



MAKING IT HAPPEN

An unconventional thinker brings the nation's first solar highway to Oregon

BY BARBARA BILLITZER

It might be surprising to learn that the very first solar highway in the United States emerged in a city notorious for its rainy climate. Yet, in December 2008, the Oregon Department of Transportation (ODOT) completed the nation's first solar photovoltaic project in the highway right of way.

While the use of solar panels along highways had been successfully used in Europe for more than 20 years, the concept had not been tried in the United States – until now.

The Oregon project is the brainchild of Allison Hamilton, Project Director of ODOT's Innovative Partnerships and Alternative Funding Office. Allison began pushing for the project in 2007, soon after watching a documentary titled "Saved by the Sun," which showed solar panels alongside the autobahn in Germany. Apparently, the development of renewable energy had transformed their entire economy.

According to Allison, a light bulb went off in her head that said, "If they can do that there, why can't we do it here?"

Photography by Gary Weber

RECYCLING THE POWER

As the first state to generate renewable electricity for freeway lighting, Oregon has proven that solar panels installed on the right of way can complement the transportation system.

Installed in the highway right of way, the ground-mounted solar array is comprised of 594 solar panels. Solar energy produced by the array—more than 125,000 kilowatt hours annually—feeds into the utility grid system during the day. At night, the meter essentially runs backward as energy flows back from the grid to light the interchange. With a total of 400,000 kilowatt hours needed to illuminate the site, the system is producing 30 percent of the energy needed to light the interchange at night.

Situated at the interchange of Interstate 205 and Interstate 5, the site is in a Federally-designated Corridor of the Future. And despite the fact that it was a significant undertaking, the project was completed just 108 days after agreements were signed.

AN UNCONVENTIONAL THINKER

While Allison's humble nature is to credit the project's success to teamwork, it's apparent that her diverse background in public transportation and private consulting played a vital role. With degrees in both civil and structural engineering, Allison has held numerous positions within the organization since joining ODOT in 1985. Some of her roles included managing the Statewide Transportation Improvement Program, coordinating the Value Engineering Program and establishing the Performance Management and Resource Planning Unit.

In 2005, Allison moved to the Office of Innovative Partnerships and Alternative Funding. Originally assigned to work on a toll road feasibility study, it was at the tail end of that project when Allison became captivated by the solar power concept. Now with her time freed up, she was able to pursue the solar highway idea.

After seeing the concept work so efficiently in Europe, Allison felt compelled to take action. "I went to work the very next day and did some research to find out what was out there on the Germany installations," recalls Allison. "There wasn't much – just a couple reports and some stuff written in German – which I don't speak. I told my manager about it and said I wanted to see if we could do something similar."



On one of her many site tours, Allison describes to Oregon's U.S. Senator Jeff Merkley how the solar array powers the interchange lighting.

Her manager suggested she speak with ODOT Director Matt Garrett and Deputy Director Doug Tindall, so Allison wrote up a summary describing the Germany installations and added some images she found online. After presenting the idea, Deputy Tindall encouraged her to continue her research and suggested she come up with a concept for a pilot project. Unfortunately, there was just one catch. Allison was advised that there was no funding available. Further investigation into the constitutional uses of the Oregon State Highway Fund seemed to preclude using any funds for the construction of renewable energy projects, no matter how laudable the public goals.



At the groundbreaking ceremony, Governor Ted Kulongoski congratulates Allison, who is joined by her uncle, Bruce Samson, a retired Vice President with Northwest Natural Gas. "This project highlights Oregon's role as a leader in developing clean renewable energy resources, and what can be accomplished with a strong public-private partnership," said Governor Kulongoski.

While launching a new construction project without funding could have created a roadblock for some, this was not the case for Allison. A perpetual optimist, she firmly believes in the power of positive thinking. Not one to back down from a challenge, she continued to stay focused on her ultimate goal.

Around this same time, Allison was invited to attend a presentation by the Oregon Department of Energy (ODOE), which described how to get a solar project financed using state and federal tax credits and utility incentives. She soon learned that public entities and non-profits were able to take advantage of this financing mechanism by partnering with any entity that had a tax liability.

THE POWER OF PARTNERSHIPS

Public-private partnerships are critical when developing a new industry – especially those that directly serve the public good. These tend to be projects where there is cooperation between government agencies and private companies in the financing, development, construction, operation and ownership of infrastructure assets. These partnerships are similar to the way many other essential services are already delivered, such as water, waste disposal, and electricity and gas utilities, which are largely developed and managed by a private partner, but operated under governmental regulation.

