

Renewable Energy Generation in the Highway Right-of-Way

FHWA-HEP-16-052



Contents

1. Introduction 2

2. Compatible with U.S. DOT Priorities 2

3. Renewable Energy Highway Projects: Key Information..... 2

4. Potential Business Models 3

5. Federal Regulatory Requirements 5

6. Applicable State Rules, Regulations, and Policies 6

7. Potential Funding Sources 6

8. Examples of Solar Development Programs..... 7

9. Program Checklist for Alternative Uses of the ROW 8

10. Useful Terms 9



1. Introduction

State Departments of Transportation (DOTs) are increasingly exploring the use of highway right-of-way (ROW) to accommodate renewable energy technologies. The ample lands DOTs manage are often close to electrical loads and have sometimes already been disturbed, potentially making these properties ideal locations for renewable energy applications.

Highway ROW renewable energy projects can:

- Add value to ROW assets and create a revenue source for State DOTs to offset energy demand and operating costs.
- Reduce greenhouse gas (GHG) and other pollutant emissions
- Promote energy security by diversifying energy generation and delivery methods
- Foster the creation of a local green job market that enhances the viability of the Nation's renewable energy industry

Currently, solar, wind, and bioenergy technologies offer the most immediate opportunities for generating renewable energy in the ROW. Of these, solar energy has been implemented most to date.

2. Compatible with U.S. DOT Priorities

The implementation of renewable energy technologies is compatible with current U.S. DOT priorities—specifically its goal of finding sustainable ways to address the Nation's transportation needs. As such, the Federal Highway Administration (FHWA) aims to be a leader and work with partners to advance innovation while developing and promoting effective transportation policy.

In response to the increasing number of proposals to use the highway system ROW to accommodate renewable energy facilities, in 2009 FHWA issued [guidance](#) to clarify the applicability of Federal laws and regulations to such proposals.

3. Renewable Energy Highway Projects: Key Information

Renewable energy highway projects can involve installing photovoltaic (PV) cells or wind turbines or planting biomass, within or near highway ROW, and are designed to complement, not compromise, the transportation system.

These projects generally:

- Involve payback periods contingent on credits, government incentives, and energy availability.
- Potentially allow DOTs to purchase green energy at or below grid rates.
- Are currently on the ground along highways at five places in three states, at rest areas and other highway facilities in several states, and in numerous roadway locations internationally.

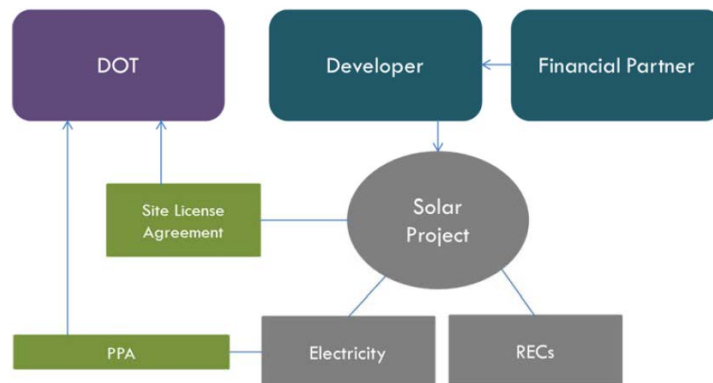


*Oregon Solar Highway Demonstration Project
Photo: Gary Weber, ODOT*

4. Potential Business Models

Federal tax credits and public-private partnerships can complement funds that DOTs appropriate for developing renewable resources with the ROW. Projects to date have utilized the following business models:

- DOT allows a utility or private developer to install and operate a renewable energy facility in the ROW; and the DOT purchases the electricity the system produces. Involves: Lease agreement, PPA, and net metering agreement (see page 6 for more information on net metering)
- DOT allows a utility or private developer to install and operate a renewable energy facility in the ROW; and the DOT does not purchase the electricity the system produces. Involves: Lease agreement
- DOT allows a utility or private developer to install and operate a renewable energy facility in the ROW; and the DOT acquires ownership of the REC associated with the renewable energy generated at the site. Involves: Lease agreement
- DOT owns and operates the renewable energy system. May not involve any ongoing third-party agreements.



