

# Alternative Energy Matrix Users Guide ver.1.0

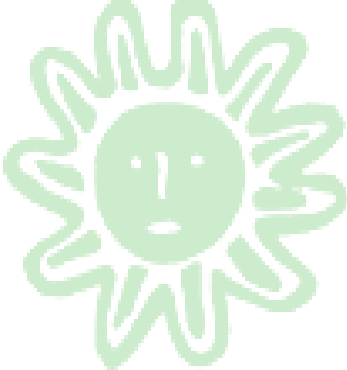


Public policies to mitigate the effects of climate change in the Southwestern United States and develop alternative energy technologies were discussed on a regional basis since 1995 without meaningful federal involvement prior to the March 2007 release of the Intergovernmental Panel On Climate Change's (IPCC) Summary Report for governments. The IPCC report was a catalyst for US citizens' understanding of climate change effects and alternative energy applications to reduce them. The matrix below considers alternative energy sources that are alternatives to fossil fuels; some alternative energy sources are definable as renewable energy, and others much less so. It was prepared to assist citizen participation in public climate change and energy policy discussions. This Matrix does not address CO2 emissions management schemes, a critical policy tool for mitigating the impact of fossil fuel derived CO2 emissions on global warming, since it manages oil and coal pollution, nor does it consider gains in efficiencies in new or retro-fitted buildings, a highly beneficial approach to energy conservation. For a fuller explanation on the relationship between climate change and energy production, see the Climate Change and Alternative Energy background paper (UNA-SA 2007).

The Alternative Energy Matrix below describes major alternative sources of energy and their applications, their viability, and policy applications. Documented research is based on findings of cited organizations. This is a publication of the United Nations Association, Southern Arizona Chapter (UNA-SA). The information herein was compiled by Don Boone and Blake Gentry. The UNA-SA supports greater public discussion of United Nations climate change initiatives. This matrix compares applied technologies fueled by alternative energy sources, their capacity for implementation, and regional geological advantages for non-hydro, non-fossil fuel, and non-nuclear energy sources. Research and development in this document is designated as R & D.

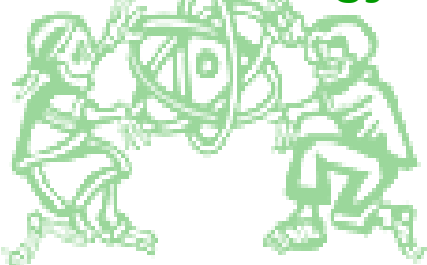


**Energy Source** – a source of energy with a commercially applicable use and scalability for industrial production or mass consumption. Preference is for renewable and sustainable production of energy. The lower the level of carbon emissions or other environmentally destructive affects, the better the source is.

**Viability** – the graded capacity (see graph 3 for comparisons: low, medium, or high) of alternative energy technology in marketable applications that reduce carbon emissions without other critical environmental effects or production of greenhouse gases at CO2 levels higher than 300 Parts Per Million. Criteria include *cost, deployment, and scalability*. Viability assumes increasing levels of private and government funded research and development, harmonization of state regulations into national legislation, and commercial applications of energy technologies. Most deployment scenarios assume a timeframe of roughly 20 years from 2007.

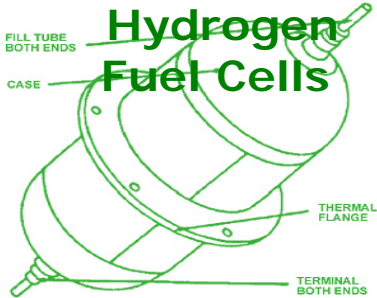
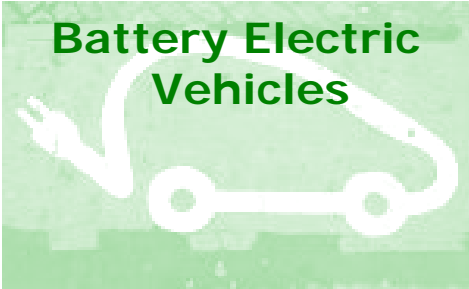
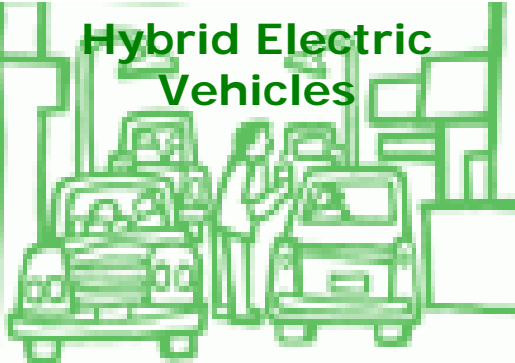
**Policy Application** – a defined use of an energy source and application given current modes of production and consumption considered acceptable by policy makers, e.g., in consumer markets, industrial production, and transport. Policies that favor an energy source may use various trade offs between carbon emissions reduction schemes, technology R & D tax breaks, production incentives, and consumption taxes for targeted R & D funds. Regional variation in policy application due to geological features are key to an overall carbons emissions reduction scheme.

