



Solar Fuel Stations for Plug-In Electric Vehicles *Fact Sheet*

What is a solar fuel station?

Solar fuel stations charge plug-in electric vehicles with solar energy generated via photovoltaic panels mounted on carports or adjacent building roofs. Both system designs can be outfitted so that electricity is fed back to the grid or the onsite host building if cars are not charging.



Kyocera Headquarters, San Diego, CA



Google Headquarters, Mountain View, CA

What are the benefits of a solar fuel station?

Reduces GHG Emissions and Criteria Pollutants: Solar fuel stations reduce emissions associated with producing electricity from power plants. In comparison to driving a conventional car, a vehicle powered by the sun avoids 5.29 tons of CO₂ equivalent emissions annually.

Builds California's Economy & Generates Green Jobs: Solar fuel stations generate cutting-edge green jobs, from designers to engineers, installers, and cement and steel workers. Currently, there is a high concentration of solar power and advanced technology companies (770 solar firms alone) in California with the capacity to install solar-fuel stations.

Promotes Local Energy Independence: When not fueling cars, solar fuel stations act as distributed generation facilities (or "mini-grids") that feed the larger grid, decreasing the need for peaker plants and transmission lines. In the future, electricity can also be stored in vehicle batteries and fed back to the grid (Vehicle-to-Grid or V2G) to avoid brown and black-outs.

Reduces Petroleum Use: Driving a plug-in with a 40 mile battery range will displace most, if not all, of the average American's petroleum use of 500 gallons of gasoline per year.

Generates Renewable Energy: One station with 10 charging spaces generates 30,000 kWh of electricity annually, powering approximately 120,000 miles of zero-emissions electric driving per year.

Supports the Adoption of Electric Vehicles: Highly visible solar fuel stations will boost consumer confidence, providing assurances that plug-in electric cars can be reliably and cleanly fueled while away from home, and at a free or substantially cheaper price than gasoline.

Promotes Infill Development: Solar fuel stations use built space, cutting down on the use of virgin land for electricity generation and providing valuable shade to parked cars.

What are some potential locations for solar fuel stations?



■ **Public Administration**



■ **Main Thoroughfare**



■ **Zoo**



■ **Shopping Center**



■ **Train Station**



■ **Amusement Park**



■ **Trolley Station**



■ **Park**



■ **Sports Arena**

Likely spots for solar fuel stations include public parking garages, government & private company parking lots, transportation depots like BART and Amtrak, airports, hospitals, malls, restaurants and college campuses. The blue areas pictured above represent potential station sites.



For More Information on Solar Fuel Stations:

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Solar Fuel Stations for Plug-In Electric Vehicles *Cost Fact Sheet*

Carport Station – A free-standing carport structure with mounted solar panels.

Approximate Cost: \$4,764 after federal & state incentives for businesses; \$12,850 after state solar rebates for municipalities. Costs include carport construction & materials, solar panels, wiring, and all charging technology.

Financing Options: Municipalities can utilize a number of options to help finance the upfront cost of the stations (see back for more info).

Payback Periods: The payback period of stations will range from 5 to 30 years per charging unit, depending on the initial cost of the system and available incentives.



Rooftop-Sourced Station – Vehicle charging spaces are tied to rooftop solar arrays.



Approximate Cost: \$4,367 after federal and state incentives for businesses; \$8,590 after state solar rebates for municipalities. Costs include installation labor, solar panels, wiring, and all charging technology.

Tie-in to Existing Solar Arrays – Utilize an *existing* solar array built on a rooftop or over a parking lot and install parking lot charging units.

Approximate Cost: \$1,750 per charging space after federal incentives for businesses; \$3,500 for municipalities. Final cost depends on the specs of the existing system and hook-up requirements.