The public sector commonly provides the policy framework, the mandate for change and financial incentives (for instance, tax credits) to the private sector projects that fulfill the need and serve the public good. In this way, government is able to capitalize and support the early stages of market development.

The private sector brings additional capital, expertise and technology to the development process and becomes established in the new market. After the new market has reached a self-supporting threshold, government can reduce its investment and allow the new market to flourish on its own. The profits from the new enterprises ultimately return value to the general fund through corporate taxes and personal income taxes.



In preparation for solar panel footings, trenching is undertaken in the middle of the intersection.

The Oregon Innovative Partnerships Program was created, in part, for incubating specific market sectors that could enhance the delivery of transportation infrastructure projects and funding options. This program offered the perfect framework for developing a solar highway program. Using tax credit financing mechanisms available through a public-private partnership, ODOT could secure clean, renewable energy – without paying a premium – from assets it already owned. Since the agency had no tax liability, they were unable to take advantage of tax credit financing on their own. However, the private sector partner could use the 50 percent State Business Energy Tax Credit, in conjunction with the 30 percent Federal Investment Tax Credit and utility incentives, to finance the projects, as well as own, operate and maintain them. Then ODOT could simply purchase the energy produced.

This innovative financing structure makes it possible for clean, renewable electricity to make real inroads into the energy portfolio offered to consumers.

THE TEAM EVOLVES

Once Allison understood the funding options available, the next challenge was finding someone who knew how to develop a solar highway project using these tax credits. More importantly, she needed someone who knew how to do it using a highway right of way.

Allison decided to post a formal request for information on the ODOT procurement webpage. From the two qualified providers that responded, she ultimately selected Five Stars International to help transform the project from a concept into reality.

“They were too good to be real,” says Allison as she describes Five Stars International. “The president, Lynn Frank, was a past director of the ODOE, and he just happened to be the brains behind the Oregon Business Energy Tax Credit. The company’s vice president, Fred Miller, was past director of both ODOE and ODOT, as well as a past vice president of Portland General Electric – the utility that supplies most of ODOT’s electrical needs. With Lynn’s vast



Allison meets with Boris Klebensberger, President of SolarWorld Industries America LP, the company that supplied the solar panels. (Photo by Lynn Frank)



Breaking ground on the project, Governor Ted Kulongoski and PGE Chief Executive Officer Peggy Fowler demonstrate how the solar panels will be angled.



Using the existing right of way, ODOT installs solar panels on the Federally-designated Corridor of the Future.

knowledge of utility regulations, public policies and government workings and Fred's experience in transportation as a past director of ODOT, I felt as if I had hit the jackpot."

The next step was finding a suitable utility partner. Holding meetings with several utility providers, there was only one who seemed genuinely intrigued by the project—Portland General Electric (PGE). Once Allison rallied ODOT and PGE to support the endeavor, she knew that the solar highway concept was on its way to becoming a reality.

Mark Osborn, Distributed Resources Manager for PGE, said, "ODOT was interested in solar for the highway right of way, which in essence, was on land that can't be used for much else." In picking the ideal spot for the project, Mark recalls, "The Transportation Department came up with a couple of possible locations. At the I-5/205 interchange, there's a perfectly formed triangle in that intersection. That seemed like the perfect spot."

ODOT agreed. Not only was the solar exposure good, but there were nearly 150,000 vehicles passing by every day. The potential for public visibility was enormous.

ODOT undertook the responsibilities of environmental clearance and made sure there were no hazardous materials, threatened or endangered species or migratory bird issues. In essence, they made the site "shovel ready." PGE took it from there and secured all permits, approvals, financing, design and construction.

ENGAGING THE PUBLIC

Public involvement was vital to the success of this project. One key in gaining public support was affirming the value of the solar resource installation. An important objective was to enhance public awareness about the potential contribution that solar power would have in meeting Oregon's energy needs.

Sharing information with the public in terms it could understand was critical, as was presenting the information in easily accessible venues, such as on websites and in public presentations. A communications plan was developed by a team of public affairs experts from PGE and ODOT, and they launched press releases early in the process. PGE and ODOT also teamed up to create appropriate protocols and focused on the importance of collaboration with various stakeholders.

Working in partnership with the governor's office, ODOT and PGE organized the groundbreaking ceremony, which resulted in statewide media coverage. As Allison recalls, "The story was picked up by news outlets across the nation, and questions started coming in about what we were doing and how we were doing it. The response was overwhelmingly positive."