Public-Private Partnership—DOT Purchases Electricity

Example Applications

The following table outlines example applications of the use of ROW to accommodate solar energy technologies.

Project	Purpose	Size	Timeframe	Permitting	Business Model
Oregon: I-5/I-205 Interchange Solar Demonstration Project Dec. 2008	Illuminate adjacent interchange	594 panels 104 kW 0.2-acre footprint	~ 1.5 years	Utility permitting process	A utility-managed limited liability company (LLC) owns and operates the facility. Oregon DOT has power purchase agreement to buy the electricity produced at same rate as conventional grid power. The private partners used state and Federal tax credits and state utility incentives to help finance the \$1.28M project.
Ohio: I-280 Veterans Glass City Skyway Bridge Dec. 2010	Test different panels' abilities to offset demand & operating costs of LED bridge structure.	115.6 kW	-	Research project	Partnership between the Ohio DOT and the University of Toledo. During the research phase, the university operated and maintained system. Now, Ohio DOT has assumed ownership and responsibility. The Ohio DOT received a grant from the Department of Energy to help finance the \$1.5M project.
Oregon: Baldock Safety Rest Area Jan. 2012	Generate/retain Renewable Energy Certificates	6,994 panels 1.75 MW 7-acre footprint	~ 3 years	Utility permitting process	Portland General Electric (PGE) operates and maintains the array under a lease arrangement with Bank of America, which financed and owns the project. The energy goes into the grid to serve PGE customers. Oregon DOT retains portion of Renewable Energy Certificates. The private partners used state and Federal tax credits and state utility incentives to help finance the \$10M project.
Massachusetts: State Route 44 Oct 2012	Power nearby water treatment facility	99 kW 1.26-acre footprint	~ 3.5 years	ROW Use Agreement	Massachusetts DOT granted a 25-year easement to the Town of Carver. The town pays \$880/year to MassDOT to use the land. The solar facility is owned and operated by the developer; the Town of Carver entered into a 20-year power purchase agreement with the utility.
Massachusetts: I-91 District 2 Highway Administration Building Dec 2012	Offset onsite energy demand	325 panels 70 kW with expansion up to 500 kW possible	-	ROW Use Agreement	Public-private partnership in which highway property is leased to contractor for the installation, activation, and operation. MassDOT purchases power directly from contractor at a fixed price for duration of lease.
Massachusetts Solar PV Program	Purchase electricity generated through low, 20-year rate schedule	Various locations	-	ROW Use Agreement	PPP in which highway property is leased to contractor for the installation, activation, and operation. MassDOT purchases power directly from contractor at a fixed price for duration of lease.
Michigan: Solar Canopy at I-96/M-44	Power lighting at interchange and carpool lot	385 panels 96 kW	-	-	MDOT partnered with the U.S. Department of Energy and the Pure Michigan Energy Department to develop and finance the project.
Various States (e.g., FL, HI, MI, MO, NY, and WY)	Solar at rest areas and other highway facilities				

5. Federal Regulatory Requirements

This section describes some of the primary Federal statutes and regulations that govern the use and management of highway ROW for renewable energy development.

Utility Accommodation

FHWA has determined that the use of highway ROW to accommodate public utility facilities is in the public interest. To the extent that any such facilities serve "the public," they can be accommodated under the DOT's approved Utility Accommodation Policy (UAP). If the use of such facilities serves a private or proprietary interest, the use would have to be approved under ROW use agreement requirements ([23 CFR 710 Subpart D](#)). Thus, the distinction between a public or private use, which is defined by state statute, determines which regulations apply.