Google's Headquarters, Mountain View, CA

Financial Assistance for Public Entities¹:

Power Purchase Agreements (PPAs): Solar systems can be installed with no upfront cost to the host site by entering into a PPA. The host site leases their rooftop or parking lot space for the installation of solar power by a third party. The solar parking lot array pictured to the right was built through a PPA at St. Mary's Medical Center in California. In return, the host pays a fixed rate for energy over an agreed upon time period. Solar Power Partners is a well-known company that offers PPAs. For more information, visit their website at <http://www.solarpowerpartners.com/>.



St. Mary's Medical Center, Apple Valley, CA

CEC Alternative Fuel Funding Incentives: The California Energy Commission (CEC) has over \$120 million per year in funding available over the next seven years to support the development of alternative fuel vehicle infrastructure like solar fuel stations. By generating commitments to build these stations from municipalities and businesses, FoE will present a strong case to the CEC for subsidies to be awarded.

Federal Stimulus Funding: Approximately \$10 billion in federal tax credits and incentives were passed as part of the February 2009 Stimulus Package (the American Recovery and Reinvestment Act of 2009) for the manufacture and purchase of plug-in electric vehicles. Approximately \$450 million of those funds were allocated to the deployment of charging infrastructure, most of which is available through the Department of Energy, including the Clean Cities Program (<http://www.energy.gov/>).



UC San Diego, San Diego, CA

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¹ Public entities include municipal governments, schools, hospitals and any other public sector entity that does not generate taxable income and therefore is not eligible for state or federal tax credits for the installation of solar systems and electric charging infrastructure.



Solar Fuel Stations

State and Federal Tax Credits and Rebates

Federal Tax Credits for the Purchase of Plug-In Electric Vehicles:

- Between \$2,500 and \$7,500 is available per plug-in vehicle purchased, after December 31st, 2008, based on the mileage range of the battery.
 - This tax credit will decrease in dollar amount after 200,000 plug-in vehicles per automaker are sold.
 - The credit expires at the end of 2014.

Federal Tax Credit for Installation of Charging Infrastructure:

- For commercial sites, up to 50% of the cost of installing electric fueling / charging stations, with a \$50,000 cap per site.
 - Station owners who install qualified equipment at multiple sites are allowed to use the credit towards each location.
 - This credit is available until January 1st, 2011.
- For residential sites, up to 50% of the installation costs, with a cap of up to \$2,000 per site.
 - The credit is effective for equipment put into service between December 31st, 2005 and January 1st, 2011.

Federal Tax Credits for Solar Power Installation:

- A federal tax credit of up to 30% of the total cost of an installed solar system is offered to income-generating entities (i.e. businesses). This federal tax credit was recently reauthorized and signed into law through 2016.

State Rebates for Solar Power Installation: California Solar Initiative

- Rebates are based on the expected performance or energy yield of a given solar installation. For larger systems, the incentive is based on the actual performance of the system over the first five years.
- The incentive level available to a given project is determined by currently available incentives in each utility territory for each customer class.
 - As an example, for a commercial solar installation project of under 50 kilowatts (kW) in PG&E territory, the payback is currently \$1.55 per watt (e.g., a 20kW system will receive \$26,040 in payback.)

Further incentives are available—we will update this list with additional info in the near future.



Solar Fuel Stations *Project Vendors*

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Key Solar Carport Projects:

Kyocera Headquarters, San Diego, CA (top right):

- Covers 186 parking spaces
- Generates approximately 427,000 kWh annually
- Avoided emissions (in pounds, annually):
 - Carbon Dioxide: 338,905
 - Nitrogen Oxides: 421
 - Sulfur Dioxide: 253



UC San Diego, Gilman Parking Garage (right):

- Covers 92 parking spaces
- Generates 275,000 kWh annually
- Avoided Emissions (annually, in pounds)
 - Carbon Dioxide: 263,480
 - Nitrogen Oxides: 239
 - Sulfur Dioxide: 180



UC San Diego, Hopkins Parking Garage (below right):

- Covers 160 spaces
- Generates 494,000 kWh annually
- Avoided Emissions (annually in pounds)
 - Carbon Dioxide: 473,306
 - Nitrogen Oxides: 430
 - Sulfur Dioxide: 323

Location of Projects:

Envision Solar is based in San Diego, California, and has completed the majority of its projects in Southern California (San Diego, Los Angeles, Apple Valley), but also has worked in the Southwest. They are currently working on a series of solar fuel stations in Albuquerque, NM, and have the capacity to design systems in Northern California and beyond.

