Tackling Climate Change in the U.S.

Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030

Executive Summary

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Energy efficiency and renewable energy technologies have the potential to provide most, if not all, of the U.S. carbon emissions reductions that will be needed to help limit the atmospheric concentration of carbon dioxide to 450 – 500 ppm.

Photo Courtesy: NASA

For SOLAR 2006, its 35th annual national solar energy conference last July, the American Solar Energy Society (ASES) chose to address global warming, the most pressing challenge of our time. Under the theme "Renewable Energy: Key to Climate Recovery," climate experts James Hansen of the National Aeronautics and Space Administration (NASA), Warren Washington of the National Center for Atmospheric Research (NCAR), Robert Socolow of Princeton University, and Marty Hoffert of New York University (NYU) described the magnitude of the global warming crisis and what is needed to address it.

A key feature of the conference was a special track of nine invited presentations by experts in energy efficiency and renewable energy that detailed the potential for these technologies—in an aggressive but achievable climate-driven scenario—to address the needed U.S. carbon emissions reductions by the years 2015 and 2030. These presentations covered energy efficiency in buildings, industry, and transportation, as well as the following renewable technologies: concentrating solar power, photovoltaics, wind, biomass, biofuels, and geothermal. Since the conference, these studies were subjected to additional review and were revised for publication in this special ASES report.

According to Hansen, NASA's top climate scientist, we need to limit the additional average world temperature rise due to greenhouse gases to 1°C above the year-2000 level. If we fail, we risk entering an unprecedented warming era that would have disastrous consequences, including rising sea levels and large-scale extinction of species. Limiting temperature rise means limiting the carbon dioxide (CO_2) level in the atmosphere to 450–500 parts per million (ppm).

What does this mean for the United States? Estimates are that industrialized nations must reduce emissions about 60–80 percent below today's values by mid-century. Figure 1 shows the U.S. reductions that would be needed by 2030 to be on the right path. Accounting for expected economic growth and associated increases in carbon emissions in a business-as-usual (BAU) case, in 2030 we must be offsetting between 1,100 and 1,300 million metric tons of carbon per year (MtC/yr).

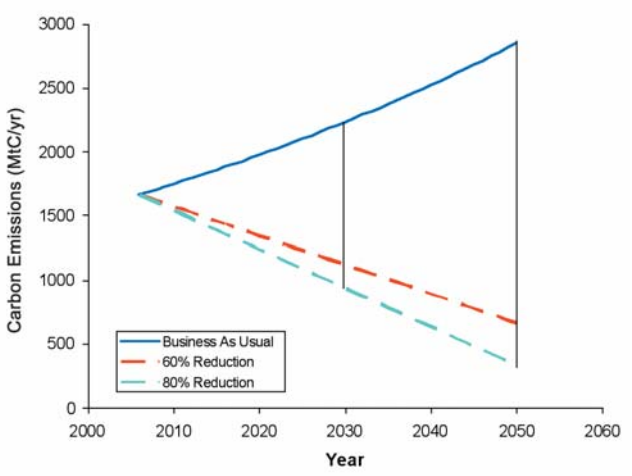

Figure 1. Triangle of U.S. fossil fuel carbon reductions needed by 2030 for a 60% to 80% reduction from today's levels by 2050.

The SOLAR 2006 exercise looked at energy efficiency and renewable energy technologies to determine the potential carbon reduction for each. The authors of the renewable technology papers were asked to describe the resource, discuss current and expected future costs, and develop supply and carbon-reduction curves for the years 2015 and 2030.

Table 1 summarizes the potential carbon-offset contributions from the various areas. (Energy efficiency contributions in the buildings, transportation, and industry sectors are combined into one number.) Figure 2 shows all the contributions on one graph. Approximately 57 percent of the total carbon-reduction contribution is from energy efficiency (EE) and about 43 percent is from renewables. Energy efficiency measures can allow U.S. carbon emissions to remain about level through 2030, whereas the renewable supply technologies can provide large reductions in carbon emissions below current values.

