



Solar in Transportation Toolkit

Like many federal, state, and local governments, regional councils and metropolitan planning organizations (MPOs) incorporate an array of sustainability concepts into their plans and projects. The integration of solar technology can help meet a number of goals related to transportation and energy, yet the use of solar in transportation is still in the nascent stages for many regional councils and MPOs. As a result, there is tremendous opportunity for future growth in this area. Solar energy can help your region meet air quality standards, reduce operating costs, and demonstrate a region's commitment to sustainable development, job creation, and local air pollution reduction.

The *Solar in Transportation Toolkit* discusses ways regional councils and MPOs can incorporate solar energy into their transportation initiatives and includes examples of projects from across the nation. The toolkit provides resources to assist in the process that can eventually lead to widespread integration of solar into a region's transportation network. The examples included in the toolkit can be modified for use by any regional council or MPO.

The *Solar in Transportation Toolkit* is designed as a companion to the National Association of Regional Councils' [Regional Solar Deployment Handbook](#). The handbook provides general resources on how your region can go solar, including information about the current solar market, financing tools, and regional solar best practices. Together, the handbook and toolkit provide the necessary foundation to understand the more complex components of solar energy development.



THE CASE FOR SOLAR

According to the U.S. Environmental Protection Agency (EPA), the **transportation sector** contributes nearly thirty percent of total U.S. greenhouse gas (GHG) emissions, and GHG emissions from this sector have been increasing in absolute terms over the past few decades. Federal and state government agencies have responded to GHG emissions and related climate change impacts by establishing air quality standards and vehicle emission regulations. Solar can play a role in helping regional transportation systems conform to these standards and regulations.

Solar Energy Solutions for Transportation: Improving Air Quality & Saving Fuel with Idle Reduction Technology

National Association of Regional Councils

This webinar explores the regulatory and market forces behind the demand for idle reduction technologies, reviews the range of solar-powered alternative technologies, and highlights examples of communities faced with meeting idle reduction standards.

Idling Regulations Compendium

American Transportation Research Institute

This resource is a compilation of state and local idling rules and regulations that can be proactively addressed in regional plans. In subsequent sections, the toolkit offers examples of how to meet these standards using solar technologies in the transportation sector.

Solar Energy Solutions for the Transportation Industry

eNow

This presentation provides specific examples of how solar-powered technology and equipment can address issues in the transportation industry such as rising fuel and operational costs and meeting government regulations.

Funding is often a limiting factor in the implementation of transportation projects. Despite price declines of almost 50% over the past two years, municipalities are often unable to cover the upfront expenditures for solar installations. Incorporating solar technology into a transportation project might qualify it for additional federal, state, and private sector funding. The following resources provide an overview of available options to finance regional and local solar transportation projects, including links to federal funding sources, mechanisms, and examples of public-private partnership-funded solar projects.

FEDERAL RESOURCES FOR REGIONAL AND LOCAL USE

[Congestion Mitigation and Air Quality Improvement Program](#)

Federal Highway Administration and Federal Transit Administration

The Congestion Mitigation and Air Quality (CMAQ) program provides competitive funding for transportation projects that aim to reduce congestion and improve air quality in designated nonattainment and maintenance areas under the *Clean Air Act*. This program guidance provides information on CMAQ funding availability, specifies project eligibilities, and outlines the selection process.

[Low or No Emissions Vehicle Deployment Program](#)

Federal Transit Administration

FTA's Low or No Emissions (LoNo) program provides transit agencies with funding to deploy zero and low-emission transit buses and their corresponding fueling and maintenance facilities. This resource provides descriptions of the ten most recent LoNo project selections.

[The Office of Energy Efficiency & Renewable Energy](#)

U.S. Department of Energy (DOE)

DOE's Energy Efficiency & Renewable Energy (EERE) Office provides information on renewable energy technology and applications, educational and training services, and technical assistance to communities for the deployment of alternative energy technology. This resource offers a full list of funding opportunities available via the EERE Exchange, as well as guidance for the application process and updates on current recipient projects.

[Clean Cities Initiative](#)

U.S. Department of Energy

Established by EERE, Clean Cities coalitions and stakeholders have access to competitive awards for projects that reduce petroleum use. This resource lists financial opportunities currently available through the Clean Cities program and a summary of past project selections. Awarded projects cover a range of themes, including electric vehicle community readiness and idle-reduction strategies.



National Clean Diesel Campaign

U.S. Environmental Protection Agency

EPA established the National Clean Diesel Campaign (NCDC) to promote clean air strategies among elected officials, manufacturers, fleet operators, and other transportation industry stakeholders to reduce emissions from diesel-fueled vehicles. One strategy for reducing diesel emissions is to provide an alternative power source while the vehicle's engine is idling. Solar energy can be harnessed for this purpose through a solar power-assist system (see Implementing section). Grants awarded through NCDC programs for solar power-assist and other clean diesel technologies receive funding authorized by the *Diesel Emissions Reduction Act* (DERA). This resource provides access to past and current project selections as well as funding sources available through the NCDC, with special attention to DERA grants and rebates.

