

Successes In Stewardship

Celebrating 10 Years

December 2011

Utilizing the Highway Right-of-Way to Generate Renewable Energy

In recent years, public agencies have expressed a growing interest in generating and utilizing renewable energy to fulfill a portion of their energy needs or to meet climate change-related goals. The generation of renewable energy produces public benefits, such as reduced greenhouse gas (GHG) emissions and increased fuel diversity and national security, while supporting regional economic development. Some public agencies aiming to increase renewable energy production in the near term have begun pursuing opportunities for installing technologies that produce renewable energy in spaces not traditionally considered for green energy generation.

One such area that has gained recent attention is the highway right-of-way (ROW). With over 8 million lane miles of public roadway under State Department of Transportation (DOT) supervision, these locations have the potential to generate significant amounts of renewable energy. Many international transportation agencies have demonstrated the viability of utilizing the highway ROW for decentralized renewable energy production. Austria, France, Germany, Netherlands, Switzerland, and the United Kingdom, for example, have been installing solar energy arrays on noise barriers along highways and railways since the 1980s. Given the promise of these and other international projects, several State DOTs in the United States have begun pursuing similar projects. The Federal Highway Administration's (FHWA) Office of Real Estate Services supports State DOT initiatives to generate renewable energy in the highway ROW.

State Renewable Energy Initiatives

Currently, solar, wind, and biomass growth, or "bioenergy," technologies offer the most immediate opportunities for generating renewable energy in the highway ROW.

Solar Energy

Solar energy technologies convert sunlight into usable energy without producing any emissions. The primary technology used for generating solar power is photovoltaic (PV) technology. There are two types of PV systems: traditional flat-plate PV systems and concentrating photovoltaic (CPV) systems. Flat-plate PV systems convert sunlight into electricity. These panels can be fixed in place or allowed to track the sun. CPV systems use lenses or mirrors to capture the sun's energy and focus it onto solar cells, greatly increasing the efficiency of the cells. CPV solar cells increase the power output while reducing the size or number of solar cells needed.

The Oregon DOT (ODOT), in partnership with Portland General Electric, developed the Nation's first solar highway project in 2008. The project, now commonly known as "[Oregon's Solar Highway Demonstration Project](#)," is located at the interchange of Interstate 5 and Interstate 205 in Tualatin, Oregon. This project consists of a 594-panel, 104-kilowatt (kW) ground-mounted solar array system that produces enough electricity to supply one-third of the energy needed to power ODOT's lighting and road signs at the site. In the summer of 2011, ODOT broke ground on a second and much larger solar highway project in an area adjacent to the Baldock Safety Rest Area on Interstate 5. The Baldock Solar Highway Project will consist of a 6,994-panel, 1.75-megawatt (MW) ground-mounted solar array that will produce approximately 1.94 million kW hours of electricity. ODOT's solar highway projects contribute to the State's goal of meeting 100 percent of the agency's electricity needs with renewable energy by 2025.



Aerial view of Oregon DOT's Solar Highway Demonstration Project. (Courtesy of ODOT)

The Ohio DOT's [Veterans' Glass City Skyway Bridge Solar Array Project](#) is another example of solar energy harvesting in the highway ROW. In 2010, Ohio DOT, in conjunction with the University of Toledo, installed a 100-kW solar array in the highway ROW off Interstate 280 in Toledo, Ohio. Electricity generated by the solar array is sent to the energy grid and indirectly offsets the electricity demand of the Veterans' Glass City Skyway Bridge, which has a 196-foot lighted pylon containing 384 light-emitting diode fixtures. Ohio DOT is testing rigid and flexible PV panels, both of which are manufactured in Ohio, to determine the viability of each in potential future applications.

Wind Energy

Wind can be used to generate electricity through the use of wind turbines. The amount of energy wind turbine systems can produce currently ranges from less than 100 kW for small wind turbines to 2.5 MW for utility-scale turbines. While the size of the highway ROW is typically too small to accommodate mid- and utility-scale turbines, recent advances in smaller and micro-wind turbine technologies are providing the opportunity to explore the harnessing of wind energy in many locations not previously feasible, such as along roadways.

