in these offices should be consulted in the site selection and site review processes.

Solar PV experts in the private sector and potentially in a state energy office can help evaluate a site's solar potential and identify its access to the electrical grid. Agency staff unfamiliar with context sensitive approaches to developing transportation facilities should consider working with professional consultants versed in sustainable transportation planning.

Environmental impact analysis

Each project will require an environmental site assessment to conform to appropriate environmental due diligence standards such as the Federal Highways Administration's National Environmental Policy Act (NEPA) regulations and other state-specific environmental regulations. Many of the same disciplines engaged by an agency when evaluating potential impacts of other transportation projects will also prove useful for solar projects. As a result, most agencies will either have discipline experts on staff or be familiar with other agencies and consultants that can provide the appropriate technical assistance.

Some of the discipline experts to include are biology, wetlands, hazardous materials, geotechnical, stormwater, historic, archeological, cultural resources and land use.

Utility policy and regulation

Electric utilities are subject to an assortment of federal and state regulations from the setting of rates to the accommodation and composition of generating resources. Moreover, the applicability of these rules varies by utility ownership structure. The complexity and variability of utility regulation can either facilitate (e.g. requiring a utility to allow the interconnection of renewable energy systems) or impede project development (e.g. restricting project ownership structures).

Successfully understanding and negotiating this regulatory landscape requires the expertise of professionals well versed in the details of the state's specific regulatory frameworks. This expertise may reside with staff at a state energy office, public service or utilities commission. Electric utilities often have individuals designated to facilitate renewable energy development who may also be of assistance.

Solar PV design and engineering

Developing a project requires expertise in the design and engineering of solar PV systems. Working with a reputable solar developer will ensure that the system is built to maximize energy and financial performance. Many solar contractors are design-build firms and as such will be familiar with relevant electrical, safety and building codes, local utility regulations, current financial incentives, and system installation and commissioning and operation and maintenance requirements.

Incentives and financing structures

The landscape for renewable energy incentives and revenue streams is constantly evolving—as a result, so are the business models used to deploy solar projects. Analyzing and selecting a financing structure that optimizes a project's financial performance and safeguards public resources requires knowledge of available federal, state and utility financial incentives, the markets for electricity and renewable energy credits and the regulatory constraints associated with particular financing structures. It also requires the skilled application of financial analysis tools to evaluate the attractiveness of different business model scenarios.

While solar developers typically possess the expertise to optimize a project's financial structure to take advantage of the range of incentives, the agency must conduct its own due diligence to evaluate project alternatives. Support for conducting this due diligence may be available from experts within a state energy office. However, it may be necessary to work with a consultant independent of the solar developer.

Oregon Solar Highway Program Highlight

The Oregon Solar Highway Program has been made possible by drawing on the expertise of public agencies as well as private sector partners. Below is a list of some of the partners and the type of expertise they provided for the demonstration project.

Portland General Electric — electric utility and development partner

U.S. Bancorp — project tax equity partner

United Fund Advisors — financial advisor to PGE and U.S. Bancorp

Five Stars International — electric utility and renewable energy consultant

Aadland Evans Constructors, Inc. and Moyano Leadership Group, Inc. — construction and project management

Advanced Energy Systems — solar PV system design and installation

Good Company — public involvement and sustainability communications specialist

Energy Trust of Oregon — financial assistance

Oregon Department of Justice — review of project agreements

Oregon Department of Energy — grant seeking and technical support

Oregon Department of Revenue — interpretation of state tax incentives

ODOT Right-of-Way — inventory of available parcels

ODOT Geo-environmental Office — environmental consultation

ODOT Region 1 — utility accommodation permit

FHWA Oregon Division Office — permitting considerations

FHWA Office of Planning, Environment, and Realty — national guidance on renewable in federal highway right-of-way

Legal issues

In order to maximize the value of available financial incentives, a public agency will in most circumstances work with a private sector partner to develop a project. Under the most common arrangement, the private developer will finance, build, own and operate a solar generating facility hosted on public agency property and the agency will purchase the electricity generated by the system. This type of arrangement requires a number of contracting agreements specifying the terms and conditions of power sales/purchases, ownership of environmental attributes, land use agreements, utility interconnection agreements and the roles and responsibilities of the involved parties.

These as well as regulatory compliance issues will require thorough examination by legal counsel familiar with not only the agency's regulatory obligations, but also solar power purchase agreements. This advice may be available through departmental counsel or a state Attorney General's office. A number of private sector firms also specialize in renewable energy legal issues as well.

Contracting and procurement expertise

Identifying and selecting qualified firms capable of providing the necessary professional services to assist an agency in developing a solar highway program requires knowledge of state contracting and procurement rules. The details included or omitted in the procurement process can clearly influence the quality and performance, and therefore, agency staff preparing requests for proposals or requests for qualifications must be familiar with the types of services, technical specifications and evaluation criteria included in a work scope. It may be advisable to have a consultant familiar with these technical issues work with a procurement office to develop a robust request for proposals.

Public involvement and marketing

Since these types of projects tend to have high public visibility, it is critical to have a communications plan in place. The plan should be developed at the outset and include strategies for engaging community stakeholders and identifying and responding to their concerns. The plan will also include a marketing component to inform and educate the public at-large and key stakeholders about the project and its progress.

Agency public involvement and public relations specialists can be useful resources in developing a communications plan and working with stakeholders, including local elected officials. Public relations contractors can supplement the work of agency staff by providing third-party facilitation, conducting stakeholder interviews, planning and coordinating events or preparing public information and outreach materials. Working with an outside consultant may also be preferable because it allows project managers to focus on project delivery.

Right-of-way

Projects sited within the right-of-way of the interstate highway system must conform to applicable federal regulations and standards. Experts within the state transportation agency's right-of-way office should be called upon to review the relevance of current policies and practices, as articulated in the state's right-of-way manual, as they relate to the siting of renewable energy facilities. The emergent nature of these types of projects may require changes or modifications to current policy and these same experts will be integral to any such revisions. Additionally, program managers should consult with the state-level FHWA division office at the outset of program development to ensure all parties understand the appropriate framework for accommodating potential projects.

Identify and Prioritize Candidate Sites

Identifying and prioritizing sites suitable for solar energy development is an obvious prerequisite for project development. Narrowing the list of potential sites to a manageable number of suitable sites is a multi-step process.

Taking a deliberate approach to site selection will help avoid incompatibilities and limitations that prevent a project from coming to fruition. It may also be attractive to potential partners to have this initial site search step completed prior to their involvement. Many of the following actions can and should be conducted concurrently.

Preliminary screening of ROW assets

The first step is to conduct a preliminary screening of right-of-way assets in order to determine sites worthy of further feasibility analysis.

Screening is a preliminary analysis based on existing and preferably, easily collected data in order to determine which sites are candidates for a feasibility study. Screening is most often conducted on a large number of sites to focus an agency's effort on sites most likely to have viable projects.

It may not be possible for an agency to consider all right-of-way assets in this preliminary screening and agency staff may find that focusing on assets within a particular region or utility service territory is a reasonable place to start. The preliminary screening should consider:

- ✓ Solar energy generation potential
- ✓ Current and future uses
- ✓ Land requirements
- ✓ Access to the electric grid
- ✓ Access and safety

Each of these screening criteria could potentially preclude site development and are discussed in further detail in this section.

Solar energy generation potential

A site's solar resource is obviously a critical aspect in site selection. A site's solar resource is determined by its insolation—the amount of solar radiation received on a given surface area per unit of time. Measurements of solar energy are typically represented in kilowatt-hours per square meter per day (kWh/m^2/day).

Oregon Solar Highway Program Highlight

ODOT took a qualitative approach in identifying a potential location for the Oregon Solar Highway Demonstration Project.

Starting with the knowledge that Portland General Electric was a willing partner in developing the project concept, the Solar Highway program manager focused first on sites in the utility's service territory around the Portland metropolitan area. By interviewing staff in the agency's regional office, the program manager was able to identify a number of right-of-way assets that could accommodate a site.

After this initial site screening process, ODOT hired a Geographic Information System (GIS) consultant to conduct a statewide assessment of the agency's more than 19,128 miles of right-of-way to determine and prioritize suitable project locations. The GIS site feasibility analysis considered a number of criteria including parcel size, shape, land limitations, access to the electrical grid, and annual solar resource, slope and aspect.

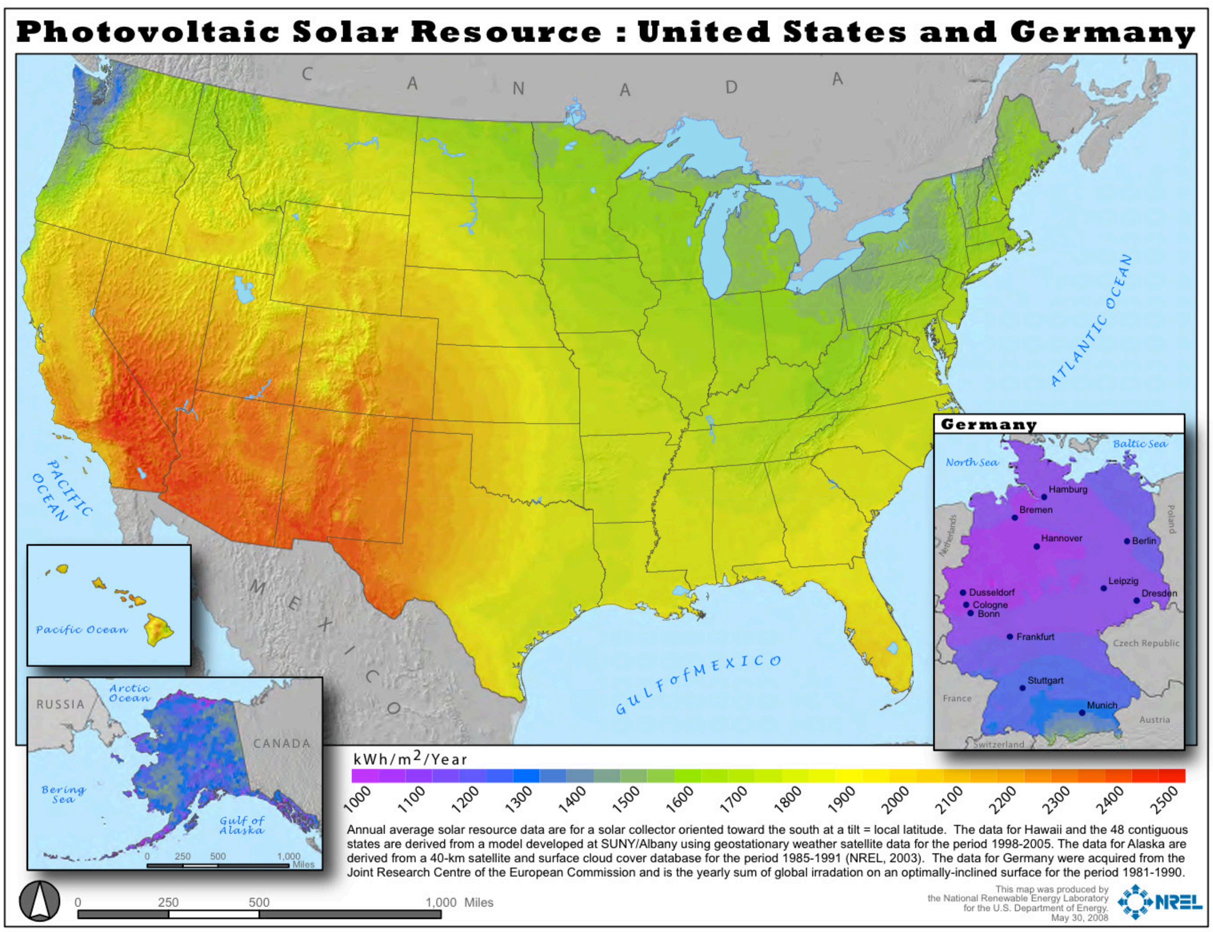
Given the right balance of incentives and utility rates, most locations in the United States receive enough solar radiation to make solar a financially viable renewable resource.