Area of Expertise:

Envision Solar is known for building large-scale solar parking lot arrays, designed with conduits for charging technology to be installed (wiring, breakers, payment technology systems etc.). Envision Solar is the designer of systems; it partners with local contractors and solar panel providers. Envision Solar works with solar panel manufacturers throughout the world, but if a client wants a local or U.S.-based company, Envision Solar will seek out and work with such companies.

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Key Solar Fuel Station Project:

Google Headquarters, Mountain View, CA
(right & below):

- Currently fuels 6 plug-in electric vehicles with additional capacity for future vehicles.

Location of Systems:

Suntech's U.S. office is located in the Bay Area, with headquarters in China. They have built systems locally, such as Google's solar fuel station (pictured right).



Area of Expertise:

Suntech, previously known as E.I. Solutions, built one of the first solar fuel stations in the world at Google's Headquarters in Mountain View, CA, and is considered one of the leading experts in the field of *direct* charging of vehicles from solar power.

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Key Solar Carport Project:

State Compensation Insurance Fund, Vacaville, CA

- Covers 90 parking spaces
- Generates 320,000 kWh per year

Location of Systems:

Cupertino Electric has built solar carports mainly in Northern California.

Area of Expertise:

Cupertino Electric is a design build and electrical contractor, but has completed numerous photovoltaic installation projects, including at AT&T Park, PG&E (San Francisco Harrison St. parking lot), and the State Compensation Insurance Fund (see above). They are a Bay Area-based company, but can work throughout the state.



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Key Solar Fuel Station Project:

AMTRAK / NJ Transit Center, Trenton, NJ (pictured right)

- Covers dozens of parking spaces



- Generates approx. 300,000 kWh annually
- Complete with vehicle charging stations which charge directly from panels



Location of Projects:

Premier Power has offices on both the West and East Coasts, so has a large national scope in terms of potential projects.

Area of Expertise:

Premier Power built one of the first solar fuel stations on the East Coast (in New Jersey, pictured above) at an Amtrak transit center. They have a good working knowledge of both solar systems and electric vehicles, batteries and charging technology.

Solar City

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Key Solar Carport Project:

- British Motors, San Francisco, CA (right)
- Dozens of parking spaces
 - Generates 370,000 kWh annually

Location of Projects:

Solar City works nationally, but is based in the Bay Area. Solar City has solar carport projects in San Francisco and other West Coast sites.

Area of Expertise:

Solar City is a national leader in solar installation and offers a bundle of technological services to complete an entire solar fuel station in-house. For example, Solar City carries C-10 Electrical and B General Contractor's License and state contractor's licenses in California, Arizona and Oregon.

Solar Power Partners

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Solar Power Partners offers Power Purchase Agreements (PPAs).

Key Power Purchase Agreement Project:

Media Retail Space in Hunters Point / Bayview neighborhood (pictured above)

- Generates approx 500,000 kWh annually w/ 1,500 solar panels spread across three privately owned buildings.
- Largest solar facility for the city of San Francisco.

Location of Projects:

Solar Power Partners (SPP) serves the continental United States and Hawaii and teams with various solar companies to build customized, renewable energy installations. SPP's customers include water districts, schools, colleges and universities, hospitals and healthcare facilities, water districts, airports, detention centers, commercial facilities, agricultural facilities, and municipalities.

Areas of Expertise:

Solar Power Partners helps businesses, institutions, municipalities and agricultural customers finance the installation of solar energy. SPP develops, owns, and operates distributed solar energy facilities (SEFs) and sells solar-generated electricity through solar Power Purchase Agreements (PPAs), long-term energy financing solutions that help customers go green without the hassles or costs of solar facility ownership and maintenance.