Qualified Energy Conservation Bonds

U.S. Department of Energy

A Qualified Energy Conservation Bond (QECB) is one of the lowest-cost financing tools available for qualified local governments. Through a QECB, government issuers borrow money to fund projects supporting energy conservation and the U.S. Department of Treasury subsidizes their borrowing costs. This webpage provides an overview of the advantages and disadvantages of using a QECB, the options for structuring the taxable bond, and the types of QECB fundable projects.

PRIVATE SECTOR RESOURCES

Carver, MA Power Purchase Agreement

National Association of Regional Councils

In a power purchase agreement (PPA), a public entity provides the structure or land upon which a solar energy system will be installed and the partnering solar power producer handles the financing, installation, management, and operation of the system. The public entity purchases energy produced by the system from the power company at a lower rate. This case study describes how the town of Carver, Massachusetts formed a PPA with SolareAmerica, obtained use of highway right-of-way, and funded the project through tax credits and a federal grant.

Solar Investment Tax Credit

Solar Energy Industries Association

The solar investment tax credit (ITC) is a thirty percent federal tax credit for eligible solar energy systems installed on residential and commercial properties. This resource explains solar ITCs and the benefits of their commercial application.

Because solar panels have become more durable and mounting systems have been designed to accommodate nearly any location, solar photovoltaic system (PV) equipment can be installed on a wide range of surfaces for a multitude of purposes. Solar energy systems may be installed on vehicle rooftops, buildings and facilities, roadways and lighting systems, and can be used to power equipment that assists in traffic flow management and safety. Several examples of solar PV projects specifically applicable in transportation programs and systems are listed below.

TRANSPORTATION FACILITIES

BUS STOP SHELTERS

Solar can help address some of the major concerns for transit planners, including safety, user experience, and system efficiency. Installing solar PV systems on bus stop shelters provides energy for: overhead lighting, which increases visibility and deters crime; bus signaling strobes, which make routes more efficient; and illuminated route schedules, which allow for real-time navigation. In some cases, the initial cost of the system can be eliminated by providing LED-lit advertisement space for lease. The following are examples of both grid-connected and off-grid solar energy systems designed for bus stop shelters.

- [On-Grid in Corona, CA](#), *Greentech Media*
- [Battery Storage in Perris, CA](#), *City of Perris, CA*
- [Off-Grid and Remote](#), *Sundial Energy*

BUS PARKING CANOPIES

A solar canopy is a roofing structure lined with solar panels that generates electricity while providing a shaded shelter for buses. Municipalities have installed solar canopies in fleet maintenance facility parking lots, school campuses, public libraries, and other municipal sites. A canopy can increase vehicle lifespan by protecting buses from weather and helping lower on-bus air-conditioning costs. Energy generated by a canopy reduces facility operations costs and may be sold back to the grid. The following resources detail how regional transportation authorities have benefited from using solar canopies for public transit fleets.

- [Santa Clara Valley Transportation Authority](#), *Valley Transportation Authority*
- [Metropolitan Atlanta Rapid Transit Authority](#), *National Association of Regional Councils*



RAILWAY TERMINALS

From New Delhi to New York, cities around the world are installing solar on their railway terminals. Coney Island's Stillwell Avenue Railroad terminal is the largest above-ground station in the New York City subway system and the site of a new solar glass train shed. This project is the world's largest building-integrated, thin-film PV structure and offers an example of the city's sustainability and climate preparedness efforts.

- [Coney Island's Stillwell Avenue Project](#), *Kiss + Cathcart*

AIRPORT TERMINALS

Installing solar arrays at airports is becoming an increasingly popular way to reduce operating costs, demonstrate a region's commitment to sustainable development, create jobs, and reduce local air pollution. Although there has been concern about installing solar panels close to airports due to glare, modern PV panels reflect as little as 2% of incoming sunlight, about the same as water and less than soil or wood shingles. A number of cities have had success with solar installations near airports, including Boston, New York, San Francisco, and Denver. The following resources include examples of successful projects, a tool developed by the Federal Aviation Administration to analyze potential glare impacts of proposed solar installations, and information to guide the evaluation process for developing airport solar projects.

- [Indianapolis International Airport Solar Farm](#), *IND Solar Farm*
- [Denver International Airport Solar Arrays](#), *Denver, Colorado Airport*
- [Burlington, Vermont Solar Field](#), *The SunShot Solar Outreach Partnership*
- [Why Solar is Taking Off at Airports Across the Country](#), *ThinkProgress.org*
- [Glare Factor: Solar Installations and Airports](#), *Solar Industry Magazine*
- [Technical Guidance for Evaluating Selected Solar Technologies on Airports](#), *Federal Aviation Administration*



ALTERNATIVE-ENERGY VEHICLES AND INFRASTRUCTURE

Electric Vehicle (EV) Charging Stations

Increasing investment in the electric vehicle industry, which now includes personal vehicles, public transit vehicles, and commercial trucks, has augmented the demand for electric vehicle charging infrastructure. The following projects demonstrate the breadth of technology available for harnessing solar energy for charging electric vehicles, and offer project partnership options that can address funding and implementation challenges.