In fact, most parts of the United States receive more solar radiation (see map below) than Germany, ranked first in the world for cumulative installed solar capacity. However, a number of factors can limit a site's solar potential and should be factored into a preliminary screening. They include:

- Climate. Drier micro-climates with less frequent overcast conditions tend to have more solar energy available at ground level.
- Shading. Nearby hills, vegetation and the built environment can cast shadows across a surface, decreasing the amount of solar energy reaching a surface.
- Cardinal orientation. In the northern hemisphere the sun crosses the sky from east to west across the southern sky. Therefore objects facing south will receive more sunlight.

Given these potential limiting factors, the preliminary screening should focus on sites with good southern exposure without topographic or other shading. Sites should also have limited vegetative coverage as extensive clearing and

Most parts of the United States receive more solar radiation than Germany, ranked first in the world for cumulative installed solar capacity.



grubbing will add to site preparation—and possible environmental mitigation—costs.

For the purposes of the preliminary screening, this review can be conducted remotely using aerial photographs or satellite imagery to determine if a site will receive adequate sunlight for solar energy technologies to be effective.

Current and future conflicting uses

The preliminary screening should also consider current and future site incongruities. Of paramount consideration should be highway and traffic safety. Any potential project is best accommodated outside of the highway clear zone for safety reasons.

The appropriate clear zone is dependent on traffic speed and volume as well as the geometric characteristic of the roadway. As a preliminary screening rule, the project boundary should be at least thirty feet from the edge of travel lane shoulders.

As site selection is refined, project managers should work with agency highway engineers and consult relevant American Association of State Highway Transportation Officials (AASHTO) guidelines to ensure that a potential site is suitable.

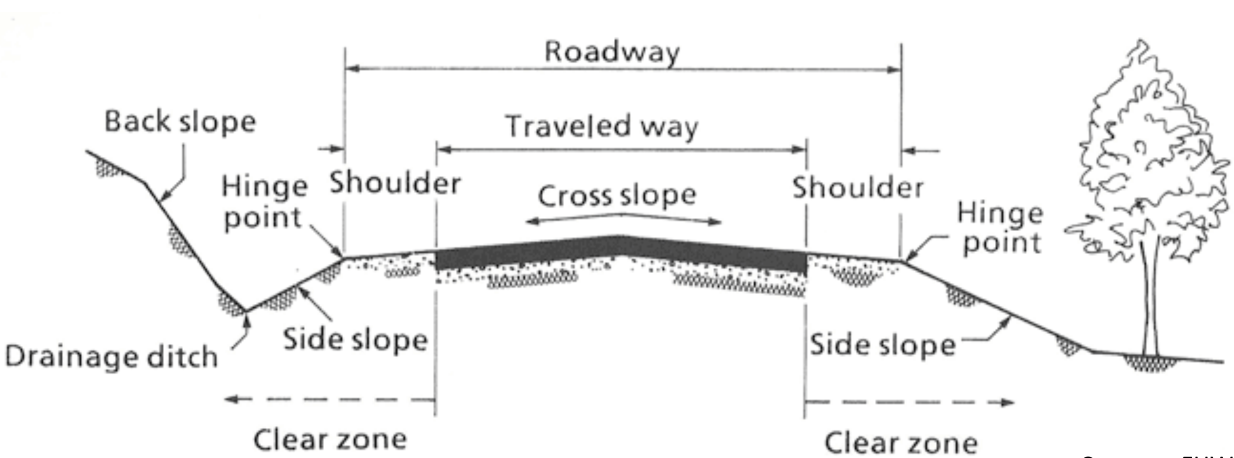
This review should consider both current and planned highway alignments. The preliminary screening should also seek to identify locations with obvious sensitive environmental resources such as water resources, wetlands and threatened and endangered species.

Similar consideration should also be given to archeological, cultural and historic resources. The intention at this stage of site evaluation is not to make a definitive determination about potential impacts but to avoid sites that pose obvious risks of complex and costly environmental reviews or public involvement processes.

Land requirements

In addition to adequate solar exposure, a site must also be of sufficient area so as to physically accommodate an installation. The amount of required is primarily a function of the amount of generating capacity installed—the more capacity the greater the area of land required.

The clear zone is the traversable area that starts at the edge of the traffic lane and extends laterally a sufficient distance to allow a driver to stop or return to the road before encountering a hazard or overturning. Any potential project is best accommodated outside of the highway clear zone for safety reasons.



Courtesy FHWA

The optimal capacity and configuration of a system is influenced by a number of factors including utility rates, available financial incentives, solar PV costs, site preparation and transaction costs and system performance. Ultimately the system must be large enough to realize an economy of scale that will make the project financially viable. While site conditions in some locations may justify smaller installations, it is likely that a ground mounted project will need to be at least one megawatt to achieve financial viability.

Since approximately 3.5 acres of land are required per megawatt of installed capacity, the preliminary screening should generally focus on potential sites that are five acres or larger. Potential locations large enough to accommodate a project may include wayside information centers and rest areas, interchanges, inactive or abandoned weigh stations, rest areas or maintenance yards.

While ground mounted solar PV systems can be constructed on steeper slopes or in areas with hard subsurfaces layers such as granite or basalt, negotiating these site conditions can add significant costs. The highest quality sites will have relatively little slope (less than 5%) and feature cohesive soils. Other land limitations to take into account during the preliminary screening include natural hazard zones, such as flood and landslide areas.

Proximity to the electrical grid

A site with physical access to the local electrical grid is generally a precondition for any project. Ideally, the project site would be within a half-mile of an electric grid. Depending on the scale of the installation the grid will need to accommodate a three-phase interconnection. A site with preexisting electrical service in most circumstances will be located where the nearby utility infrastructure can accommodate a grid interconnection.

Access and safety

Site access for construction, operations and maintenance may require additional facilities, such as graveled access roads. Such access though must be thoughtfully developed and controlled to avoid potential safety and security issues associated with access by the general public. Ideally, site access would not be directly from the highway itself but from other roadways or existing access breaks. Creation of any new, modified or temporary access point to the interstate highway system will require FHWA approval.

For more information on state-specific regulatory issues, visit www.dsireusa.org

Assess Candidate Site Feasibility

Once a set of candidate sites has been identified, the next step is to conduct site-specific feasibility assessments to identify and evaluate technical design and site development considerations. The purpose of this project feasibility assessment is to make a go or no-go decision on proceeding with the procurement process.

A solar site feasibility study should include onsite solar resource evaluation, context sensitive screening, a preliminary environmental screening, and a preliminary economic analysis. Each is discussed in detail below.

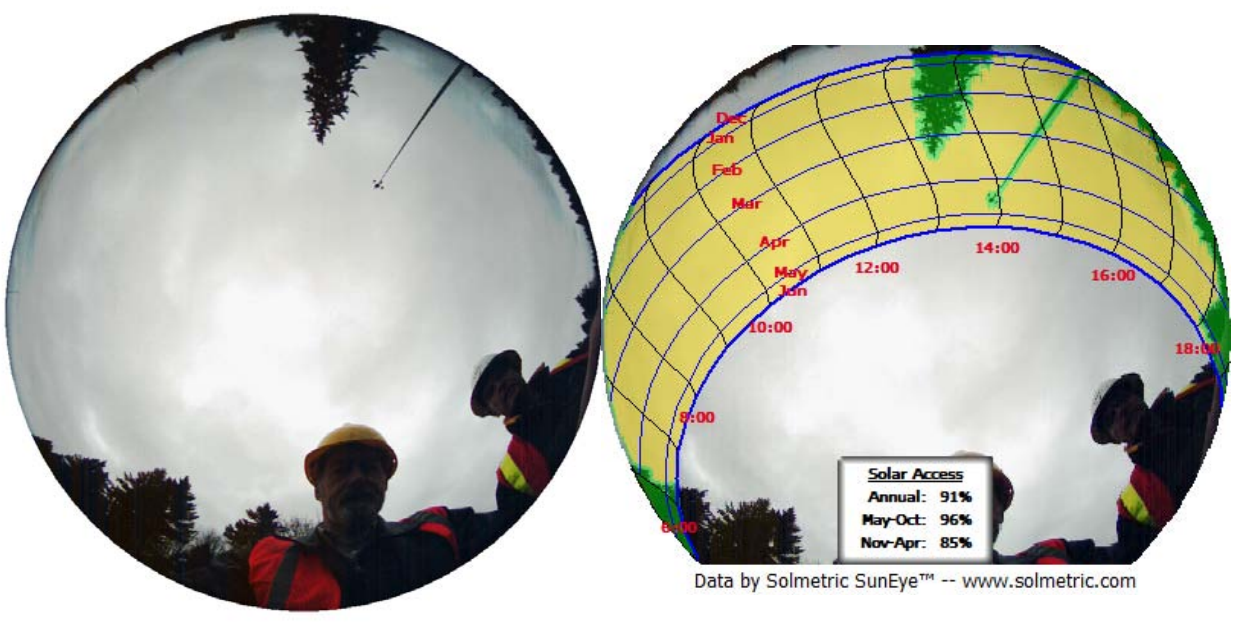
On-site solar resource evaluation

A solar site analysis is an onsite evaluation of the available solar resource conducted by a solar PV professional. The information gathered during the site visit will be used during the design process to optimize system size, configuration and performance. The information is also used to customize energy production estimates which feed into the project financial analysis. During the survey the assessor measures and analyzes site conditions including:

- The amount of sunlight and shading received by the site—its solar access
- The site's proximity and access to electric grid infrastructure
- The site's physical properties such as total area, grade, orientation and soil type

A site's solar access is the ratio of the site's available insolation with shading to the insolation in the absence of shading. More simply put, it is the amount of solar resource

Advanced Energy Systems used the Solmetric SunEye to determine current and potential sky view obstructions on the Solar Highway Demonstration Project site. Note the trees and interchange light pole that would shade the solar PV system at certain times.



available after accounting for shading losses. The site evaluator will use a specialized site analysis instrument, such as the Solmetric SunEye (see photo on previous page) to take a series of measurements at various positions across the site in order to identify potential shading obstructions.