	Accommodation	Approval Process
Public Utility	UAP	If the renewable energy facility qualifies as a utility per the state's UAP then a DOT can approve the installation in accordance with the process outlined in the UAP without referral to the FHWA. If the type of facility is not included in the UAP, then the FHWA Division Office must review and approve the facility.
Private Utility	ROW Use Agreement (23 CFR 710 Subpart D)	The Federal ROW Use Agreement requirements apply to projects in which Federal funds or assistance will be used in any phase of project development. The regulations require agencies to charge current fair market value or rent for the use of the ROW if the property was obtained with Title 23 funds. They also provide an exception to charging fair market rent if the DOT shows and the FHWA approves that such an exception is in the overall public interest for social, environmental, or economic purposes.

Control of Access to the Interstate

The FHWA retains all approval rights to the control of access to the Interstate system (23 CFR 620.203h). A DOT is required to obtain FHWA written approval when access to the Interstate system is added or modified. Both temporary and permanent modification of access control for transportation and non-transportation purposes require FHWA approval.

Use and Occupancy Permit

Renewable energy facilities in the highway ROW require a Use and Occupancy Agreement (Permit) (23 CFR 645.213). The permit must reference State DOT standards, and include: a description of the type, size and location of facility; adequate drawing showing existing/proposed facility, ROW lines, control of access limits, and approved access points; extent of liability and responsibilities of future adjustments; and action to be taken for non-compliance.

National Environmental Policy Act (NEPA)

Under Federal law, NEPA applies to any proposed action or transportation project where Federal funds or assistance will be used at some phase of project development or where Federal permits or approvals are required. FHWA approval of ROW Use Agreements or access control constitutes a Federal action, and thus requires that NEPA procedures be followed.

6. Applicable State Rules, Regulations, and Policies

Several State statutes and regulations govern the development and delivery of renewable energy, including net metering, interconnection standards, and Renewable Portfolio Standard (RPS).

Net Metering

Net metering allows for the flow of electricity both to and from customers who generate their own electricity. When a customer's generation exceeds his/her use, electricity from the customer flows back to the grid, offsetting electricity the customer consumes at a different time during the billing cycle. As of March 2013, 43 states plus the District of Columbia have adopted a net metering policy.

Interconnection Standards

"Interconnection" refers to the physical linking of an energy generator to the larger electric grid. Assuming a renewable energy system is to be connected to the electricity grid, local electric utilities manage that interconnection. As of 2013, 43 states plus the District of Columbia have adopted a new metering policy.

Renewable Portfolio Standard

A RPS is a regulatory mandate that required electric utilities and other retail electric providers to supply a specified minimum amount of energy from renewable sources. As of March 2013, twenty-nine states plus the District of Columbia and have established RPS requirements, while eight states have established renewable energy goals.

7. Potential Funding Sources

Renewable energy systems in the highway context may entail high upfront costs. Due to the comparable costs of electricity from traditional sources, stakeholders may find renewable energy projects in highway ROW difficult to finance without the availability of Federal or state tax credits and/or other funding opportunities. Example Federal renewable energy funding opportunities include:

- Financial Federal Tax Credits—The Business Energy Investment tax credit provides a tax credit for a percentage of expenditures on eligible renewable technologies. The Renewable Electricity Production tax credit is a per-kilowatt-hour tax credit for electricity generated by qualified energy sources.
- Corporate Depreciation—Under the federal Modified Accelerated Cost-Recovery System, businesses may recover investments in certain property through depreciation deductions.
- Grant and loan programs—Agencies, such as the Department of Energy and the Department of Agriculture, have a number of grant programs for renewable energy. Eligible technologies and funding amounts vary by program.

In addition to Federal incentives, a number of states offer tax credits, rebates and grant programs, and/or loan programs. See the [Database of State Incentives for Renewables & Efficiency](#) website for an overview of financial incentives available by state.

Renewable Energy Credits (RECs) on Voluntary and Compliance Markets

RECs can be sold in the voluntary or compliance market. Prices generally depend on a number of factors.

