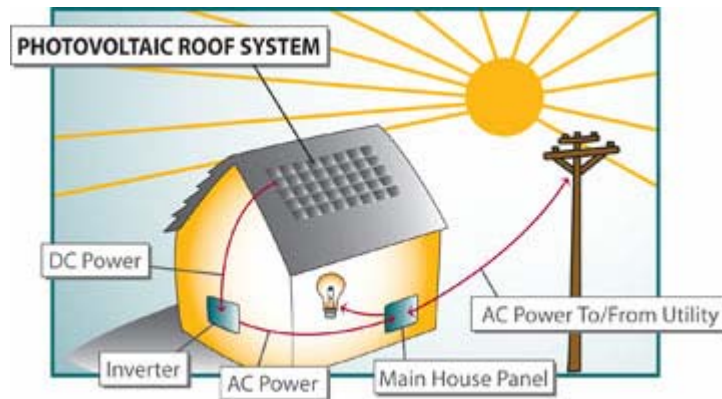


## Technology Basics: How Do Photovoltaics, or Solar Cells, Work?

Photovoltaic (PV) devices generate electricity directly from sunlight via an electric process that occurs naturally in certain types of material. Crystalline silicon - the same material commonly used by the semiconductor industry - is the material used in 94% of all PV modules today.

PV modules generate direct current (DC) electricity. For residential use, the current is then fed through an inverter to produce alternating current (AC) electricity that can power the home's appliances. (See graphic at right.)

In 2005, **82%** of all PV systems in the world were on homes and businesses that remained connected to the electric grid. Consumers use their grid-connected PV system to supply some of the power they need, and use utility-generated power when their power usage exceed the current PV system output (e.g., at night). In 39 US states, the owner of a grid-connected PV system can sell the electricity back to their local utility, watch their meter spin backwards, and receive a credit on their electric bill - a process called **net metering**. The electric grid thus serves as a "storage device" for PV-generated power. A complete listing of state and utility regulations for PV net metering is available at [www.dsireusa.org](http://www.dsireusa.org).



## Why Solar? A Near-Term Answer to Natural Gas Prices and Economic Development

The growth of solar in the US has myriad benefits for the nation, including:

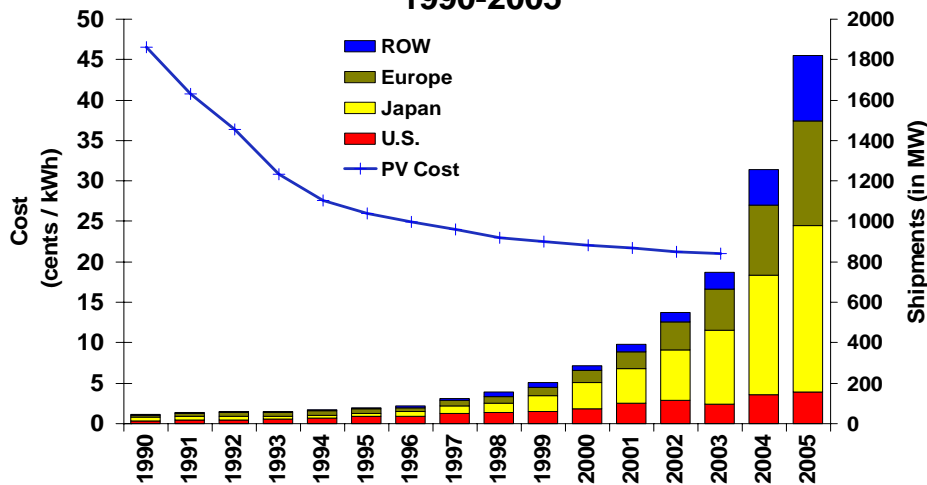
- **Consumer savings** – Wholesale natural gas prices have more than tripled since 2001, leading to skyrocketing electric rates for consumers. Through displacement of natural gas, and reducing use of the most costly peaking power plants that drive gas pricing, PV can save US consumers tens of billions of dollars in the near-term.
- **Growing domestic employment** – The industries' current expansion is on track to create more than 30,000 high quality US jobs by 2015 in manufacturing, engineering, and construction, many in small businesses. Watt for Watt, solar employs more labor than any other energy industry.
- **Secure, reliable, domestic energy** - PV stabilizes electricity prices and protects against power interruption, shortages, and price swings.
- **Clean generation and reduced water consumption** – Worldwide PV installations today avoid roughly 8 million metric tons per year of CO<sub>2</sub> emissions. PV also uses 98% less water per MWh than the most efficient natural gas generation.