Energy Source	Viability	Policy Application
<p data-bbox="352 266 638 305"><b>Solar Power</b></p> 	<p data-bbox="810 245 1377 753">Solar power is an inexhaustible source for generating heat, lighting and electricity for homes, commercial buildings, and large scale utilities. <b>Concentrated Solar Power</b> (CSP) uses large rotating banks of parabolic mirrors and other methods to focus radiant heat for storage and transmission to electricity utilities. Currently, <b>Photovoltaics</b> (PV) convert solar light into electricity for direct transmission locally or to electrical grids. PV's are arrayed in tilted rooftop panels or on ground units. CSP &amp; PV standards for deployment such as interconnection and transmission are needed. Due to current costs CSP and PV are <b>moderately viable and will increase to highly viable</b> on a large scale over time.</p>	<p data-bbox="1434 245 1894 656">U.S. catching up with Japan and Europe in R &amp; D mostly due to strong state-level policy support. Federal US government offers tax credit, but robust incentives for manufacturing and consumer education are needed. Cost is CSP's main obstacle to quick and massive scale up. Southwestern arid states and Southern California shine brightly for CSP. By 2030, CSP in the Southwest could produce the equivalent of 20% of year 2003 national electricity capacity.</p>
<p data-bbox="352 826 638 865"><b>Wind Power</b></p> 	<p data-bbox="810 824 1377 1013">One of the cleanest, most sustainable ways to generate electricity. As costs become more competitive, worldwide demand is growing exponentially. Expansive growth expected in geographically large market. <b>Highly viable</b> on a large scale.</p>	<p data-bbox="1434 824 1894 1045">Inconsistent federal government support, but record wind-power growth in U.S. is predicted for 2007. State-level renewable electricity standards are a primary driver of wind development. High Plains, Appalachia, and Western Mountain states are key regions.</p>
<p data-bbox="317 1159 680 1198"><b>Thermal Power</b></p> 	<p data-bbox="810 1146 1377 1367">New geothermal projects under development in U.S. could almost double the installed geothermal power capacity for households. Deployment of thermal power is limited regionally. <b>Moderately viable</b> in limited geographic area due to cuts in federal funding, otherwise highly viable in NW.</p>	<p data-bbox="1434 1146 1894 1399">Federal government production tax credit must be restored to previous levels to allow completion of new projects. Northwestern states feature geological advantages. Northwestern region may lack political clout to secure adequate federal funding for thermal power R &amp; D.</p>



Energy Source	Viability	Policy Application
<p data-bbox="300 272 663 318"><b>Nuclear Energy</b></p> 	<p data-bbox="772 248 1262 597">104 nuclear fusion reactors provide over 70 percent of U.S. emission-free electricity generation. US Nuclear Regulatory Commission approved site permits for a new plants in the Southeast and in Illinois. Bush administration favors expansion of nuclear power. Less vigilant regulatory burdens and renewed high level federal subsidies suggest <b>moderately viable</b> on large scale.</p>	<p data-bbox="1310 248 1820 630">Risks and barriers include proliferation of fissile materials usable for nuclear weapons, lack of permanent storage of radioactive wastes, and security concerns due to catastrophic accidents or terrorist attack. Nuclear energy requires large volumes of water; generally this disfavors arid Western and Southwestern states, favors Great Lakes area and Southeastern US. Projection for nuclear as percentage of national energy use is around 20%.</p>
<p data-bbox="348 719 657 764"><b>Corn Ethanol</b></p> 	<p data-bbox="772 699 1262 984">Corn ethanol reduces burning of gasoline or diesel, but overall reduction of heat-trapping emissions is small to none. <b>Viability is moderate towards low</b> on large scale over time due to 1) unfavorable comparative carbon emissions, 2) highly subsidized production in a 3) highly monopolized industry in a protected market.</p>	<p data-bbox="1310 699 1820 1049">Ethanol produced in U.S. from switch grass or perennial grasses has lower carbon emissions than corn ethanol, which consumes more energy per unit in production than it provides as a fuel. Upper Midwest and Upper Plains, Southern, and Northwestern states show promise. US corn producers grain subsidies are largest worldwide. Policies designed to shift subsidies to alternative grasses are desirable.</p>
<p data-bbox="417 1138 642 1183"><b>Bio-Fuels</b></p> 	<p data-bbox="772 1122 1262 1341">Produced from plant materials and animal waste, include all forms of ethanol. Numerous environmental benefits. Supplies 15 times as much energy in U.S. as wind and solar power combined. <b>Moderately to Highly viable</b> on large scale, deployment is growing.</p>	<p data-bbox="1310 1122 1820 1373">A truly sustainable biomass energy system replaces fossil fuels with biomass or other renewable energy sources. Government support of R &amp; D is on - going. Upper Midwest and Upper Plains states have the most potential, though other regions produce useable plant material as well.</p>