Coulomb Technologies

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Key Charging Infrastructure Projects:

Both San Jose & San Francisco City Halls have Coulomb Technologies ChargePoint systems installed. These are mostly for demonstration purposes, but have garnered significant press. The

systems allow customers to purchase charge time. This technology can be used in solar fuel station designs, but adds between \$500-\$3,000 to the cost of each charging space.

Key Solar Fuel Station Project:

Coulomb unveiled the first solar-powered electric vehicle charging station in the City of Chicago in the beginning of April (no images available yet). The Solar Plug-In Station is located and operational at the City of Chicago Department of Fleet Maintenance. It will be used daily by the City of Chicago to fuel the city's electric vehicles with power from the sun.



Location of Projects:

Coulomb works nationally, although they are based in the Bay Area and have done the most demonstration projects here.

Areas of Expertise:

Coulomb is a leader in developing charging and payment technology for electric car drivers. Coulomb primarily delivers networked charging stations to municipalities, electric utilities and government entities by providing.

Disclaimer: FoE does not endorse any of the aforementioned companies or groups. This list is mainly for informational purposes.



Plug-In Hybrid Electric Vehicles (PHEVs) *Fact Sheet*

What is a Plug-in Hybrid Electric Vehicle?



A Plug-In Hybrid Electric Vehicle ("Plug-In" or "PHEV") is a conventional hybrid car, such as a Toyota Prius, with a more powerful battery and a simple electric plug. Although the plug-in looks and feels like a "regular" car, its battery can be plugged in and charged at any home outlet or other charging locale, allowing 20 to 60 miles of all electric driving. It's like having an electric car with an insurance policy – you fill up at home from a standard outlet, at an equivalent cost of under \$1/gallon, and when your battery runs out, your car operates as a regular fuel-efficient hybrid.

What are the benefits of a Plug-In?

Plug-ins are fueled in part by cleaner, cheaper, domestically produced energy. This results in reduced greenhouse gas emissions and improved air quality, even when vehicles are charged on the national grid. The consumer benefits from dramatic fuel savings, reduced vehicle maintenance costs, and more free time (fewer trips to the gas station). The nation benefits because fueling from electricity reduces our dependence on imported oil and reduces our trade deficit.



What is the electric range of a Plug-In?

Electric range depends on the size of the battery in the vehicle. In general, demonstration plug-ins currently have all-electric ranges from between 25 and 60 miles. The forthcoming Chevy Volt is likely to have a 40 mile all-electric range. Plug-ins can also be configured to run on a mixed mode, switching automatically between electricity and gasoline (or other liquid fuel) to maximize fuel efficiency.

Are government incentives available to help lower the upfront costs of buying a Plug-In?



Currently, a federal tax credit is available which provides consumers with \$2,500 to \$7,500 per plug-in vehicle purchased, after December 31st, 2008, based on the mileage range of the battery. The credit expires at the end of 2014. State and local incentives may also be available; check your state and local government websites for more info.

(over)

Aren't you just moving the pollution from the car's tailpipe to the coal powered electrical plant?

No. Recent studies demonstrate that emissions of most pollutants and greenhouse gases are lowered by a shift from internal combustion engines to plug-in vehicles. Further, California's grid is rapidly becoming cleaner as a result of state goals to incorporate at least 20% renewable energy sources like solar and wind into the grid by 2012 and 33% by 2020. As grid electricity continues to get cleaner, the environmental benefits of plug-ins only increase.

Where can I get a Plug-In?



Both General Motors and Toyota have publicly stated that they are on a production course to bring plug-ins to market by 2010. Many other automakers are following suit in coming years, including Chrysler, Nissan, Volvo, Saab, Mercedes and BMW, to name just a few. In the meantime, some small companies and non-profits are converting conventional hybrids, such as the Toyota Prius, into Plug-ins to demonstrate that these cars are a viable near-term transportation solution.

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