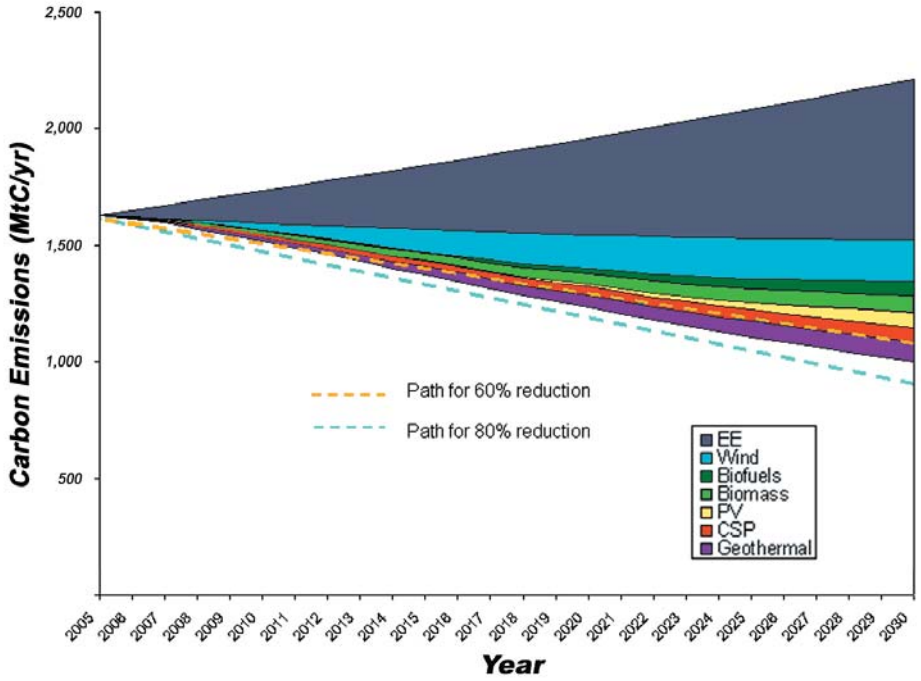

Figure 2. Carbon offset contributions in 2030 from energy efficiency and renewable technologies and paths to achieve reductions of 60% and 80% below today's emissions value by 2050.

Table 1.
Carbon offset contributions (in MtC/yr in 2030) based on the middle of the range of carbon conversions.

Energy efficiency	688
Concentrating solar power	63
Photovoltaics	63
Wind	181
Biofuels	58
Biomass	75
Geothermal	83

The U.S. is extremely rich in renewable energy resources. Figure 3 shows how the various potential renewable contributions in 2030 are distributed throughout the country.

The carbon-offset contributions for the year 2030 total between 1,000 and 1,400 MtC/yr, or an average of about 1,200 MtC/yr based on a mid-range value for electricity-to-carbon conversion. This would put the U.S. on target to achieve the necessary carbon-emissions reductions by mid-century. A national commitment that includes effective policy measures and continued research and development will be needed to fully realize these potentials. Integration of these technologies in the marketplace could reduce these numbers somewhat due to competition and overlap in some U.S. regions. On the other hand, even greater wind and solar contributions might be possible through greater use of storage and high-efficiency transmission lines.

The studies focused on the use of renewable energy in the electricity and transportation sectors, as these together are responsible for nearly three-quarters of U.S. carbon emissions from fossil fuels. Goals for renewables are often stat-

ed in terms of a percentage of national energy. The results of these studies show that renewable energy has the potential to provide approximately 40 percent of the U.S. electric need projected for 2030 by the Energy Information Administration (EIA). After we reduce the EIA electricity projection by taking advantage of energy efficiency measures, renewables could provide about 50 percent of the remaining 2030 U.S. electric need.