Voluntary markets are those in which consumers and institutions purchase renewable energy to match their electricity needs on a voluntary basis. Voluntary RECs can be sourced either regionally or nationally.

Compliance markets are created when a state passes a Renewable Portfolio Standard (RPS), thus requiring retail power suppliers to obtain a set percentage of the electricity they sell from renewable sources.

8. Examples of Solar Development Programs

Developing solar highway projects is an emerging practice. Few agencies have developed formal programs to guide their solar energy development process. The following section highlights examples from the Oregon DOT and the Bureau of Land Management (BLM).

Oregon DOT's Solar Program Implementation Steps

Oregon DOT (ODOT) developed a guidebook that provides an overview of a process State DOTs could use to develop solar projects in highway ROW. The following are best practices adapted from [ODOT's guidebook](#):

- **Identify state-specific policy context.** Build understanding of state-specific policy landscape for renewable energy development, including net metering rules, solar power purchase agreements, and financial incentives.
- **Evaluate business models.** Research and understand variations in public-private partnerships and business models, and the associated agreements.
- **Coordinate with FHWA Division Office.** Work with FHWA Division Office to determine permitting framework (i.e., utility accommodation or ROW Use Agreement).
- **Identify and prioritize candidate sites.** Identify a list of potential sites that warrant further evaluation. Screen sites based on solar energy potential, land requirements, access to electric grid, and environmental resource impacts.
- **Assess candidate site feasibility.** Conduct in-depth site-specific evaluations to determine the feasibility of proceeding with a project at a particular site. Evaluation should include on-site solar resource evaluation, a preliminary environmental screen, and a preliminary economic analysis regarding project cost effectiveness. As part of the analysis, compare project expenses and revenues to calculate a savings to investment ratio or simple payback period. The cost-effectiveness of a given project is highly dependent on local electricity prices and financial incentives.
- **Conduct public involvement and communication.** Inform and gather input from project stakeholders and the public.
- **Identify and select a solar developer.** Use procurement tools, such as a Request for Information, Requests for Qualification, or Requests for Proposals, to identify potential solar developers.
- **Project delivery and implementation.** Coordinate with developer to secure necessary permits and approvals.

Bureau of Land Management (BLM) Solar Energy Development Program

In 2012, BLM established updated policies for authorizing ROW applications for solar energy development projects. Key aspects of BLM's solar energy program include:

- **Solar Energy Zones (SEZs):** BLM established 17 initial SEZs that serve as priority areas for utility-scale solar development. Projects located within the SEZs receive simplified permitting, as well as other economic incentives.
- **ROW authorization:** Applications for commercial solar energy facilities will be processed as ROW authorizations with lease terms of 30 years.
- **Rental fees:** BLM requires payment of annual rent for the use of the public lands for utility-scale solar energy development. the total authorized capacity for the approved project.

9. Program Checklist for Alternative Uses of the ROW

The following checklist includes questions that DOTs might consider should they decide to assess whether a program to accommodate renewable energy or alternative fuel facilities in their state is viable. The checklist is not meant to communicate particular roles and responsibilities or imply that these are the only considerations necessary. Instead, it should help DOTs identify important components it already has in place versus those that might also be necessary to accommodate alternative uses of their ROW.

