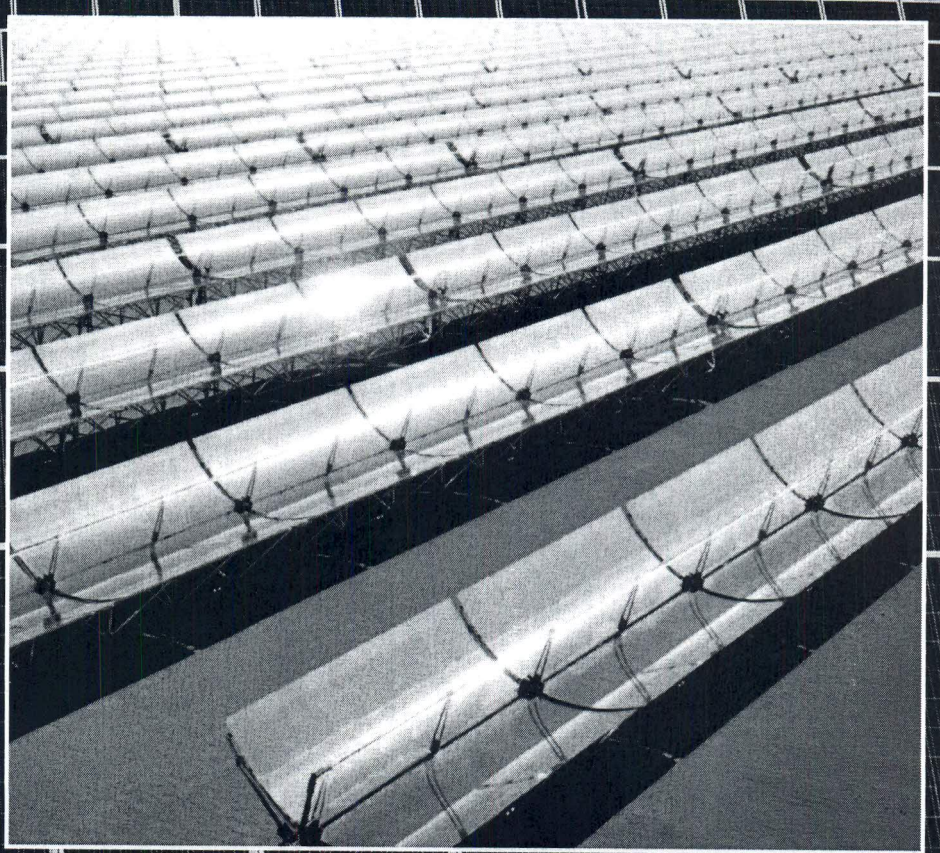
U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

2008 SOLAR TECHNOLOGIES MARKET REPORT



JANUARY 2010

tilting stationary PV modules to maximize annual sunlight exposure or by incorporating one- or two-axis solar tracking systems, which rotate the modules to capture more normal sunlight exposure than is possible with stationary modules. Figure 3.5 shows the effect of insolation and use of tracking systems on PV capacity factors. Fixed tilt (at latitude) capacity factors are 14%–24% for Seattle to Phoenix, whereas 1- and 2-axis tracking systems result in higher ranges. Analysts sometimes use 18% or 19% for an average U.S. PV capacity factor.[35]