To date, only a few State DOTs have examined the feasibility of installing wind turbines in the highway ROW or at highway rest areas. For example, the Ohio DOT is installing a small 32 kW wind turbine at a maintenance facility adjacent to Interstate 68 in Northwood, Ohio. The electricity that the turbine produces will be used on-site, and Ohio DOT anticipates that it will help meet up to 65 percent of the maintenance facility's electrical needs.

The Massachusetts DOT (MassDOT) also began exploring the feasibility of locating wind turbines on MassDOT-owned land to meet the renewable energy targets established for all Massachusetts State agencies. Following a statewide analysis of potential wind turbine sites along the Massachusetts Turnpike, the agency determined that a 68-acre site adjacent to its Blandford service area was suitable for wind power development. In 2009, MassDOT began working with a developer to construct a 400-foot tall, 1.5 MW wind turbine. However, in 2011, town residents voted against a wind power zoning bylaw that would have allowed the development of the proposed turbine, putting the future of this project in question.

Bioenergy

Bioenergy is a form of renewable energy made from 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 for energy-generating purposes. Several agencies are beginning to explore the potential for bioenergy generation in highway ROWs through the [Freeways to Fuel \(F2F\) National Alliance](#). The F2F National Alliance investigates the use of non-traditional agronomic lands, such as roadside ROWs, for growing crops that can be processed into biofuels. States participating in the F2F National Alliance include Michigan, North Carolina, Tennessee, and Utah, among others. As participants in the F2F National Alliance, these States contribute to the research on whether the use of non-traditional lands to generate biocrops is economically and environmentally feasible.



NCDOT crews plant canola along I-40 in Raleigh. (Courtesy of NCDOT)

The North Carolina F2F National Alliance project, a cooperative effort between the North Carolina DOT (NCDOT) and North Carolina State University, began in 2009 and is now largely regarded as one of the most successful programs in the F2F National Alliance. NCDOT first planted four 1-acre plots of canola and sunflower crops. In 2010, NCDOT harvested the biocrops and extracted 3,000 pounds of canola seed, which produced 100 gallons of virgin oil. The virgin oil was then combined with conventional diesel to produce approximately 600 gallons of B20 product (a blend of 20 percent biodiesel and 80 percent diesel) that NCDOT used to power its dump trucks, tractors, and other equipment. NCDOT recently completed its fourth biocrop planting.

Renewable Energy Projects Help Meet Sustainability Goals

The State DOTs in these examples and others are capitalizing on opportunities to develop sustainable energy sources on highway ROW land. In several cases, the renewable energy projects are contributing to statewide GHG reduction or renewable energy targets. These projects can provide a way for State DOTs to offset their carbon footprints, meet

sustainability goals, and help create or sustain a local, green job market. They can also help reduce highway maintenance and operational costs while potentially generating additional revenue for transportation agencies.

Although the collective experience with such projects is growing, State DOTs currently face considerable economic, ecological, legal, and political uncertainties in developing and implementing renewable energy projects in the highway ROW. FHWA supports State DOTs' pursuit of these projects and is a resource for information on the issues that may arise and the topics that States need to consider when designing, developing, and implementing renewable energy projects in the highway ROW.

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Look What's New!

- The Western Transportation Institute at Montana State University released a [report](#) that summarizes a multi-agency effort to develop a Regional Ecosystem Framework for Colorado's I-70 Mountain Corridor. The project partners collaborated to integrate wildlife concerns into transportation infrastructure development by applying the principles of FHWA's *Eco-Logical* program.
- FHWA issued a draft [report](#) summarizing the Climate Change Mitigation Peer Exchange. The peer exchange brought together State DOT and FHWA staff to discuss actions that State DOTs can take to mitigate greenhouse gas emissions and the challenges that they face in doing so. The event, which was held in Baltimore, MD, in June 2011, addressed topics including climate action plans, mitigation strategies, creating greenhouse gas inventories, and communication strategies.

Successes in Stewardship is a Federal Highway Administration newsletter highlighting current environmental streamlining and stewardship practices from around the country. To subscribe, visit http://environment.fhwa.dot.gov/sis_registration/Register.aspx or call 617-494-2092.