## The Global Manufacturing Picture: Robust Industry Growth, Steady Reduction in Prices

Worldwide, the PV industry sold over \$15 billion of new product in 2005, continuing a five-year trend of 30%+ annual market growth.

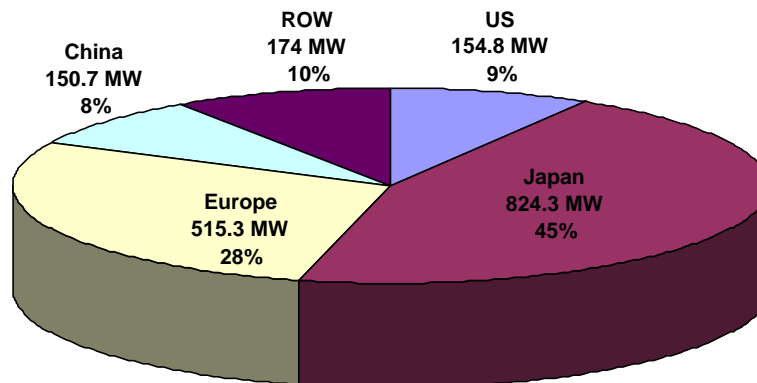
Thanks to national R&D programs and major capital investments in manufacturing, solar PV costs 1/10 what it did in the 1980s. Each doubling in cumulative manufacturing has brought prices down by ca. 18%. With electric rates and natural gas prices skyrocketing nationwide, if manufacturing continues to scale up and significant R&D commitments are made, continued progress will bring rooftop solar costs below retail electricity rates in the US.

### PV Cost to Consumers and Manufacturing Shipments, 1990-2005



However, while worldwide production of PV cells increased by 45% in 2005, the United States – once the global leader in PV manufacturing – fell in market share from 11 percent in 2004 to less than 9 percent. The surging player in the industry was China, which increased production from 51.8 MW in 2004 (4.1% market share) to 150.7 MW (8.3%) and now trails the US by the slimmest of margins. Japan remains the dominant country in PV manufacturing.

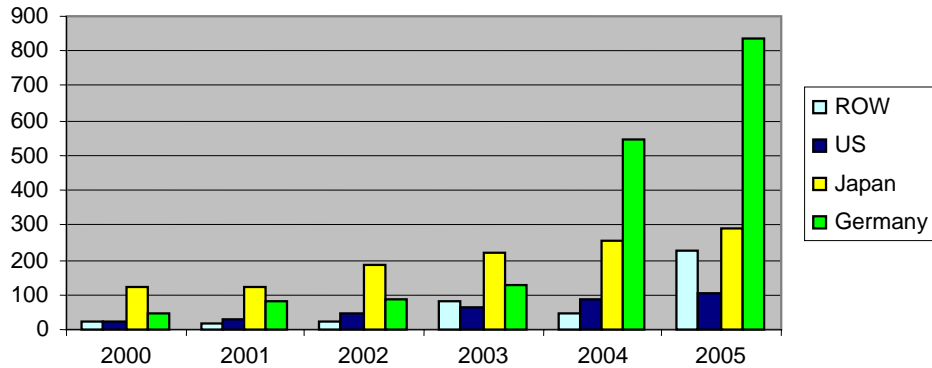
### PV Manufacturing Share by Country, 2005