Total Solar Resource Fraction

The evaluator will also take into account any loss of insolation due to less than optimal tilt and orientation to produce a metric called a Total Solar Resource Fraction (TSRF). Some financial incentives require that projects meet a minimum threshold and the higher the ratio the better. The minimum TSRF appropriate for any given location will be a function of project costs, utility rates and total insolation, but as a general rule projects should have a TSRF not less than 75%.

Requirements for grid interconnection

The site analysis should also include documentation of potential points of grid interconnection and the characteristics of the adjacent distribution system. This is necessary to determine what type of interconnection equipment may be required and what, if any, hardware upgrades on the utility side of the point of interconnection may be required.

Site physical properties

In addition to evaluating a site's solar resource and requirements for grid interconnection, the onsite analysis should also note the approximate acreage with suitable solar orientation and slope. This information will be used to preliminarily determine the size and configuration of an array. Information about slope and soil type can be used to ascertain the appropriate type of mounting and racking system for the installation.

Other factors that should be considered during the onsite evaluation include site access for construction and maintenance equipment and safety and security requirements.

Estimate of system size and cost

The evaluator should be asked to provide a rough scale estimate of the potential system size and cost. When working with the solar PV professional it should be made clear that this estimate is not a request for a formal development proposal but simply a professional opinion about the site's technical potential.

Trees versus solar

Many right-of-way sites considered for solar development projects contain sky view obstructions such as interchange light poles and trees. The shading effects of these obstructions, and specifically trees, on solar panels can negatively impact the performance of a system depending on the number of trees, stage of the tree's growth (typically, the younger the tree, the more effective the carbon sequestration potential), path of the sun and the amount and time period of the shading.

Yet trees provide many benefits, including habitat for wildlife, aesthetics and carbon sequestration raising questions about the trade-offs between removing trees and maximizing the efficiency of a photovoltaic system.

The relative benefit of removing trees to enhance electricity production from a photovoltaic system in terms of greenhouse gas (GHG) impacts depends on a number of factors including the carbon intensity of the electricity the system displaces, the decrease in system productivity from the shading and the type and quantity of trees in questions.

However in most cases, the amount of GHG emissions displaced by the photovoltaic system will exceed the carbon sequestered by the trees.

In any event it is a good idea to repurpose any felled trees as mulch or aquatic habitat enhancement and replant a similar number and type of trees in another location.

Context sensitivity screening

The feasibility assessment should also consider the site's natural, economic, cultural and community attributes and inventory potential issues and concerns.

A context sensitive approach requires the early involvement and input of project stakeholders in order to facilitate information and knowledge sharing about the site's environmental, cultural and community context. This early engagement provides the opportunity to deepen the project team's understanding of the challenges and opportunities associated with a potential project.

Depending on the scale of the project, this can be accomplished through interviews with residents neighboring the proposed solar site and with neighborhood and community thought leaders, or through a more structured public involvement and engagement process. By identifying any community issues early and scaling them appropriately, the project team can avoid conflicts that may result in unanticipated costs and schedule delays. This early engagement will help frame up a future, larger public involvement and communications plan.

Preliminary environmental screening

The results of the context sensitive screening should feed into a preliminary environmental screening. The purpose of this screening is to review existing site conditions, identify topic areas requiring further study and inform decision makers about potential environmental and social issues and constraints.

The conduct of this screening should follow the transportation agency's established policies and procedures for complying with federal, state and local environmental and land use laws.

The discussion below reviews the issues typically considered in this type of screening.

Biodiversity and habitat

Project managers should consult with professional biologists to identify any habitat or wildlife concerns including the presence of any sensitive, threatened or endangered species (both flora and fauna) in the project area. This should include an onsite survey and a review of

To evaluate the potential impacts to scenic and visual resources from the proposed Solar Highway Project in West Linn, OR, ODOT produced renderings to illustrate the before and after affects of the project.

natural resources databases. The biologist should prepare the appropriate documentation to substantiate their analysis.

Water Resources

Project managers should consult with agency or consultant water quality wetlands specialists to determine if water resources are present within the project area and evaluate potential impacts. Water resources include groundwater, rivers, lakes, streams and wetlands. This review should include examination of the soil survey and wetland maps and if necessary, a delineation study. The specialist should also help identify if any stormwater management or erosion control measures will be necessary. The specialist should explain their analysis with a written report.

Hazardous materials

Project managers should consult with an appropriate agency or consultant staff to check for the presence of hazardous materials such as lead-based paints, asbestos, underground storage tanks or contaminated soils in the project vicinity. This evaluation should include historical land use research, property owner/ manager interviews, an environmental records review and site reconnaissance. The evaluator should prepare a written record of their findings.

Local Land Use

The project team should determine if the project will be consistent with existing zoning and land use regulations or if the project would require any plan amendments or exception. This is achieved through review of state and local land use plans and maps and consulting with local jurisdiction planners. An assessment should be done to determine whether the project will have an impact on surrounding land uses.

Solar PV systems in highway right-of-way are a novel type of land use for which most local zoning codes do not have specific standards. This causes confusion for local governing jurisdictions, as they try to determine what reviews and approvals are required. This can result in added cost or delay to the project.

If the local jurisdiction decides the project is an outright permitted use, consider asking for a higher level of review that includes public notice and participation. Ideally if there is time, work with statewide and local jurisdictions to adopt uniform statewide review and approval standards and procedures for solar projects in highway rights-of-way.

Noise

The project team should identify any nearby sensitive noise receptors such as schools, parks and private homes to determine if the project will create a significant increase in noise levels compared to current conditions. The most likely source of potential impacts will be the temporary use of construction equipment. Vegetation removal is perceived as attenuating noise levels, so it should be done with as much sensitivity to noise receptors as possible.

Geology

The project team should consult with a licensed geotechnical engineer to determine if the site presents any geologic hazards. If the area has a history of instability, a formal geotechnical evaluation may be required.

Historical and cultural resources

The project team should work with agency cultural resources specialists to determine the likely existence of any prehistoric or historic resources.

Parks

The project team should investigate if the project would impact any public parks, recreation areas, wildlife and waterfowl refuges or other Department of Transportation Act Section 4(f) resources. Additionally, the project team should determine if any portion of the site was acquired or developed with Land and Water Conservation Act funds (i.e., is the site a Section

6(f) resource?). If impacts to park lands are unavoidable, the project may be subject to the additional scrutiny of a Section 4(f) or Section 6 (f) evaluation.

Scenic and visual resources

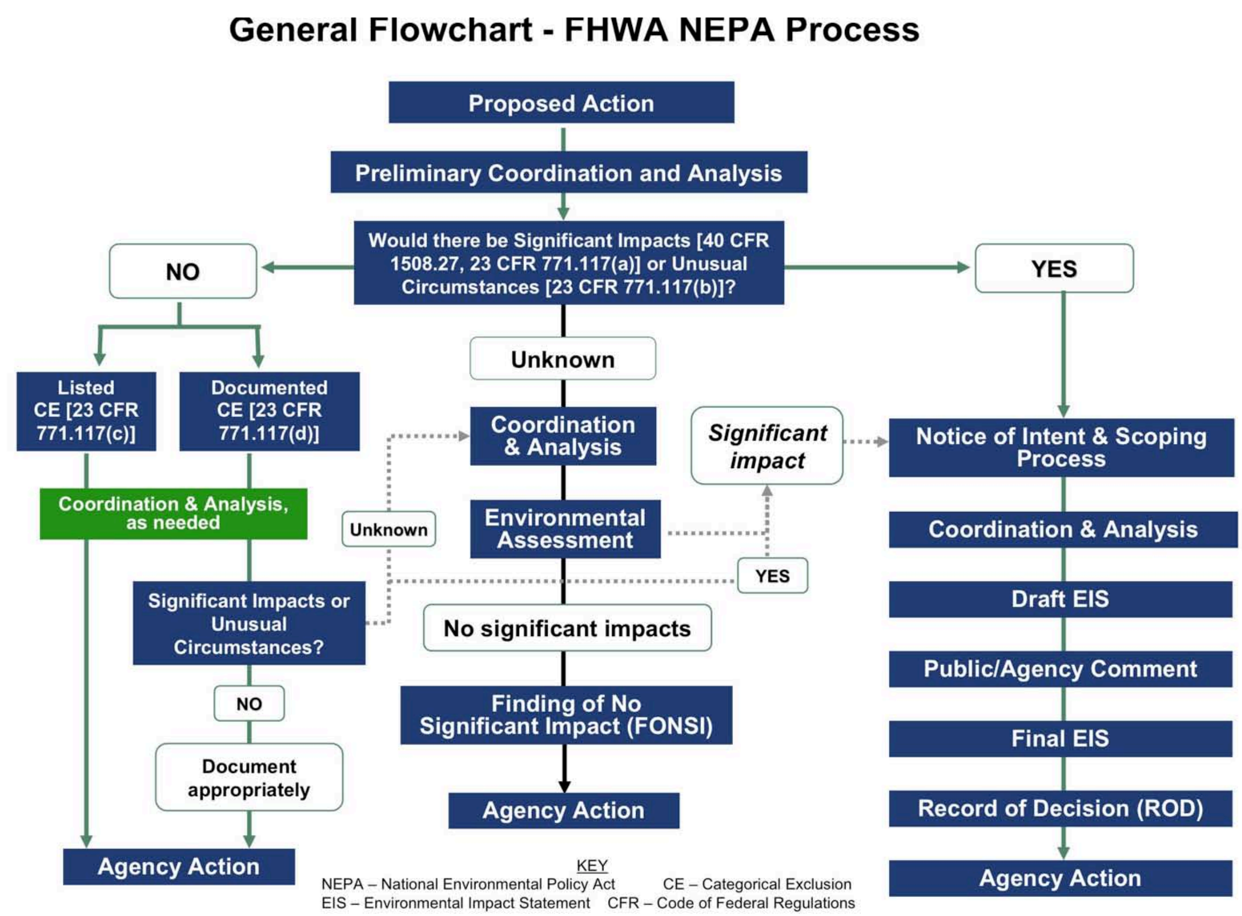
Project managers should also consider whether or not a project would result in changes in the character of scenic resources. Preferably this evaluation should be conducted by a licensed landscape architect and include an inventory of existing visual features from the perspective of viewer groups and an analysis of how proposed project elements may impact these features.

Socioeconomics

The project team should investigate if development at the proposed site would displace any residential, commercial or community structures, adversely impact access to community services, and if these potential impacts would be disproportionately borne by minority and low-income populations. Potential socioeconomic impacts can be determined by analyzing census block-level demographic data of populations in the immediate vicinity of the project.

NEPA requirements

Any project that involves federal funds or impacts a federal resource, including the interstate system right-of-way, triggers the environmental review process required by the National Environmental Policy Act (NEPA). The point at which NEPA requirements should be addressed during the project development process, including notification of the appropriate FHWA Division office, should be



made in consultation with the agency's NEPA compliance manager.