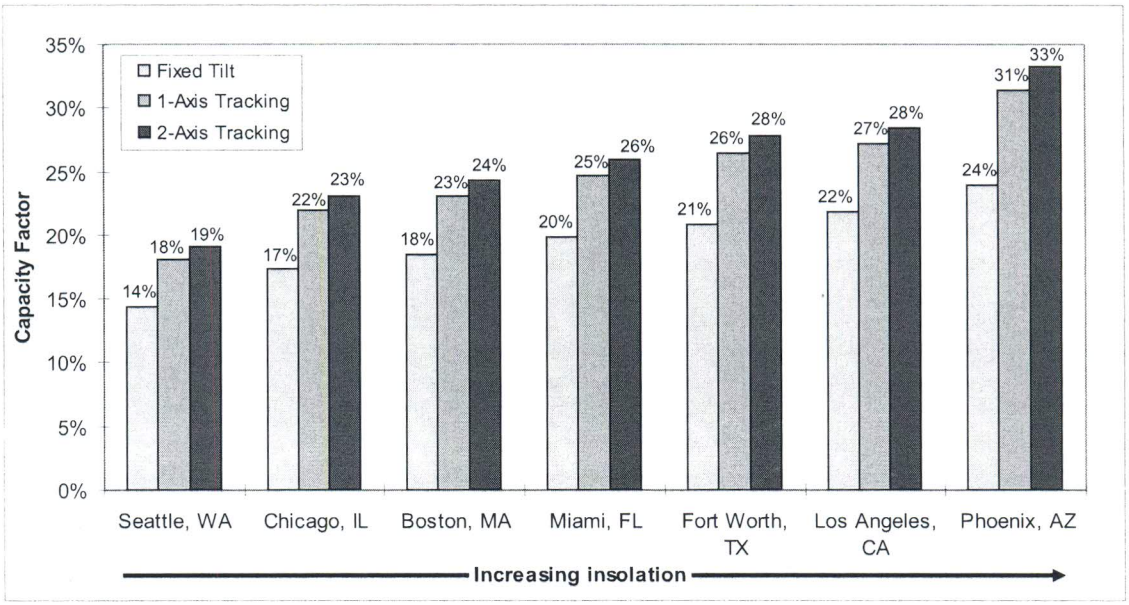


Figure 3.5. PV capacity factors varying by insolation and use of tracking systems (NREL 2009b)[36]

The most recently built CSP trough, tower, and dish-engine systems have AC capacity factors in the mid-20% range. With 6 hours of thermal storage, capacity factors increase to about 40%, and additional increases in thermal storage will enable capacity factors and dispatchability (the ability to increase or decrease electricity generation on demand) to increase even more.

3.3 PV Cell, Module, and System Efficiency

In addition to the solar resource and capacity factor discussed above, the amount of electricity produced by PV systems depends primarily on the following factors:

- Cell type and efficiency
- Module efficiency
- System efficiency
- Module reliability.

[35] These are DC capacity factors, i.e., based on the DC rating of a PV system and taking into account inverter and other system losses. By definition, they are lower than an AC capacity factor, which is how fossil, nuclear, and CSP plants are rated and thus are not directly comparable to more traditional AC capacity factors.

[36] Capacity factors were estimated using data from NREL's PVWatts, a performance calculator for on-grid PV systems: http://rredc.nrel.gov/solar/codes_algs/PVWATTS/version1/. The capacity factors shown here reflect an overall derate factor of 0.77, with the inverter and transformer component of this derate being 0.92, the defaults used in PVWatts. The array tilt is at latitude for the fixed tilt systems, the default in PVWatts.

new inverters and controllers with interfaces to energy-management systems; and 2) Established monitoring of large-scale PV performance at high-penetration sites in California, Colorado, and Hawaii to better understand how high levels of PV impact the grid and reduce installation costs.

The Market Transformation subprogram[87] promotes the commercialization of solar technologies by addressing non-R&D barriers to solar energy adoption. Activities include codes and standards development, outreach to state and utility decision makers, workforce development, solar installation technical assistance, and the Solar America Cities program. DOE partners with several organizations including the Solar America Board for Codes and Standards, the Solar Electric Power Association, the Interstate Renewable Energy Council, the National Association of Regulatory Utility Commissioners, the National Conference of State Legislatures, and the Clean Energy Group. Highlights in FY 2008 were: 1) Strengthened the responsiveness, effectiveness, and accessibility of PV codes and standards through the Solar America Board for Codes and Standards, including release of three studies on interconnection procedures for utility regulators, solar access laws, and external disconnect switches; and 2) Expanded the Solar America Cities program from 13 to 25 partnerships, to further accelerate deployment of solar energy technologies by providing financial and technical assistance to cities committed to making solar a mainstream energy source (Figure 5.5).