## PV Installation Markets

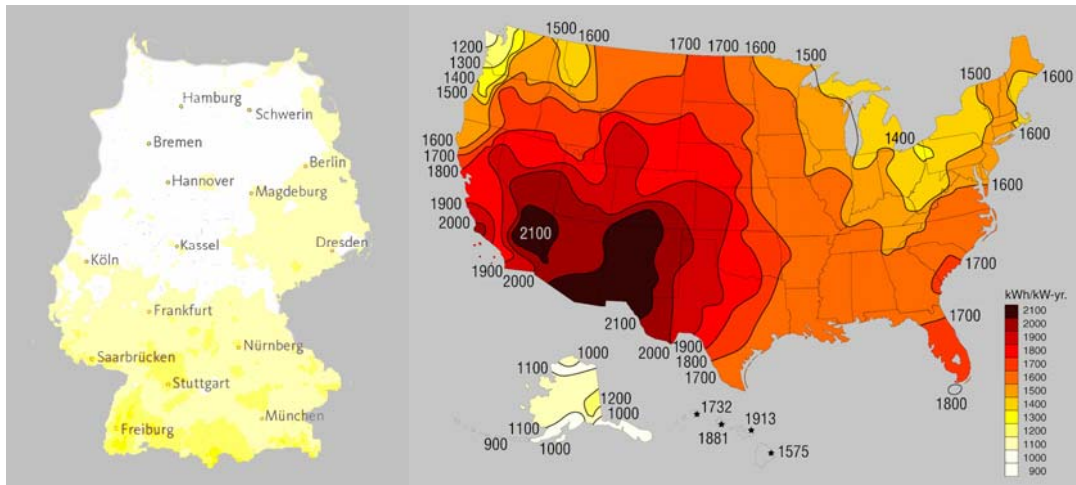
The United States now has an estimated 467 MW of installed PV capacity, approximately 55% of which is connected to the electric grid. This PV capacity is enough to power about 240,000 homes. In 2005, the two largest US state markets alone (California and New Jersey) combined for \$360 million in sales revenue (45 MW installed).

**Annual PV Installation Market by Country (in MW), 2000-2005**



However, the US lags behind Germany and Japan in installations as well as in manufacturing. Germany and Japan have surged to the lead with coherent, long-term national incentive policies, despite dramatically inferior amounts of sunshine (see chart below).

**Solar Resources: Germany and Japan vs. United States**  
(in kWh of solar electricity produced per kW of solar capacity)



## Policy as Market Driver

Germany and Japan have taken the lead in solar manufacturing and installations because of long-term national incentive policies designed to make solar power mainstream. Germany incentivizes solar installations by paying 3 – 4 times retail electric rates for the electricity generated from PV systems, while Japan instituted a carefully designed rebate program that phased out over the last ten years.

The United States, on the other hand, offers a patchwork of more than 50 distinct markets, each with its own interconnection and net metering rules, and until 2006 had no incentives for individual installations of solar. Yet, states have increasingly invested in solar power development; in the past decade, the number of states with solar rebates has risen from just one to 26, and the number of states with net metering increased from 11 to 36.

### Federal Incentives

Federal solar tax credits enacted in the Energy Policy Act of 2005 have taken effect and SEIA member companies are reporting a 10- to 20-fold increase in consumer interest thus far. In 2006 and 2007, spending on eligible solar property may qualify businesses and homeowners for a tax credit worth 30% of system costs (for homeowners, the cap is \$2,000). A comprehensive tax manual for the credits is now available at [www.seia.org](http://www.seia.org).

### Top US State Markets

Fifteen states offer homeowners tax breaks for solar energy, which may include income tax credits, sales tax exemptions, and property tax exemptions. In twenty-six states, state or local governments offer direct solar rebates. A complete listing of state and federal incentives for solar is available at the Database of State Incentives for Renewable Energy, [www.dsireusa.org](http://www.dsireusa.org).

**California** is the dominant PV market in the US and the fifth largest market for PV in the world. More than **15,000** systems have been installed on homes and small businesses connected to the electric grid as of December 2005 under the California Energy Commission's rebate program. The California Public Utilities Commission recently created an 11-year, \$3.2 billion program to provide homeowners and businesses with rebates for installing grid-connected PV. Within three years, the annual PV market in California will exceed the entire US market in 2005.

Another state with a highly successful program is **New Jersey**, which provides a \$5.10 per Watt rebate and an exemption from the sales tax. Owners of PV systems receive a solar renewable energy certificate (SREC) for each megawatt-hour of solar electricity produced by their system, which they can sell to utilities or middleman brokers on the open market. The SRECs are used by NJ utilities to meet a state **renewable portfolio standard (RPS)**, which requires an increasing amount of the power they provide to come from renewable energy. Nineteen states and the District of Columbia have passed RPS; Colorado, Nevada, New Jersey, Pennsylvania and DC all feature solar requirements within their RPS.

The Northeast market (outside of New Jersey and California) is the third largest market for PV. **Massachusetts, Connecticut, and New York** offer substantial rebates on PV consumers and the cost of retail electricity is significantly higher in the Northeast than in southern states; for example, the average price in Massachusetts in 2005 was 40 percent higher than in Florida, according to the Energy Information Administration.