- [CALSTART Carport Canopy](#), *SolarWorld*
- [Chicago Charging Canopies](#), *Alternative Transportation for Chicagoland*

Bicycles and Bike Share Stations

Solar equipment may be deployed throughout bike share networks as a direct mount on bicycles or as an installation at bike stations. The equipment powers network elements like bike locking systems and ticket kiosks, and can illuminate stations and maps of the station network at night. Extensive solar-powered bike share programs have been used to promote bicycling as an alternative travel mode in several major urban regions. [Boston](#), [Phoenix](#), [Tulsa](#), [Washington DC](#), and [San Antonio](#) have all installed solar-powered bike share programs. The following resource is a guide to implementing a bike share program in your region.

- [Bike Sharing in the United States: A Guide to Implementation](#), *Federal Highway Administration*

Heavy-Duty Bus and Truck Fleets

Commercial trucks, school buses, and public transit buses typically run on diesel fuel and must comply with various diesel emissions standards and idling restrictions. The solar power-assist system, which powers vehicle air conditioning as well as personal and wireless electronic equipment while the engine is idling, can help regional fleets meet anti-idling and emissions standards while reducing operating costs. The solar energy collected from vehicle rooftop solar panels is stored in the vehicle's on-board battery bank, which is rechargeable, requires little maintenance, and can be drawn from when needed. The following resources detail solar power-assist systems for heavy-duty diesel buses and trucks.

- [Solar Power-Assist for Buses](#), *Clean the Air Energy Blog*
- [Solar Power-Assist for Heavy-duty Trucks](#), *Go Power*



Streetcars

Solar panels can generate enough energy to power an entire streetcar system. Electricity is stored in the streetcars' on-board battery bank and the system can interact with the local electric grid as needed during night time hours. The following resource demonstrates the world's first solar-powered wireless streetcar, installed in a mixed-use community in San Antonio, Texas.

- [San Antonio Wireless Streetcar](#), *TIG/m*

Suspended Monorails

Solar-powered monorails are suspended overhead, fueled by solar energy collected from panels on top of the rail line, and can be designed to transport freight as well as people. The following resource provides an example of this technology.

- [JPod Pilot Program in New Jersey](#), *NationSwell*

TRANSPORTATION INFRASTRUCTURE

Bridges

There are several examples of solar energy's incorporation into bridge infrastructure. In Ohio, the Department of Transportation (DOT) uses highway right-of-ways to support a solar array that powers the highway's lighting system. In Oregon, the DOT used solar-powered LED lighting to replace existing and outdated lighting systems. The new lighting system installed on a coastal bridge connecting Oregon and Washington employs five different types of solar lights.

- [Veterans' Glass City Skyway Bridge Right-of-Way](#), *Ohio DOT*
- [Astoria-Megler Bridge](#), *Oregon DOT*

Roadways

This technology replaces asphalt roadways with a system of LED light-covered solar panels, taking advantage of thousands of miles of sun-exposed road surface. The system also increases driver and pedestrian safety by incorporating motion sensors and real-time warning signals pictured in the LED lights. While this technology is not yet commercially available, it has been publicly endorsed by U.S. Senator Mike Crapo (R-ID) and referenced by the Obama Administration. Testing of the technology has received financial support from federal grants and an enthusiastic following.

- [Solar Roadways](#), *Solar Roadways*

TRANSPORTATION MANAGEMENT

Traffic Signals and Signs

Solar-powered speed limit signs can regulate traffic flow, warn drivers of speed limit violations, improve speed limit adherence, and increase user safety. The University of Nebraska-Lincoln's Mid-America Transportation Center's Energy Plus Roadways project integrates wind and solar energy systems at traffic intersections to power on-site streetlights, traffic signals, and off-site facilities through grid distribution. In case of power outage or malfunction, each intersection system may switch modes to operate independently of each other and the grid. The following resources provide an overview of solar-powered traffic signals, message boards, and other roadway safety equipment.

- [Traffic Signals and Signal Systems](#), *Mid-America Transportation Center*
- [Speed Radar](#), *Radarsign*
- [Speed Limit Signs](#), *Traffic Logix*
- [Highway Message Boards](#), *National Trench Safety*

For more information on implementing solar in your region, see the [Regional Solar Deployment Handbook](#). This comprehensive resource provides an overview of solar technology and the solar market.



This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer,

or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

SunShot Solar Outreach Partnership (SolarOPs) references are based upon work supported by the U.S. Department of Energy under Award Number DE-EE0003526. The U.S. Department of Energy (DOE) SunShot Initiative is a collaborative national effort to dramatically reduce the cost of solar energy before the end of the decade. Through this partnership, the [National Association of Regional Councils](#), the [International City/County Management Association](#) (ICMA) and the [American Planning Association](#) (APA) provide outreach, education, and technical assistance to expand local and regional governments' innovative efforts to accelerate the local adoption of solar energy on their facilities and community-wide. For more information, visit www.solaroutreach.org.