There are uncertainties associated with the values estimated in the papers, and, because these were primarily individual technology studies, there is some uncertainty associated with combining them. The results strongly suggest, however, that energy efficiency and renewable energy technologies have the potential to provide most, if not all, of the U.S. carbon emissions reductions that will be needed to help limit the atmospheric concentration of carbon dioxide to 450 – 500 ppm.

We hope this work will convince policymakers to seriously consider the contributions of energy efficiency and renewable technologies for addressing global warming. Because global warming is an environmental crisis of enormous magnitude, we cannot afford to wait any longer to drastically reduce carbon emissions. Energy efficiency and renewable technologies can begin to be deployed on a large scale today to tackle this critical challenge.

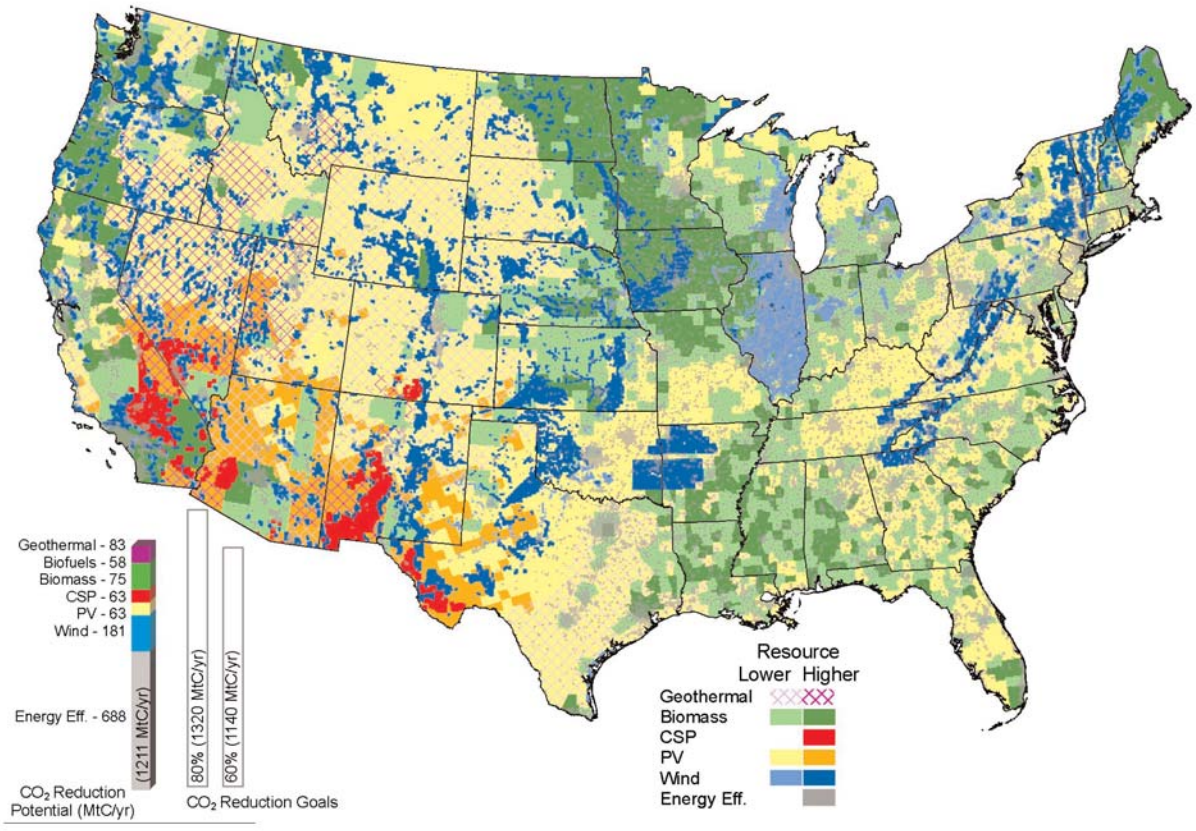

Figure 3. U.S. map indicating the potential contributions from energy efficiency and renewable energy by 2030.