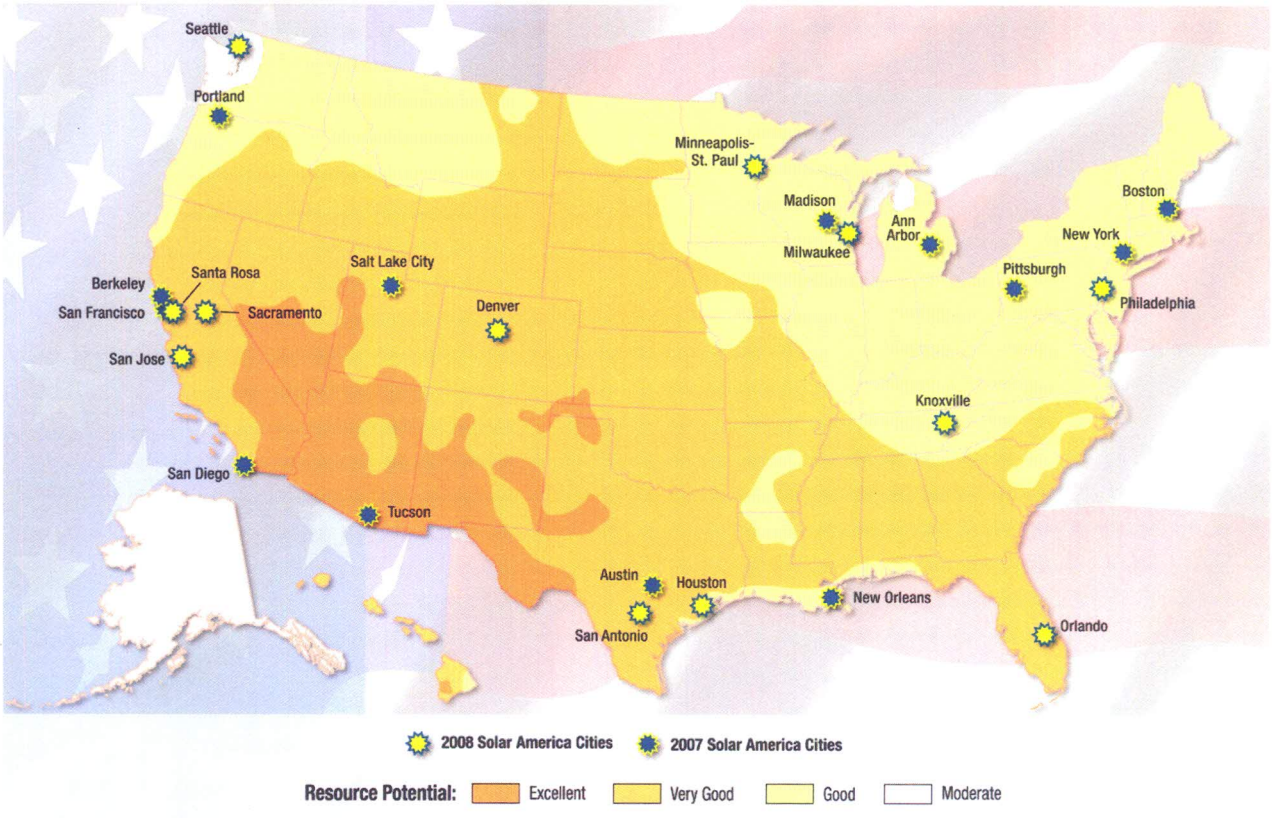


Figure 5.5. 2007 and 2008 Solar America Cities

[87] DOE SETP Market Transformation subprogram: http://www.eere.energy.gov/solar/market_transformation_program.html.