"The public education impact of having a renewable energy project this visible has been great," notes Mark. "PGE and ODOT both get feedback all the time from people who drive by and really support the direction we're taking. It's been very positive." Mark said the project has produced other benefits. "I have never seen an energy project capture the public's interest like this one. It's been amazing."

PERMITTING CONSIDERATIONS

There were several considerations that made this project unique. Siting a prototypical solar resource project on the transportation system required system-specific permitting. The process of siting solar photovoltaic arrays in the right of way provided interesting insight into regulatory issues that may inadvertently limit opportunities for renewable resource development.

Through review by ODOT, the Oregon Department of Justice and the Federal Highway Administration, it was determined that, since the project was to supply electricity for ODOT's own use,



Virginia Tsu of the Federal Highway Administration played a vital role in helping ODOT facilitate regulatory compliance. At the 2010 Federal Agency Update, she spoke on optimizing energy efficiency and shared a video on the Oregon Solar Highway project.

It was permitted on ODOT right of way through the normal Oregon Administrative Rules Division 55 (OAR 734-055) Utility Permit process, which follows the Federal Utility Accommodation Plan. Required of all states, the plan describes the process through which each state transportation agency works with utilities for siting, relocating and maintaining utility infrastructure on state rights of way.

Tying the solar installation to ODOT's need for electricity made use of the right of way fully compliant with regulations for property purchased with highway funds and with the utility permitting process. It also became critical to demonstrate that electricity produced by the project would continue to be for ODOT's own use to meet net metering requirements associated with their generating plant. This was handled through a solar power purchase agreement with PGE, wherein ODOT buys the energy produced by the array at the same rate they pay for regular energy from the grid.

Allison recalls some of complex legal and regulatory requirements and obstacles that arose during the permitting process. There was a lack of expertise in solar power purchase and site license agreements within the department, so there was an inherent learning curve associated with these agreements and the application of related state transportation law. The Oregon Public Utility Commission required further review of the application of net metering and energy supplier laws and rules, and needed more information regarding how the application of those rules might adversely affect ODOT's interests in the project and future solar resource development.

It was also challenging to develop data sharing protocols acceptable to the IT departments of each party, while also considering cost, firewall and confidential information issues, hardware (conduit, fiber) and software sharing, as well as data formatting. It is expected that protocols developed for this first project will carry over to other projects sited in PGE territory.

SAFETY AND MAINTENANCE

Public safety was of paramount concern in siting the solar photovoltaic project, as there are very clear standards about locating anything inside a highway facility's "clear zone," or errant vehicle pathway. Solar installations must be located outside the clear zone or behind a barrier such as guardrail. The clear zone is site-specific and takes into account facility type, topography and design speed, among other considerations.

Because interchanges have limited access, a traffic control plan was submitted to the ODOT district office as a prerequisite to the utility permit. Stipulations governing the access, ingress and egress of the site were incorporated into the utility permit, providing control over the times and conditions under which access would be permitted. ODOT's existing point of maintenance ingress and egress from the interstate highway had functioned adequately over many years. Therefore, the maintenance access point was maintained and only a small segment of gravel access road was constructed, leading from ODOT's existing access road to the array. By making use of ODOT's existing infrastructure, there was no increase in risk to the traveling public, and project costs were minimized.

A critical issue was determining how and where the interconnection could be most cost-effective. The interconnection that joins the photovoltaic array with the electric power grid crosses two interstate freeways, I-5 and I-205. The most economical means of connection was achieved by mounting the electrical conduit to the underside of an existing bridge crossing I-205 and by installing the conduit beneath I-5 using directional boring. These construction techniques eliminated the risk to the traveling public, alleviated any impact to the flow of traffic and prevented damage to the existing infrastructure.

The photovoltaic array was positioned as far from the roadway as possible to minimize the risk of roadway debris that might impact the safety and functionality of the array. The compound incorporated low-maintenance options, such as low growing grass that requires little mowing and an access road designed to minimize the need for repair. Barring damage from external factors, the photovoltaic system should require very little maintenance during its service life.

Concerns about reflection and its potential impact on traffic safety were dispelled by referencing how solar panels are designed to absorb sunlight and how the Federal Aviation Administration had previously considered such issues in allowing solar arrays to be sited at airports. The concerns were further mitigated using research from Europe which showed no change in driver breaking habits before and after a solar project was installed in the right of way.