- 1. Does the DOT have leadership support to explore the accommodation of renewable energy technologies and/or alternative fuel facilities in the highway ROW?** A committed project champion within DOT leadership is vital in overcoming barriers and keeping projects on the paths forward.
- 2. Are there state requirements or incentives for state agencies to acquire a certain percentage of their electricity from renewable sources? Are there state requirements or incentives for state agencies to reduce their GHG emissions?** The presence of such requirements or incentives can help DOTs “make the case” for pursuing alternative uses of highway ROW. If the answer to this question is no, accommodating alternative uses of the ROW could still be practicable; the justification would likely need to focus on economic or other environmental stewardship-related purposes.
- 3. Does the DOT’s UAP distinguish or include provision for renewable energy technologies?** DOTs interested in utilizing the ROW for renewable energy technologies or alternative fuel facilities should be proactive in their approaches to implementing these projects. DOTs are encouraged to review their respective UAP to ensure they are consistent with current needs.
- 4. Does the DOT have an encroachment policy or other policy that might discourage some alternative uses of the ROW?** If so, the DOT should assess whether the policy pertains to all potential alternative uses and/or whether the policy still aligns with current priorities. A DOT might consider forming an interdisciplinary team to identify and address the unique issues—including those related to design and construction—that alternative uses of the ROW present in that state.
- 5. Are the DOTs ROW property maps available electronically and/or geospatially-enabled format(s)?** Having electronically available ROW property maps would likely facilitate analyses of potential sites for accommodating alternative uses of the ROW.
- 6. Does the DOT have staff qualified and available (likely GIS staff) to review data on natural resource location(s)? Does the state have natural resource data that the DOT can use/leverage? If no, is the DOT in a position to hire a consultant to perform analyses of natural resource location data in relation to DOT property maps?** For potential renewable energy projects, not all suitable locations from a transportation perspective will necessarily be in locations with suitable natural resource (e.g., solar, wind, or soil resources) availability.
- 7. For renewable energy projects, has a utility company or private developer(s) that is willing to partner with the DOT been identified?** DOTs will need to find a location(s) of a sufficient size(s) to ensure the economic feasibility of the alternative use of the ROW being considered. Developing criteria for what constitutes adequate acreage (based on the proposed project type) would be a useful activity for DOTs to consider.

8. Does DOT legal staff have experience working with agreements related to renewable energy projects? Renewable energy projects can involve complex legal documents that DOTs may not be able to develop given current areas of in-house expertise. Therefore, the DOT may need to utilize outside legal counsel or consultants to help guide the development process of these agreements.

10. Useful Terms

Bioenergy: Bioenergy is a form of renewable energy made from any organic material. Sources of bioenergy are called "biomass" and include agricultural and forestry residues, municipal solid wastes, industrial wastes, and terrestrial and aquatic crops grown solely for energy purposes.

Lease Agreement: defines the responsibilities of project partners. Effective lease agreements often reflect legal, planning, design, environmental, construction, maintenance, insurance, safety, warranty, and security requirements.

Other Renewable Energy Sources: Wave and tidal power, roadway vibrations, and geothermal sources provide additional sources of renewable energy resources.

Power Purchase Agreement (PPA): a long-term contract between an energy provider and a customer to purchase renewable energy for a fixed price over the length of the agreement. A typical PPA term spans 20-25 years. Third-party PPAs are currently legal in 22 states and the District of Columbia for solar PV projects (www.dsireusa.org)

Private utility. A facility is "private" if it serves a limited proprietary use; for example a telecommunications company that proposes to place a line within the highway ROW to serve a select group of users on a lease arrangement basis would normally be considered "private."

Public utility. A facility is "public" if it directly or indirectly serves the public. A small utility company servicing a small community or limited number of neighborhoods would normally be considered a "public" use, if it is generally available to any occupants within the service area.

Renewable energy credit (REC): RECs are tradable environmental commodities that represent the renewable attributes associated with the generation of electricity from renewable energy resources. One REC is typically equivalent to 1 megawatt hour of electricity generated.

Utility facility. Privately, publicly or cooperatively owned line, facility, or system for producing, transmitting, or distributing communications, cable television, power, electricity, light, heat, gas, oil, crude products, water, steam, waste, storm water not connected with highway drainage, or any other similar commodity, including any fire or police signal system or street lighting system, which directly or indirectly serves the public ([Subpart B of part 645](#)).

Solar: Solar energy technologies convert sunlight into usable energy. The primary technology used for generating solar power in the highway ROW is PV technology.

Wind: Wind can be used to generate electricity through the use of wind turbines. Wind turbine systems vary in size, application, and wind requirements.