The documentation required to comply with NEPA depends greatly on the site's existing condition and the level of impacts to environmental resources. Projects with minor impacts may be classified as a Categorical Exclusion and require only limited documentation.

However, if a project adversely impacts sensitive environmental resources or attracts significant and valid public opposition it may require the more extensive analysis and documentation required in an Environmental Assessment or Environmental Impact Statement. Given the costs and timelines associated with these more expansive environmental review processes, a project with unknown or significant impacts may not be worth pursuing.

Carbon footprint analysis

Carbon footprints, also known as greenhouse gas (GHG) inventories, can quantify the GHG emissions associated with a project. Project-based carbon footprints should measure the sources of emissions over the full life cycle of the project from design concept through operation and decommissioning.

The analysis should include calculation of the life-cycle emissions associated with construction materials, energy use related to development, transportation of items to and from the site, fuel used to run onsite equipment as well as analysis of any potential mitigation or emissions reduction strategies.

The carbon payback period for the project should be calculated and there should be a substantial net reduction in carbon emissions.

For more information
on carbon footprints visit:
www.oregon.gov/ODOT/HWY/OIPP/docs/

Oregon Solar Highway Program Highlight

A life-cycle GHG analysis was conducted by Good Company, an ODOT contractor, to quantify the net emissions over entire life of three solar highway projects.

The following emissions sources and sinks were considered:

Embodied emissions in goods and services

Emissions associated with the manufacture of PV panels, balance of system components and engineering and professional services.

Tailpipe emissions from transportation

Emissions associated with the combustion of fossil fuel in vehicles and equipment used during construction, operation and maintenance and for worker commute.

Emissions from tree removal

Net emissions from the decomposition of cleared trees as well as the carbon benefit to the soil through composting the trees.

Displaced electricity grid emissions

Carbon benefit associated with the displacement of conventional electricity generation.

Emissions from on-site electricity use

Emissions associated with the use of electrcity from conventional generation resources to power on-site lights and security cameras.

Emissions from project decommissioning

Emissions associated with the deconstruction, demolition, and restoration of the project site as well as the carbon benefit from recycling of PV panels and construction materials at the end of the project's useful life.

Economic analysis

Public agencies have a duty to invest scarce public resources wisely, so before proceeding with a project the project team should complete a thorough financial evaluation. At the most basic level, determining the financial viability of a project is a matter of comparing project expenses and revenues over the life of the project. Established financial metrics can assist decision makers in judging if a proposed project is worth undertaking from a purely economic perspective.

Project life-cycle cost analysis

The analysis of life-cycle project costs should include estimated capital and operation and maintenance (O&M) costs. Capital costs include the direct costs of equipment, labor and materials associated with site development and system installation and commissioning. Capital costs also include indirect costs associated with project development including engineering design, environmental studies and legal and administrative expenses.

O&M costs are those post-construction costs necessary to ensure the continued effectiveness of the system and include things like security and system performance monitoring, system cleaning and if necessary equipment replacement. If the project involves debt financing then the cost of debt service should also be included.

Project revenues

The analysis of project revenues should include project income, the value of utility, state and federal incentives and tax credits, and electricity cost savings. Project income includes revenues generated from the sale of electricity under net metering or a utility generation incentive.

Another potential revenue stream is the sale of renewable energy credits. The value of state and federal incentives include the cash equivalent of federal investment tax credit (or the Section 1603 Renewable Energy Grant in lieu of the ITC), federal accelerated tax depreciation for investments in solar PV and any applicable state or utility incentives. Electricity cost savings is valued as the avoided electricity purchases or the price difference between regular retail rates and the price of electricity under the terms of a power purchase agreement.

Additional factors to consider in an economic evaluation include assumptions about system performance over time (system output will degrade as equipment ages), the future price of electricity, the avoided cost for developing other renewable or nonrenewable energy generation sources and applicable state and federal income tax rates.

Analytical tools

A number of public domain and private party software applications have been developed to assist with economic analysis including the National Renewable Energy Lab's (NREL) System Advisor Model. The NREL model is a powerful tool that can be used to generate estimates of system costs, energy outputs, and cash flows based on user defined factors such as project location, system specifications and financial assumptions.

The SAM model also calculates several financial metrics including net present value, internal rate of return and simple payback. Project partners should also be expected to provide pro formas detailing their understanding of project expenses, cash flows and net revenues.

For more information on NREL's SAM tool visit: http://www.nrel.gov/analysis/sam/

Plan Public Involvement and Communications

A well-crafted public involvement and communications strategy reaches out to, informs and gathers input from project stakeholders and promotes the project among the broader public.

Each project should have an outreach plan that includes: a list of target audiences and stakeholders and their issues or concerns, a clear and compelling project description and case statement, and a description of planned outreach tactics and activities to address concerns. The depth of the plan will depend on where the project site is and the size of the project.

Project stakeholders

The list of target audiences and stakeholders should include:

- Adjacent property owners and neighbors
- Impacted transportation users
- Local officials and decision makers
- Internal agency staff
- Regional and local jurisdictional partners
- Local businesses
- Community civic organizations
- Environmental interest groups

Each stakeholder group will have different perspectives on and questions about a potential project. While compiling the list of groups to communicate with, project managers and public information specialists should try to anticipate and discover these perspectives to craft the core messages in a project case statement.

Project case statement

The case statement should include a description of the project and the agency's motivation and an explanation of project benefits framed around community values and priorities—

ODOT's Lynn Averbeck, speaking to neighboring residents at an open house to share the results of the feasibility analysis for a solar highway project proposed in West Linn.

insight derived from the context sensitive screening activity. It may include addressing environmental benefits, energy independence, job creation and economic development.

Planned outreach to target audiences

The public involvement and communications plan should also list the planned outreach actions. It is important to remember that different outreach tactics will reach different audiences. It is also important to keep in mind that different audiences will respond differently to different messengers.

Outreach tactics might include a combination of unilateral, bilateral and multiparty communication tools. One-way, unilateral tactics like websites, press releases and direct mail are useful for reaching a broad audience with minimal effort.

Two-way, bilateral tactics like one-on-one in-person meetings and phone calls are more time consuming and costly but provide an intimate setting that more readily allows for candid exchanges.

Multiparty tactics like community meetings or online forums can reach broad audiences and can help with project transparency. However, if not managed carefully these approaches can devolve and turn into an opportunity for critics to vent frustrations. The most effective multiparty tactics encourage small group interactions. Examples of these are open houses or project site tours.

Engaging project advocates and critics

Despite broad-based public support for renewable energy, solar PV projects are not exempt from criticism by stakeholders. If not addressed, these criticisms can result in costly delays and may even derail a project. There are a number of techniques that can be deployed in response. The best approach is to proactively mobilize project supporters to share their outlook with other community members.

Once project advocates have been identified, recruited and mobilized, focus should shift to responding to project critics. Outreach should begin with active listening, preferably in a one-on-one or small group setting. Often the critique has less to do with the project and more to do with an individuals' own desire to be consulted on matters affecting their community or neighborhood.

Any misperceptions and misinformation should be corrected with clear and concise informational pieces such as fact sheets, websites, white papers and frequently asked questions (FAQ sheets). Finally, project managers might consider project modifications or mitigations to address real or perceived threats to community interests.

Oregon Solar Highway Program Highlight

Through its public outreach process community members and stakeholders have raised a number of concerns. These included the potential of adverse human health effects related to electromagnetic fields associated with the project, the potential environmental and health hazards associated with the life cycle of solar panels, and the potential for glare from the solar panels impacting driver safety.

ODOT responded to these concerns by commissioning supplemental evaluations and soliciting the opinion of relevant issue experts. In each case, the supplemental analysis yielded no evidence to validate the concerns.

For more information

about the public information papers prepared for ODOT visit: www.oregonsolarhighway.com

Since public agencies cannot generally take advantage of the full range of financial incentives (e.g. federal and state tax credits) available for investments in solar PV systems, it has become increasing common for public agencies interested in such projects to partner with a private sector partner who can.

Public-private partnerships

Under such an arrangement the agency enters into an agreement with a private sector partner, to design, finance, install, own and operate a solar PV system on its property. In addition to agreeing to host the solar PV system, the agency may agree to purchase the electricity generated by the system and if permitted, can also enter into an net metering agreement with its electric utility under which the utility agrees to purchase the electricity generated by the system in excess of the needs of the host agency.

The host agency benefits from this financing structure by avoiding upfront capital investment and ongoing operating and maintenance responsibilities. If the agency agrees to purchase the electricity from the system, it can be done at a long-term, predictable price that often starts out lower than current utility rates.

The private sector partner benefits by receiving revenue from electricity sales, either from the host agency or the electric utility, and by capturing the tax benefits and financial incentives made available from developing the project.

The private sector partner is often a joint enterprise between a solar developer with the expertise to manage the engineering, procurement, construction, maintenance and operation of the system and an investment partner with capital available to finance the project and the tax liability to take advantage of the tax credits and incentives. Because of the involvement of the third-party investment partner (also called a tax equity partner), this business model is commonly referred to as a third-party financing mechanism.

Because public agencies are generally precluded from owning equity in a private enterprise, the host agency typically does not own the system assets. However, there are means, discussed below, for ultimately transferring ownership to the transportation agency if that is desired.

Third party business models

There are three basic variations of the third-party financing mechanism that relate to the dynamics between the developer and the tax equity partner: the partnership flip, sale-lease back, and inverted pass-through lease models.

It is important for the transportation agency to understand these variations as the different approaches can influence the terms of agreements entered into between the agency host and the private sector partner.

Partnership flip model

In the partnership flip model, the private sector solar developer and the investment partner form a special purpose entity (SPE), commonly a limited liability corporation (LLC), incorporated for the sole purpose of developing and owning a particular project. It is with the LLC that the agency enters into agreements to host the system or purchase the electricity the system generates.

While only contributing a nominal share of project equity (as little as 1%), the solar developer is typically the managing member in the LLC—coordinating with the agency host and responsible for arranging the engineering, procurement, construction, maintenance and operation the system. The developer is compensated for their management role and may derive further value though participation in project development and construction.

The investment partner typically plays a passive role in the management of the LLC, but provides a substantive share of project equity (as much as 99%). In exchange, the investment partner receives the majority of the tax credits, incentives and revenue generated through electricity sales.

Once the investment partner has achieved a pre-negotiated return on their investment, the allocation of project benefits and ownership percentages "flips" and begins to accrue substantially to the solar developer (as much as 95%). After the flip, the developer generally has the option of buying out the investment partner's interest in the project and becoming the sole owner of the project. The parameters of the partnership-flip structure must follow guidelines set forth by the Internal Revenue Service.