The solar power purchase and site license agreements clearly assign security responsibility for the solar project to PGE and there is no public liability for security of the solar array. Since roadside equipment can be subject to theft and vandalism, PGE implemented Stop Theft technology, a proprietary theft deterrent.

The array and support equipment are also surrounded by a security fence comprised of barbed wire and razor wire coil. An electronic security system monitors the area and detects when the fence is scaled, cut or damaged. Sensors track activity around the gate, and security cameras provide remote visual monitoring and motion detection within the compound.

COMMITTED TO ALTERNATIVE POWER

The real value of the \$1.3 million project may be what it has done for the state's already green reputation. Erecting a quarter acre of panels along a prime route to its most populous city sends a highly visible message: Oregon is committed to alternative power sources.

This groundbreaking project has propelled Oregon as a national leader for innovative sustainable technology, garnering international recognition as well. With its commissioning, the project extends Oregon's role as a leader in the development

of alternative energy resources and showcases the state's vision, leadership and ability to meet current and future energy challenges creatively.

Once considered too costly to become a viable green-energy option, the solar power market has exploded in recent years, primarily because Congress passed a slew of federal tax credits that cover up to 30 percent of the cost of solar installations built since 2006. Solar development is further benefitted in Oregon through the Business Energy Tax Credit, which offsets up to 50 percent of the cost of solar projects over five years.

More businesses have recognized that Oregon is a good place for solar innovation. If the state can continue to offer such strong incentives and woo businesses there, and if the Federal government renews the much-needed incentives, revenues from the solar manufacturing industry could potentially reach \$3 billion annually by 2015.



Roughly the size of two football fields, the 104-kilowatt solar photovoltaic system covers 8,000 square feet and connects with the electric power grid on the other side of two major freeways.

“The Oregon solar highway demonstration project is performing very well, proving that solar power has the potential to become an important part of Oregon’s energy future,” said Jim Piro, president and CEO of PGE. “With Congress working on carbon legislation, as well as anticipated reductions in renewable manufacturing costs, we think renewable resources will become more competitive with thermal resources over time so projects like the solar highway will likely become a cost-effective resource for our customers.”

LESSONS LEARNED

While the total project cost was roughly \$1.3 million, the innovative public/private partnership with PGE ensured that ODOT would not need to invest any capital. Due to the tax credit structure for financing these types of projects, the partnership was a natural fit.

They used the basic “third-party flip” model for financing, where their financing partner (PGE and its tax partner US Bank) took advantage of the tax credits, utility incentives and accelerated depreciation, and ODOT supplied the land. This model was originally developed and perfected for the big wind industry in the Midwest, but has since migrated to solar project development.

ODOT is moving forward with investigating other solar highway project opportunities and identifying locations in their right of

way for more facilities in the future. Partnerships with Oregon’s utilities or private solar developers could make it possible to develop more projects on ODOT-owned land using the third-party financing model.

THE COLLECTIVE POTENTIAL

Technology transfer is—and will continue to be—an ongoing priority for ODOT. Since launching the solar energy project, the agency has forged relationships with the Oregon Department of Energy, the Oregon Public Utility Commission and has been instrumental in facilitating a relationship between the Federal Highway Administration and the U.S. Department of Energy. Through briefings with other state transportation agencies, ODOT is committed to sharing what they have learned.

According to Allison, this is not your stereotypical 100-year-old government agency. “ODOT is very open to new ideas,” she notes. “The leadership is genuinely interested in figuring out the best way to move forward. While I don’t think any of us anticipated the national and international attention this project would bring, everyone I needed to involve has been amazingly willing to jump in and contribute – even on their own time. We are building a base of expertise that will serve the department well for the continual future development of renewable energy projects.”

Recognized as the first solar highway project in the nation, the project has garnered attention and accolades through recognition by its peers.



Local media covering the groundbreaking included Portland television and newspaper media, local affiliates of ABC, NBC and CBS news stations and national trade publications like the Sustainable Industries Journal.



2009 Oregon Solar Pioneers of the Year award winners Mark Osborn, Distributed Resources Manager at PGE, and Allison, are joined by David Parker, President of Advanced Energy Systems, a key partner in building the project.

The project has been cited for its leadership role by FHWA and the American Association of State Highway and Transportation Officials (AASHTO). In addition to winning the AASHTO Environmental Excellence Judges Award for Special Recognition, the project was honored with the 2008 Project of the Year by the Portland Chapter of Women in Transportation. ODOT and PGE shared the spotlight when winning the 2009 National Solar Electric Power Association's Partnering for Success Award, as well as the 2009 Oregon Solar Pioneer Award.

