



# Solar Energy: A Global Perspective

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Germany, Spain and Japan are leading the world in integrating solar technologies into their energy policies. Now, the United States is starting to make solar a priority as well. Here, Alex Fong reviews solar policies around the globe and highlights successes and challenges.

Solar technology is certainly not new, but its prominence in the energy policy marketplace is. For the past three decades, the cost of electricity has been relatively low, so there has not been much incentive to develop solar-based solutions.

Now, however, worldwide energy demand is soaring. Although prices have declined recently due to the recession, there is little doubt that growth in energy-hungry developing economies such as China and India will escalate the demand once the economy recovers.

There is also a clear consensus in the scientific community that a continued reliance on fossil fuels may result in a rise in global temperatures. According to the U.S. Department of Energy, on average, humans are emitting 16 million tons of carbon dioxide into the Earth's atmosphere every 24 hours.

For these reasons, solar technology has taken on fresh relevance in the minds of both policymakers and the public. Many countries, including Germany, Spain and Japan, have already recognized the need to integrate alternative energy sources into their policies early in the decade. They have developed programs that have put them at the forefront of solar and wind power today. In 2008, world solar

photovoltaic market installations reached a record high of 5.95 GW—an increase of 110 percent over 2007 figures; Europe accounts for 82 percent of the demand.

The United States has lagged behind other countries in developing solar and other clean-tech sources. However, the Obama administration's explicit support for such initiatives, and his appointment of OSA Honorary Member Steven Chu as Secretary of the Department of Energy, signal a fundamental policy shift. Chu's appointment underscores the pivotal role that technology and R&D will have in identifying the next generation of energy solutions.

The administration plans to double the production of alternative energy in the next three years. Solar power—both thermal and photovoltaic—is a key component of a policy portfolio that leverages wind, biofuels, hydrogen power, natural gas, hydroelectric energy and nuclear power. In his speech to Congress, Obama proposed as an objective to “ensure [that] 10 percent of U.S. electricity comes from renewable sources by 2012, and 25 percent by 2025.” In addition, the current stimulus bill includes a provision of \$6 billion in loan guarantees for renewable energy projects,

with a focus on solar, and \$79 billion in renewable energy, energy efficiency and green transportation programs.

The U.S. Solar Energy Industries Association says that it expects much activity in 2009 in the expected energy bill, which is likely to include provisions to upgrade and expand U.S. transmission infrastructure and put a renewable portfolio standard with specific goals or requirements for solar in place.

## Global impact, global policy

Despite its limited exposure to sunlight, Germany has emerged as the leader in solar energy, producing half of the world's solar power. This is largely due to a progressive political climate that favors alternative energy, and specifically the introduction of the Renewable Energies Laws in 2000. These laws fund incentives to develop and commercialize solar by adding charges of about a tenth of a cent to the consumer cost of power from old-line utilities. Solar panels are ubiquitous and integrated throughout Germany's infrastructure; 75 percent of the world's largest photovoltaic plants reside there.

More than 500 firms participate in Germany's \$9.5-billion solar industry,

which grows at a rate of 20 percent per year. German exports accounted for 15 percent of worldwide sales of solar panels and other photovoltaic equipment in 2006.

Spain has a solar industry that has benefited from favorable government policy via a Royal Decree introducing “feed-in tariffs,” which are similar to Germany’s Renewable Energy Laws. And, unlike Germany, Spain has a favorable geographical location that provides a generous share of sunlight year-round. It has also acquired generation property in the U.S. Southwest.

Similarly, buoyed by government subsidies, Japan is the world’s leading exporter of photovoltaic solar cells. The country accounts for almost 40 percent of global production. Its government has recently embarked on the ambitious goal of equipping a third of all households with solar panels by 2030. In addition, it plans to set aside \$21 million to create a research institute to improve the cost-benefit ratio of solar cells. However, the subsidy policy has been controversial. It was eliminated two years ago only to re-emerge in response to a decline in the industry.

Until recent economic setbacks, China and Taiwan’s photovoltaic industries leveraged low labor costs to witness growth rates as high as 25 percent per year as major exporters to Germany and Spain. China and Taiwan increased their share of global solar cell production, rising to 44 percent in 2008 from 35 percent in 2007. India has also sought to invest in developing a solar industry.

The Chinese government has used direct subsidies and regulatory means to drive adoption of solar into the country’s infrastructure and has engaged in public education to promote solar. As with other producers of photovoltaics, the country has encountered an obstacle to growth due to worldwide shortages in polysilicon.

The United States continues to host most of the world’s concentrated solar thermal power capacity. However, solar currently represents less than 1 percent of the total of energy sources, and the industry has had limited support from federal government subsidies

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and incentives, the latter of which are based on tax credits aimed at bringing solar into parity with traditional energy sources. So far, in the United States, support for solar has been mainly at the state level; the most growth has occurred in California, New Jersey and Nevada.

Nevertheless, solar energy manufacturing grew 74 percent in 2007, led by the expanded capacity of thin-film photovoltaic, silicon manufacturing and other equipment production. Installed grid-tied solar photovoltaics grew more than 48 percent in 2007 compared to 2006 and, as of 2008, the United States became the third-largest installer of photovoltaic solar energy worldwide, behind Europe and before Japan.

### Meeting the challenge

Yet grid-tied solar polysilicon-based photovoltaics are not cost-effective compared to off-grid implementation, which is a potential boon for rural and developing areas. Unfortunately, however, off-grid solutions are not being widely adopted due to high upfront costs. The increasing scarcity of polysilicon is also driving up costs.

Solar thermal has lower upfront costs but is also much less efficient and not yet competitive with legacy sources on cost. Thin-film photovoltaics may address both upfront costs and operating efficiencies but is still under development. Investment is required to tip the balance towards a self-sustaining economic model.

Due to an adjustment in its solar tariff program, Germany has recently reduced the amount of tariff by 10 percent, while Spain has implemented a cap on its tariff program, restricting the number

of eligible solar installations. The declining incentives in Europe coupled with an increased worldwide supply are expected to lower the costs of solar, put pressure on suppliers, and force an industry-wide shakeout that may make adoption more affordable elsewhere.

In the United States, the recently passed economic stimulus bill contains key items favorable to solar energy. These include the creation of a Department of Treasury Grant Program, improvement to the investment tax credit by eliminating International Trade Commission penalties for subsidized energy financing, a new U.S. Department of Energy Loan Guarantee Program, tax incentives for manufacturing, and a 30 percent refundable tax credit for the purchase of manufacturing equipment used to produce solar material and components.

As an international society, OSA advocates research and development in alternative and efficient energy generation and conservation. In fact, in February of this year, the Society adopted a formal position stating that it supports government funding and incentives that spur innovation in optics and photonics in order to foster new energy technologies.

Developing nations stand to benefit most from adopting solar. According to the United Nations, more than 2 million villages worldwide are without electric power to supply them with water, refrigeration, lighting and other basic needs. Moreover, the cost of extending the utility grids is prohibitive. Solar photovoltaics represent a viable, localized solution for managing energy needs in fragile and isolated regions.

When solar technologies have been given the opportunity, they have proven to be effective in contributing to both the needs of energy consumers and the environment. Incentive programs funded either through tax credits or direct subsidies have helped put solar on equal footing with other legacy sources of energy. ▲

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