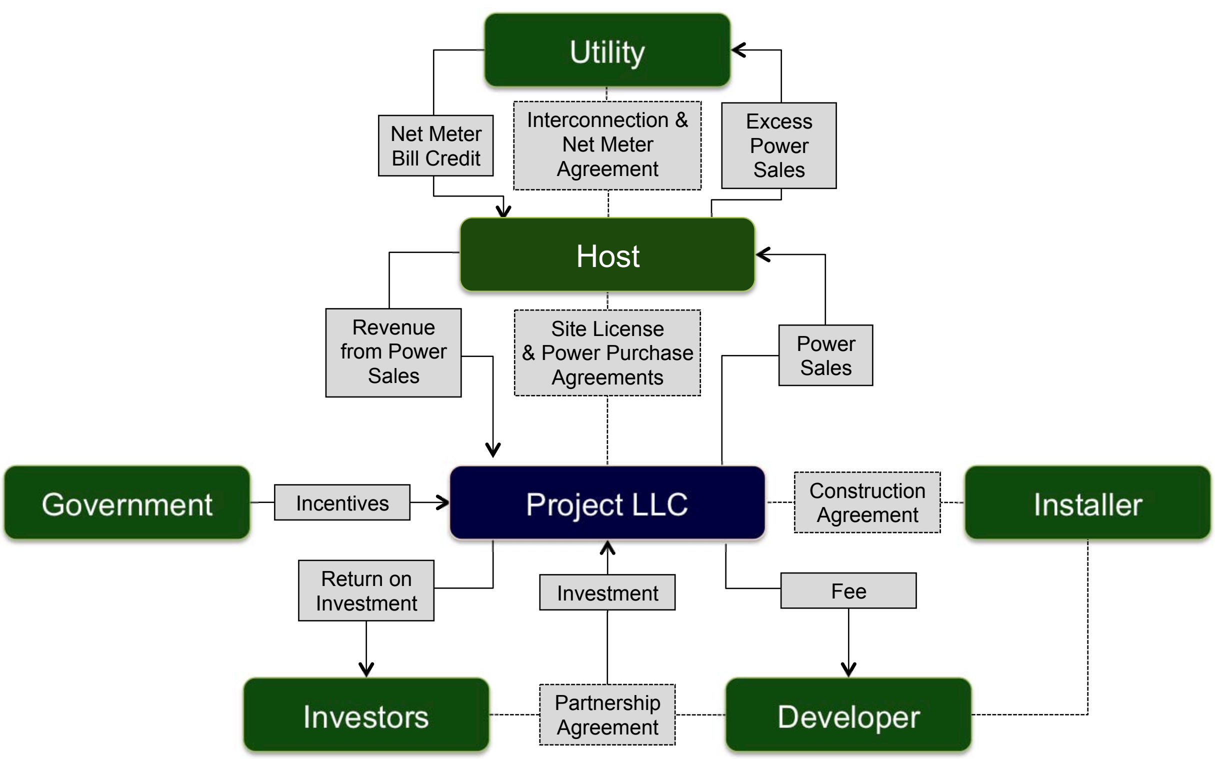
Sale-lease back model

In a sales-lease back business model, the solar developer builds a project and upon completion sells it to an investment partner. The investment partner and the developer, or a special purpose entity created by the developer, then immediately enter into an operating lease.

It is with the developer or the special purpose entity that the agency would enter into agreements with to host the system or purchase the electricity the system generates. The agreements between the agency host and the project developer must be in place prior to project construction.

Under the terms of the lease agreement, the developer-lessee makes periodic fixed payments

Diagram showing agreements, transactions and relationships of parties involved in a partnership-flip with a net metered system.



(i.e., rent) to the investor-lessor for the use of the facility for the term of the agreement. For tax purposes the investor-lessor is considered the owner of the system assets and retains all of the tax benefits associated with the project. The developer-lessee assumes the responsibility for operation and maintenance of the system and typically retains the right to purchase the system, at fair market value, from the investor-lessor at the end of the lease term. The parameters of the lease agreement must follow guidelines set forth in tax and accounting rules.

Pass-through lease

The pass-through lease is similar to the sale-lease back model. The difference is that the lessee and lessor roles are reversed which is why it is sometimes referred to as an inverted lease. In this arrangement, the developer builds the project and then leases it to a tax equity investment partner, or a special-purpose entity (SPE) established by the investment partner. It is with the investment partner or SPE that the agency would enter into agreements to host the system or purchase the electricity the system generates.

Under the terms of the operating lease agreement, the investor-lessee pays rent to the developer-lessor and the developer-lessor elects to pass through a share of the tax benefits to the investor-lessee. In addition to enjoying the tax credits, the investor-lessee can claim the lease payments as a deductible operating expense further reducing their tax liability.

Meanwhile, the developer-lessor retains the tax benefits of accelerated depreciation to shelter the income from the rent payments. Since the developer retains ownership at the end of the

Oregon Solar Highway Program Highlight

The Solar Highway Demonstration Project is essentially structured as a partnership-flip with ODOT's private sector partner, Portland General Electric (PGE), acting as the solar developer. PGE formed an SPE called Sun Way 1, LLC to finance, build, own and maintain the project with U.S. Bancorp acting as the tax equity investor. It is with this SPE that ODOT signed a 25-year PPA and SLA.

For upcoming solar highway projects, ODOT and PGE are pursuing a different approach. Rather than a partnership-flip, PGE is seeking to utilize the sale-lease back business model. PGE would still create an SPE to finance, build and maintain the project but project ownership would rest with a tax equity investor who would in turn lease the project back to the SPE.

The SPE would in turn enter into an off-take agreement with PGE, acting as the electric utility, to purchase the electricity generated by the project.

In exchange for granting the SPE an SLA to install the project on agency property, ODOT negotiated for a share of the renewable energy credits (RECs) generated by the project. Even though it is not purchasing electricity directly generated by the system, by owning a share of the RECs, ODOT can still legitimately claim that it is using a portion of the renewable energy generated to address the agency's power demands.

For more information

on the business models available to public agencies see NREL report *Solar Photovoltaic Financing: Deployment on Public Property by State and Local Governments* at: http://www.nrel.gov/docs/fy08osti/43115.pdf lease term, control of the system reverts back to the developer without any additional outlays. The parameters of the agreement must follow guidelines set forth in tax and accounting rules.

Agency-utility agreements

The net metering and interconnection agreement is the contract between the agency host and the electric utility serving the agency that allows the agency to connect the photovoltaic system with the utility's electric distribution network. The net metering agreement allows the agency host to "net" (count) the system's energy production against its utility bill at rates established by the utility and subject to utility commission approval.

Third party agreements

There are two primary agreements an agency may enter into with a third-party developer: a Power Purchase Agreement (PPA) and a Site License Agreement (SLA). Because of the interrelationship between the agreements, the SLA is commonly an exhibit within the PPA and the duration of the SLA will mirror the duration of the PPA.

The PPA is an agreement between the agency and the project developer or an SPE that owns or leases the system for the agency to purchase the electricity generated by the system for a specified period of time.

The SLA is a separate land use agreement that grants the solar developer or an SPE the right to install and operate the system on agency property. It should be noted that these types of agreements are also referred to in the marketplace as "site lease agreements" although for tax purposes they are considered service agreements. Notably the characterization of a land-use agreement as a "lease" may trigger the fair market value provisions of FHWA's air-space lease rules and raise other potential legal complications.

Utility offtake agreements

If an electric utility is acting as a partner in project development it may not be necessary for the agency to enter into a PPA with the project developer. Instead the utility itself may enter into a PPA, or offtake agreement, with the project developer or SPE to purchase the electricity generated by the system. However, this approach has both advantages and disadvantages.

On the upside, it removes the agency as a party to complicated contractual negotiations and absolves the agency from conducting due diligence over at least one financial aspect of the project—what is a fair price to pay for the electricity generated by the system. This can result in a substantial reduction in legal and transaction costs for the agency.

On the downside, by eliminating the agency as an end purchaser of the electricity produced by the system, communication about the agency's role in the project and its ability to demonstrate that the project is serving a transportation need, a legal requirement for many DOTs, becomes more complicated.

PPA and SLA terms and conditions

Some of the common terms and conditions found in PPAs and SLAs are discussed below.

Obligation to purchase power

The PPA commonly establishes an obligation for the system host to purchase 100% of the electricity produced from the solar project and the point of interconnection with the host agency's electric system. This obligation to pay for the all of the output of the system is made without regard to whether production might exceed the host's energy consumption or whether any excess production might exceed the amounts allowable under the host's net metering agreement with the utility.

The PPA commonly establishes an obligation for the system host to purchase 100% of the electricity produced from the solar project at the point of utility interconnection.

In order to measure the amount of electricity delivered to the host, most PPAs include provisions that require the system owner to install, maintain and test electrical meters at the point of utility interconnection.

Invoice and billing procedures are also detailed in the PPA with the most common arrangement being a monthly invoice detailing the quantity of electricity delivered and the amount due.

Obligation to produce power

The corollary to the obligation to purchase power is the system owner's obligation to produce power. It is prudent to include in the agreement provisions that clearly articulate the expectations that the project will produce electricity, establish timeframes for remedial action and define outcomes for failure to perform.

A system owner typically is not willing to commit to a specific level of output although such assurances are not unreasonable. If offered, any guaranties will likely be tied to a manufacturer's warranty and will likely reflect an assumption that system output will decrease over time.

Power purchase rates

The pricing regime for the electricity generated by the project can take a variety of forms. A common arrangement is for the initial price to be set on par or below current market rates with a modest annual escalator.

In evaluating the pricing conditions, it is important to consider the relative costs to the agency under the terms of the PPA versus the otherwise applicable utility tariff. This can be done by computing the present value of electricity purchases under the PPA, including any price escalator, and comparing that to the present value of electricity purchases under the utility tariff including an assumption about future rate changes.

Historically, electricity prices have escalated at a rate comparable to inflation and most utility experts expect that trend to continue. However, there is some risk in the inherent uncertainty of future electricity prices that the agency must weigh carefully.

It is important to keep in mind that costs imposed on the solar developer by the agreements may be ultimately reflected in higher rates per kilowatt-hour paid by the agency via the PPA. For that reason, an agency will want to carefully consider costs imposed by the agreements and make a prudent business decision that thoughtfully considers risks and benefits.

Duration

The agreements must be of sufficient length to ensure the financial viability of the project. While the term of the agreements can last as few as six years (the minimum time period in which tax benefits can be realized), more typically the term extends over a longer period of 20 years or more. The agreements may also include an option to renew and extend the agreement beyond the initial term. As discussed below, the agreements will also include provisions for early termination if certain events occur.

Termination for default

The PPA commonly lists events where the action or inaction of either party could jeopardize the project. Since often these circumstances are remediable, the PPA will include an opportunity for the party in default to correct or "cure" any such failure within a specified amount of time. If the party in default does not cure the condition causing the default, then the other party can provide notice of their intent to terminate the agreement. Some events of default may be considered incurable and allow for immediate termination rights.

If the agreement is terminated, the defaulting party incurs the financial liability for termination costs. For the system owner, those termination costs are generally defined by the project removal and site restoration costs apart from any other damage or liabilities incurred due to negligence. For the state agency, the termination costs could be considerably greater because it is the developer that has incurred the substantial financial liability to design, engineer, construct and install, own, operate and maintain the system. Agency default could put at risk the tax benefits the developer relied upon to arrange system financing. For this reason, the system owner may argue for a Termination Fee Schedule substantial enough to serve as a significant disincentive to agency termination.