The project also received Congressionally-Directed Appropriations in 2009 and 2010 to help develop and support the program.

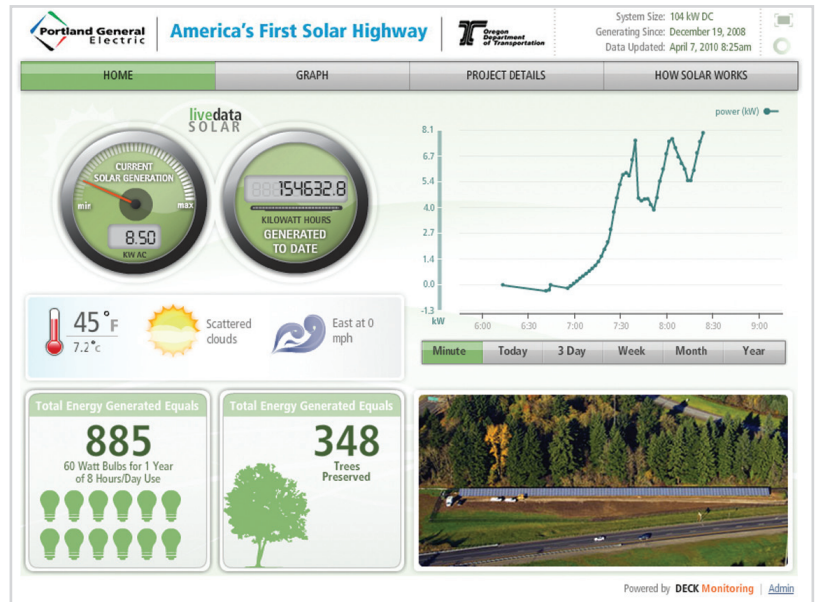
Allison notes, "I think people understand deeply the need for this country to move to renewable energy, and they're impatient to get on with it. Having the opportunity to actually do something about it is so rewarding. I think people feel that, and that's why they're here, part of the ever-expanding team. We just needed to figure out how to get the thing built with all our particular rules and regulations and with people who weren't instantly comfortable with the idea of an energy plant on the right of way."

SECRETS TO SUCCESS

What does Allison attribute to the project's success? "For this project, people just seemed to show up at the right time in the right place with the right skills and attitude to get the job done. People wanted it to work, so it did. No one really focused on whether it couldn't or shouldn't be done – they focused instead on how to get it done. A seemingly simple shift of perspective, but it made all the difference. It was an idea whose time had come."

Also attributed to the project's success is the fact that only Oregon-based companies were used for supplying materials, design and installation. Allison explains, "They were selected using a values-based solicitation. Their community support, environmental values, triple-bottom-line approach to business which values people and planet along with profit, was what made the difference."

SolarWorld AG supplied the solar panels, and PV Powered, Inc. provided the inverter that converts the solar power for use on PGE's grid. The project was designed, constructed and installed by SolarWay, a solar energy engineering, procurement and construction consortium consisting of four Oregon firms: Aadland Evans Constructors, Inc., Moyano Leadership Group, Inc., Advanced



The energy generated by this project is monitored and displayed online in real-time and cumulatively.

Energy Systems, and Good Company. SunWay 1, LLC, a limited liability company managed by PGE, owns and operates this solar power plant.

David Moyano, Principal of Moyano Leadership Group, credits the project's success to the collective potential. "It starts with the leadership within ODOT, for seeing the opportunity to leverage the right of way and their assets for the good of the climate and for the public. With strong leadership, they were able to bring in the right partners in the private sector. From the very start, the project was purpose driven and the mindset was always 'how can we,' rather than 'why can't we.' This alignment resulted in the extraordinary results that we see today."

For anyone with a vision or an idea they believe in, Allison encourages them to keep their goal in their mind's eye, no matter what shows up. "Keep believing in your idea, and don't be afraid to push or do things differently. Be comfortable with change. It's hard for some, but embracing change is so much more empowering than running from it."

When asked if she has any advice for other non-conventional thinkers, Allison admits that her guiding principles may sound a bit corny. "I firmly believe that an idea whose time has come will somehow attract the right circumstances to enable it to actualize." Her entire experience with the Oregon Solar Highway project has validated this belief structure.