Termination for official purpose

The agreement should provide terms under which the transportation agency may terminate the agreement in whole or in part for public or highway safety purposes or any other official transportation purpose. If the agency needs to exercise such a provision, it should compensate the developer.

This provision is notable in that it provides specific recognition that the primary reason a state agency has a facility or property is not necessarily to serve as a platform for the solar PV system. The agency may have an obligation to use the facility or property for a higher and better use as defined by the public interest the agency represents. While such provisions are not common in PPAs, it is intended to recognize that higher potential public obligation.

Force majeure

In addition to including provisions for fault or negligence, the PPA may also contain provisions to address circumstances beyond the reasonable control of the parties. This is for events of a "Force Majeure." The purpose of these provisions is to limit the liability either party related to any delay related to the force majeure event.

Performance guarantee

Because solar developers often form limited liability companies specific to the project, the agency may seek a performance guarantee. Such performance guarantees are not necessarily common, but may be prudent. However, requiring a performance bond or letters of credit will likely result in significant additional costs to the developer who will try to recoup those costs through higher PPA power prices. An alternative is to include a provision that allows the agency to reach through the SPE to a managing partner or some other guarantor.

Operations and maintenance

The PPA typically assigns all responsibilities for operations and maintenance (O&M) to the project owner. The agency incurs no cost for O&M unless it expressly agrees to perform certain actions specific to the project such as mitigating shading via tree trimming.

Security, emergency notification and access

The agreements assign responsibility for security of the project and any losses that may arise to the third-party. The agency and developer may choose to cooperatively provide notice to each other and law enforcement personnel of any issues that may arise. The agreements should establish protocols and procedures for such emergency notification as well for site accesses at all hours of the year.

Additionally, it may be prudent to include a requirement that the system owner provide training to agency maintenance staff and emergency responders to ensure common understanding of access shutdown and related procedures.

Warranties, manuals, and as-built drawings

The agreements commonly provide for the agency to receive all applicable manuals, as-built drawings and warranties. These are not incidental requirements should the agency ever have a need or an interest in operating the system. Similarly, the warranties should be key considerations in evaluating the underlying risk associated with the project. Even if the agency has no interest in ever operating or maintaining the system, there is a potential perceptible cost to the agency of having entered into an agreement for a highly visible project that does not work properly or at all.

Permit and licenses

The agreements require the project developer to secure all permits and licenses and prepare all requisite applications and associated documents required to secure these permits. While it is reasonable to assign responsibility to the developer for obtaining construction related permits, responsibility for site clearance related approvals should remain with the transportation agency including Section 4(f)/6(f) approval and Clean Water Act certification or wetlands permits.

Environmental attributes

The agreement should be explicit about the ownership of any environmental attributes associated with the project including Renewable Energy Certificates. Typically, those attributes belong to the project owner but this understanding should be clear in the agreements to prevent any misunderstanding.

Changes in corporate structure

As discussed above, the arrangement between solar developer and investment partner may conceive of changes in the business arrangement such as the investment partner relinquishing its interest in the project after the tax benefits have been derived. The agreements between the private sector partner and the agency host may recognize and allow potential changes in corporate structure, but commonly require the agency's prior approval.

Transfer of ownership to agency host

Since not all private sector partners will be interested in long-term system ownership, the agreements may include provisions to transfer project ownership to the host agency at predetermined points prior to the end of the agreement term. This transfer typically involves the agency paying fair market value for the system and the termination of the third-party agreements.

As a variation, the private sector partner or another entity could retain responsibility for operating and maintaining the system following an ownership transfer to the agency host. This arrangement could be incorporated into the original or successor agreement.

The advantage of owning the system is the agency does not have to pay for the power produced. If an owner has not signed an O&M contract, however, then that owner is responsible for the O&M costs. At the end of the PPA contract, the agency could purchase the system for fair market value, extend the PPA if allowed, issue a follow-on RFP, have the contractor abandon the system in place or have the contractor remove the system.

Benefit nexus

The agreements should acknowledge that electricity produced from the project has a connection to the transportation system.

Liability and insurance

In simple terms, the liabilities associated with a project of state-owned property are no different than those associated with other non-state-owned equipment on state-owned property. The special purpose entity is responsible for all equipment-based liabilities arising out of its use of the site, while the host agency is responsible for all property-based liabilities arising out of its use on the site. Therefore one party could be liable for losses incurred by the other, however, the agreements generally exclude consequential damages.

The agreement may also require the project developer to carry general liability or property insurance as necessary to cover personal injury claims or losses caused by property damage ,casualty, theft, etc.

Project removal and site restoration

Project removal and site restoration can optionally be borne by either the developer or the state agency. For example, the third-party developer could be liable under “failure to perform” or “end of term” provisions or the state agency could be liable if the agency exercises early termination provisions.

The scope of project removal and restoration is worth careful consideration and the agency host should include the level of financial assurance necessary to cover those costs in the event the developer fails to perform the work. Abandonment is an issue inherent in assessing this risk and determining needed financial assurance and may be expressly addressed in the agreements.

At a certain point in the agreement term, the third-party developer may find that it is so costly to repair or replace essential equipment relative to the value of remaining revenue streams that it does nothing and walks away from the project. Some agreements have incorporated provisions that allow the project to be declared "abandoned" after some reasonable period of time and due notice of failure to take corrective action. Such provisions may be exercised in addition to the financial assurance or in place of that assurance if the assurance is not honored.

The agency then acquires the right to dispose of the array and use whatever salvage value might be received to fulfill the remove and restore provisions which may include repairing the system for continued operation or another purpose the agency may consider appropriate.

The agreement may or may not assure the developer of some share of the economic value once the system has been declared abandoned but most do not. The opinion is that the salvage value of the system would exceed the project removal and restoration costs. The abandonment provisions then becomes an additional layer of financial assurance.

For more information

about the terms and conditions in project agreements or to request a copy of ODOT’s agreements visit: www.oregonsolarhighway.com

Identify and Select a Solar Developer

Differentiating among and evaluating the approach of candidate development teams can be facilitated through the use of standard procurement tools such as a Request for Information, a Request for Qualifications or a Request for Proposals.

Request for information

Issuing a Request for Information (RFI) is a useful strategy for obtaining feedback about a proposed project approach and understanding about the current state of the marketplace. An RFI is typically structured as a series of questions to which interested parties respond. This approach can be particularly helpful in identifying private sector perspectives on state-specific financial and regulatory barriers.

Request for qualifications

Issuing a Request for Qualifications (RFQ) can be used to generate a short list of solar developers interested in working with the transportation agency that meet a set of desired qualifications. Items to consider in an RFQ include:

- Previous project experience
- Required licenses and certifications
- References for the same or similar work
- Financial statements
- Résumés of principal and key staff members
- Sample service contracts

Request for proposals

Issuing a Request for Proposals (RFP) is the final step in selecting a solar developer in which to partner. When issuing an RFP, it is vital to articulate a clear and viable scope of work. Often an RFP is issued only after completion of preliminary site screening and identification of potential project locations.

The form and detail of a project development scope of work in an RFP depends in large part on the ownership and financial model.

Suggested content for RFP

The discussion below focuses on the issues that should be addressed with an RFP for a project developed using a third-party PPA financing

Oregon Solar Highway Program Highlight

ODOT issued an RFI early on in the development of the Oregon Solar Highway Program seeking information from interested parties about the prospects for developing solar projects in the highway right-of-way to be financed by private sector partners.

The information collected through this process confirmed that pursuit of a solar highway demonstration project was reasonable. Notably, ODOT did not use standard procurement methods to select a private sector partner.

Rather, ODOT made use of the unique authority granted by the state legislature through the Oregon Innovative Partnerships Program to directly enter into an agreement with Portland General Electric (PGE), the state's largest electric utility, to establish a public-private partnership.

ODOT and PGE signed a memorandum of understanding establishing the basic terms and conditions under which PGE would finance, construct and maintain the demonstration project and sell the electricity to ODOT. The MOU was later followed by the legally binding SLA and PPA.

mechanism, although many of the same issues would arise with other financing mechanisms including:

- Site conditions
- System requirements
- Sustainability performance criteria
- Additional requirements such as warranties
- Conceptual design
- Energy performance analysis
- PPA and SLA terms

Site conditions

This section should include a brief site description and any other pertinent site conditions that will assist a developer in preparing an informed response. This information should be collected during the preliminary site evaluation process. The type of site conditions that should be provided includes:

- Location and site description including total acreage, topography, access and solar exposure; include copies of maps and aerial images
- Discussion of environmental conditions including copies of wetlands delineations, soil and geotechnical studies and other sensitive resources in proximity to the site
- Point of grid interconnection and utility interconnection information
- Electricity bill information including the last two years monthly electricity consumption in kilowatt-hours if the project is to be net-metered; If the project will offset electricity consumption from multiple billing meters, then include the monthly sum of usage of the aggregated meters and the utility billing codes associated with those meters

System requirements

This section of the RFP should reflect the transportation agency's expectations regarding the type, scale and performance expectations of various system components. The system requirements should be outcome based (e.g. photovoltaic module power warranty guarantees minimum performance rating of 90% in the first ten years) but not be so restrictive so as to limit a developer's ability to propose a system that is most economical based on their experience. Examples of the types of system specifications that may be reflected in an RFP include:

- Minimum photovoltaic module and power inverter warranty and performance requirements
- Photovoltaic module manufacturer end-of-life product stewardship (i.e., recycling)
- Compliance with applicable electrical safety standards and building codes and listing appropriate safety laboratory
- System performance and monitoring expectations
- Site security requirements

Sustainability performance criteria

The performance specifications included in an RFP can be structured to reflect a transportation agency's and state's broader sustainability values. Including value-based performance criteria is an opportunity to translate these values into action. Notably, adopting sustainability-based selection criteria will change the focus of evaluation from least cost to best value.

Examples of sustainability performance criteria include:

- Participation of minority-owned, women-owned, disadvantaged and emerging small businesses
- Life-cycle carbon analysis
- Manufacturer's warranted end-of-useful life product recycling
- Equipment components produced in an ISO 9001/14001 certified facility

- Demonstrated compliance with industry environmental health and safety best-practices
- Local purchasing preferences, as allowed by law
- Preference to goods manufactured with post-consumer recycled content
- Mitigation plans and enhancement strategies to reduce the overall impact of the project

Additional requirements

Often utilities and other incentive providers have additional requirements that system components must meet in order to qualify for the incentive.

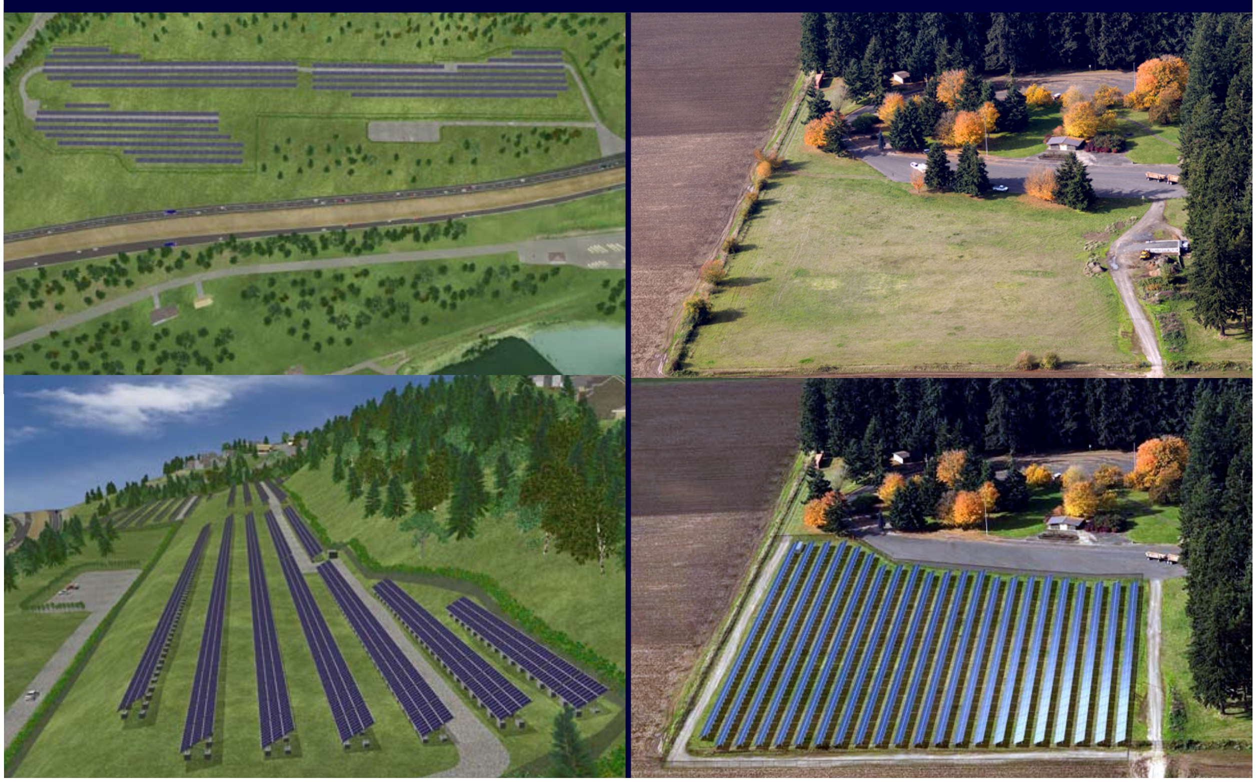
These additional requirements should be incorporated by reference in the RFP. In order to demonstrate compliance with the system requirements, respondents should be asked to provide documentation from the original equipment manufacturer such as data sheets and written warranties.

Conceptual design and renderings

All RFPs should require proposals to include a conceptual design or renderings of the proposed installation including a drawing showing the placement of all equipment and ancillary project elements with a narrative describing the proposed design.

The narrative should list the specific system components along with the technical

Below are sample conceptual designs or renderings completed by Advanced Energy Systems for two of the proposed Solar Highway Program projects: the 3-megawatt West Linn Solar Highway Project (on the left) and the 1.75 megawatt Baldock Rest Area Solar Highway Project (on the right).



characteristics the developer is proposing to utilize.

Energy performance analysis

The RFP should also ask for a detailed energy performance analysis of the proposed system. This should include estimates of monthly projected electricity generation with system degradation factored in over the term of the agreement. The RFP should specify the modeling tool each respondent should use to complete this analysis in order for the agency to have a common point of reference for evaluation.

PPA and SLA terms

It is recommended that preferred PPA and SLA language be included by reference in the RFP, as this affects the proposals submitted by developers. The final form of the draft terms included in the RFP can be negotiated after a successful bid has been accepted, but the draft language is an opportunity for the agency to telegraph project expectations that might not be listed elsewhere in the RFP. For example, the draft PPA and SLA language is an opportunity to set expectations about:

- Project decommissioning and site restoration
- Safety and security
- Insurance, liability and indemnification provisions

When developing draft agreement language, it is essential to consult with agency legal counsel.

Proposal process and evaluation

Care should be taken to ensure that the proposal process and evaluation criteria reflected in the RFP conforms to applicable public contracting rules. Moreover, since these types of projects tend to have high public visibility, it is critical that the procurement process be highly transparent and aligned with the public's sustainability expectations.

To that end, the RFP should define the process and timeline for submitting proposals including attendance at mandatory pre-proposal meetings and site visits. The pre-proposal meeting and site visit are opportunities to present the project to potential developers in detail and allow the developer to assess the site conditions firsthand.

The RFP should also make clear the criteria by which proposals will be evaluated with a scoring matrix. Evaluating proposals on cost effectiveness alone (most likely measured as the difference between the present value of electricity purchases under the terms of the PPA and the present value of power purchases made under regular utility tariffs) may not result in the selection of the project that best reflects the agency's long-term public mission or broader public policy objectives.

Value-based evaluation criteria provides the agency the opportunity to consider multiple performance factors such as product and service quality, environmental attributes and social impact. Under this approach, each factor is weighted to reflect its importance in proposal evaluation. Proposal evaluation criteria might include the proposer's:

- Relevant experience and track record
- Financial stability and ability to demonstrate a commitment from a financial partner
- Utilization of minority-owned, women-owned, disadvantaged and emerging small businesses
- Commitment to environmental stewardship
- Ability to demonstrate the use of components with long-term warranties
- Inclusion of locally sourced materials and labor
- Project management structure and approach

Project Delivery and Implementation

Once a private sector partner is selected and project agreements are successfully negotiated and executed, the agency's role becomes one primarily of coordination, facilitation and quality control. While on paper the DOT's primary responsibility is to ensure that the project developer faithfully executes the terms and conditions of the PPA and SLA, it is not uncommon for the agency to take on a more collaborative and problem solving role. The agency should be prepared to be flexible during project delivery, working with the developer to resolve unanticipated events.

Project milestones

Most PPA and SLA agreements establish milestones that commit the parties to accomplish specific tasks by certain dates in order to reach commercial operation. The agreements may specify deadlines for a variety of objectives, but not necessarily all, including:

- Assembly of the project delivery team
- Final design, permitting and utility approval
- Construction and system commissioning
- Commercial operation

Assembly of the project delivery team

The first action the project developer should undertake is to put in place its project delivery team. The delivery team is the set of professionals responsible for the design, engineering, procurement and construction tasks for the project.

The solar developer may contract out for these services or may have its own business line that serves this function. When contracting out, the developer may utilize an engineer-procure-construct firm or consortium that specializes in delivering solar projects or they may assemble the team on an ad hoc basis.

Although it is the responsibility of the developer to assemble the project delivery team, the DOT has an interest in the team's ability to deliver a high quality project. For this reason, the DOT may require the developer to provide evidence of their own or their subcontractors' qualifications, licensing, insurance certification and evidence of compliance with applicable state or federal requirements.

If state or federal dollars, other than tax incentives, are used to fund a portion of the work, the DOT's existing subcontractor approval rules may apply.

Final design and permitting

Once the project delivery team is in place, the next step is to finalize design and engineering plans. The final plans should include schematics and drawings showing the placement of all equipment and ancillary project elements and include the stamp and seal of a licensed professional engineer.

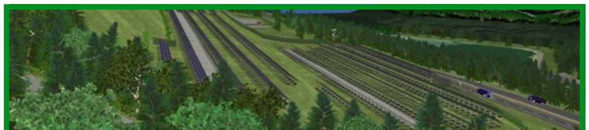
The final plans should also include a traffic control plan that addresses temporary construction and project maintenance-related site access.

At this stage, the developer should also begin to seek out the necessary approvals and permits. While the developer has the primary responsibility for preparing applications and obtaining all construction permits, the DOT should be prepared to provide reasonable assistance.

The project agreements should provide the host agency with a reasonable period of time to review and approve the applications and documents prior to their submittal.

Commonly required approvals and permits include:

- Electrical and/or construction permit from the local jurisdiction
- Land use approvals and design review permits
- Utility interconnection approval
- Construction stormwater permit
- Utility accommodation permit or air-space lease



Oregon Solar Highway Program Highlight

SolarWay supported ODOT and PGE as the project delivery team for the Oregon Solar Highway Demonstration Project. SolarWay is a "turn-key" solar energy EPC (engineer/procure/construct) consortium of companies—Aadland Evans Constructors, Moyano Leadership Group, Advanced Energy Systems and Good Company—that are active in Oregon's renewable energy industry.

Together, SolarWay member companies provided the integrated technology, construction and project delivery expertise required to assess all aspects of solar PV development for the Solar Highway Program. This included planning, permitting, design, construction, solar analysis, utility interconnection, ground-mounted security, intrusion detection and all other aspects of project development that influence project viability.

SolarWay supported ODOT and PGE in developing an effective, comprehensive program delivery strategy that maximized the benefits of current tax incentives, grants and market conditions, opportunities and relationships.

The project agreements should include a provision that allows for the DOT to review and comment on design and construction submittals prior to the commencement of any construction work.

Construction

After the DOT has approved the final plans and concurs that all permitting requirements have been satisfied, the agency may issue a "Notice to Proceed," authorizing the developer to start construction.

During construction, the DOT will need to coordinate the timing of the work so that it does not interfere with critical transportation functions or miss critical deadlines.

The construction phase activities include:

- Materials procurement
- Mobilization
- Site preparation
- Constructing foundations and support structures
- Assembling and mounting solar PV modules
- Installing power inverters and electrical systems
- Erecting security fencing and installing security systems
- Restoring and enhancing impacted areas

Commissioning

Once construction is complete, the developer or their designee will commission the system. Commissioning is the developer's final quality check to make certain the system is structurally sound and free of any deficiencies in materials or workmanship.

Commissioning also confirms that the system's electrical installation is compliant with applicable electrical codes and standards and properly labeled. Finally, commissioning determines if the system performs as expected by activating the system and verifying it operates within acceptable limits. While the commissioning of the system is the responsibility of the developer, the DOT has an interest in how well it performs since the project is hosted on agency property. The developer should notify the DOT of any issues raised during commissioning and the steps taken to resolve those issues.

When the developer is satisfied that the system is operable and that they have substantially completed the construction of the project, they should issue a final commissioning report to the DOT.

Commercial operation and close-out

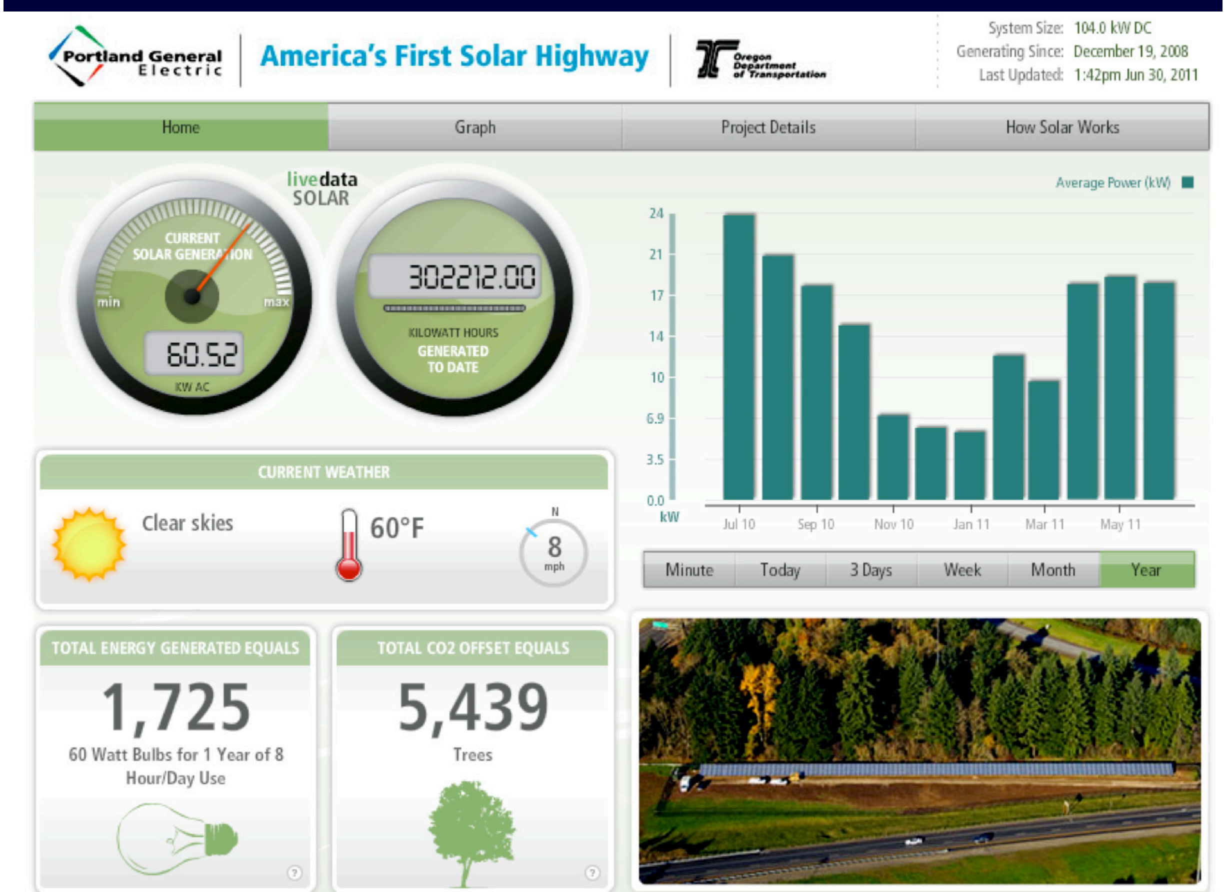
Once the developer has finalized the project commissioning, and the electric utility authorizes it, the system can commence operation and begin delivering energy to the electric grid. Once the system is in operation, the DOT should work with the developer to prepare a punch list of any work that may remain.

When these tasks are complete the developer should submit a letter certifying the final completion of the project.

Maintenance and monitoring

Maintenance and monitoring are also the responsibility of the solar developer. The maintenance requirements for grid-connected solar PV systems are minimal and typically limited to an annual inspection. The DOT may

ODOT and PGE provide live 24-7 monitoring of the solar generation for the Oregon Solar Highway Demonstration Project using a DECK Monitoring System. A live feed of this information is provided on both the ODOT and PGE websites.



request that the developer provide copies of these annual onsite inspections.

During the annual inspection, the developer or their designee will:

- Check electrical systems for signs of damage or corrosion
- Examine the solar PV array and mounting system for structural integrity
- Take readings of electric system to ensure they are within normal operating ranges
- Clean the array to remove any accumulation of dust, dirt or other debris

System monitoring occurs remotely via meter and sensors installed at the project and connected to the Internet. The developer will monitor a number of parameters in order to refine and improve system performance or identify needed repairs.

The developer should provide the DOT regular access to performance data including system output and efficiency. This data should be available through a software platform shared through the DOT's website.

Ongoing public communication

The innovative nature of these types of projects will likely generate substantial public interest and curiosity. The DOT should be prepared to respond to numerous requests for information about the project from the media, policy makers, professional peers, educators, other solar developers and the general public.

At a minimum the DOT should create a website that explains the rationale for the project and provides periodic updates on the progress of the project.

In addition, the DOT should develop a plan and policy for responding to requests for site tours. The ability to grant site tours is largely a function of the ability to provide safe access for both visitors and the traveling public. As an alternative, the DOT might consider developing educational kiosks that can offer a virtual project tour.

ODOT maintains a website to provide ongoing project information on the Solar Highway Demonstration Project and future solar PV development plans for the Solar Highway Program.

Feasibility and Implementation Checklist

Feasibility and Implementation Checklist

Program Development

1. Gain agency support

Confirm the program is consistent with agency goals and has the support of agency leadership.

- **List policy and planning frameworks that validate program**

2. Identify project manager and champion

Designate a person responsible for building program with proven leadership and entrepreneurial skills.

- **List staff responsible for project**

3. Research state-specific policy context

Build understanding of state-specific policy landscape for renewable energy development.

- **List status and scale of the following financial incentives**
  - State tax credits
  - State rebate and grants
  - Sales and property tax exemptions
- **List status of the following regulatory issues**
  - Renewable Portfolio Standard and any requirement for solar
  - Net metering
  - 3rd-party power purchase agreements

4. Coordinate with FHWA District Office

Work with FHWA district office to evaluate permitting options for projects.

- **Determine permitting framework—Utility Accommodation or Airspace Lease**

5. Assemble a Project Team

Assess technical assistance needs and identify public and private sector partners.

- **List partners to provide the following areas of expertise**
  - Context sensitive site selection
  - Environmental impact analysis
  - Utility policy and regulation
  - Solar PV design and engineering
  - Incentives and financing structures
  - Legal issues
  - Contracting and procurement
  - Public involvement and marketing
  - Right-of-way

6. Identify & Prioritize Candidate Sites

Identify a list of potential project sites that warrant further scrutiny with an initial focus on a particular region or utility service territory.

- **Screen for solar energy generation potential**

  Focus on sites with good southern exposure and without topographic or vegetative shading.

Screen for current and future conflicting uses

Outside of highway clear zone for current and future alignments and avoid sensitive environmental resources or cultural resources.

Screen for land requirements

Focus on sites ≤ 5 acres such as wayside information centers and rest areas, interchanges, inactive or abandoned weigh stations, rest areas or maintenance yards.

The best sites will have minimal slope (less than 5%) and feature cohesive soils and avoid natural hazard zones, flood and landslide areas.

Screen for access to the electric grid

Focus on sites within 1/2 mile of an electric distribution grid that can accommodate a three-phase interconnection.

Screen for safe construction and maintenance access

Focus on sites with construction and maintenance access via existing infrastructure and ideally from non-interstate roadways.

7. Assess Candidate Site Feasibility

Conduct in-depth site-specific evaluations of the feasibility of proceeding with a project at a particular site.

Conduct an on-site solar resource evaluation

Have a solar PV professional:

- Calculate site's solar access
- Determine technical requirements and/or obstacles to interconnection
- Evaluate array mounting options
- Provide estimate of potential system size and cost

Conduct context sensitive screening

Consider the site's natural, economic, cultural and community attributes to ensure a project fits with the surrounding natural and built environments. Compile an inventory of potential issues and concerns and mitigation strategies that can serve as the basis for building community support and acceptance.

Conduct preliminary environmental screening

Review existing site conditions for potential environmental constraints and identify topic areas requiring further study.

Focus on sites likely to be classified as a Categorical Exclusion. Projects with unknown or significant impacts will require more in-depth NEPA-compliant environmental reviews.

Address issues related to:

- Biodiversity and habitat
- Water resources
- Hazardous materials
- Local land use
- Noise
- Geology
- Historical and cultural resources
- Parks
- Scenic and visual resources
- Socioeconomics

Conduct preliminary economic analysis

Compare project expenses and revenues to calculate a savings to investment ratio (SIR) or simple payback period. The goal of the analysis is to get a sense of scale of project costs and returns. The cost-effectiveness of a given project is highly dependent on local electricity prices and financial incentives.

8. Public Involvement & Communication

Conduct public outreach to inform and gather input from project stakeholders while promoting the project among the broader public.

Compile list of target audiences and stakeholders

- Adjacent property owners and neighbors
- Impacted transportation users
- Local officials and decision makers
- Internal agency staff
- Regional & local jurisdictional partners
- Local businesses
- Community and civic organizations
- Environmental interest groups

Develop a clear and compelling project description and case statement

Develop a description of the project, the agency's motivation and an explanation of project benefits framed around community values and priorities.

Execute outreach activities and respond to community issues or concerns

Outreach should begin with active listening, preferably in a one-on-one or small group setting. Outreach activities should target both project advocates potential project critics.

Address any issues or concerns with clear and concise informational pieces such as fact sheets, websites, white papers and frequently asked questions.

9. Evaluate Business Models

Take time to research and understand the variations in public-private partnership and business models and the associated agreements. If the agency or state has not previously developed a solar PV project using this approach, consult with agency legal counsel to draft a Power Purchase Agreement and Site License Agreement.

10.Identify & Select a Solar Developer

Seek to differentiate among potential solar developers through standard procurement tools such as Requests for Information, Requests for Qualifications and Requests for Proposals.

Prepare requests for information

Seek feedback about a proposed project approach and understanding about the current state of the marketplace.

Prepare requests for qualifications

Generate short list of developers interested in working with the agency that meet a set of desired qualifications. Items to consider in an RFQ include:

- Previous project experience
- Required licenses and certifications
- References for the same or similar work
- Financial statements
- Résumés of principal and key staff members
- Sample service contracts

Prepare requests for proposals

Articulate a clear and viable scope of work and include discussion of:

- Site conditions
- System requirements
- Sustainability performance criteria
- Additional requirements such as warranties
- Conceptual design
- Energy performance analysis
- PPA and SLA terms
- Process for selecting winning proposal

11. Project Delivery & Implementation

After private sector partner is selected and project agreements are successfully negotiated and executed, the agency's role becomes one primarily of coordination, facilitation and quality control.

Assemble the project delivery team

Review evidence of contractor and subcontractor qualifications, licensing, insurance certification and compliance with state or federal requirements.

Complete final design and permitting

Assist project developer, as needed, in securing necessary approvals and permits. Review and approve the permit applications and documents prior to their submittal. Review and comment on design and construction submittals prior to the commencement of any construction work.

Complete construction

Coordinate timing of work so that it does not interfere with critical transportation functions or miss critical deadlines.

Commission the project and project close-out

Review final commissioning report to ensure project meets specifications and performs as expected. Prepare final punch list of any remaining work.

Maintenance and monitoring

Review annual inspection reports and monitor performance data to ensure system continues to perform as expected.

Ongoing public communication

Respond to requests for information about the project and site tours. At a minimum develop a website that explains the rationale for the project and provides periodic updates on the progress of the project.