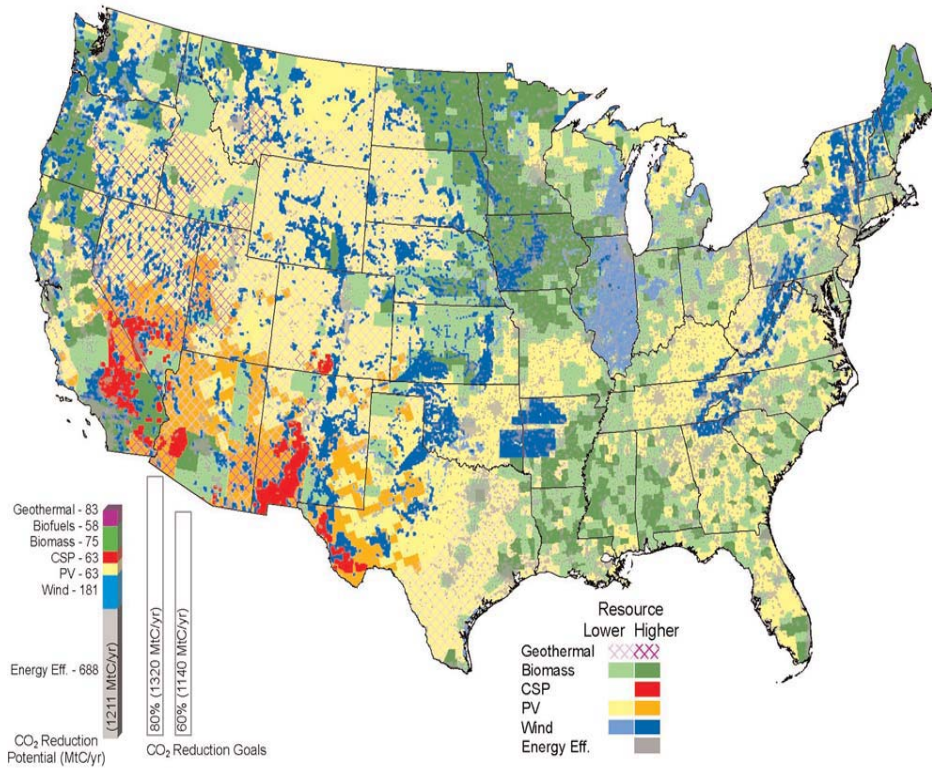


Energy Source	Viability	Policy Application
 <p><b>Hydrogen Fuel Cells</b></p>	<p>Widely hailed as a major solution for reducing our oil dependence and eliminating pollution from our transportation system. A long term commitment to research is needed to produce hydrogen cells for fuel storage conversion. If successful, hydrogen fuel cells could largely replace fossil fuels. <b>Viability is low</b> due to immature technology without deployment.</p>	<p>Development will take decades. Strong national policies needed to ensure development of renewable-based hydrogen. Possible application to large scale industrial and residential energy needs, as well as transportation. Costly reconstruction of fuel stations will be required nationwide. Initial public subsidy and regulatory oversight are called for.</p>
 <p><b>Battery Electric Vehicles</b></p>	<p>More energy-efficient than internal-combustion vehicles. Produce no emissions when running. Future depends largely on improvements in battery performance and scaled up production,. <b>Low to Moderate viability</b> mostly due to technology R &amp; D and weak deployment due to low electrical grid transmission capacity.</p>	<p>Promoted in the U.S. through tax credits. Major US auto makers and federal research institutions have produced Battery Electric Vehicles but do not market them. R &amp; D funding needed to solve technical and infrastructure challenges such as battery storage capacity, under capacitated electricity market, and publicly accessible recharging stations.</p>
 <p><b>Hybrid Electric Vehicles</b></p>	<p>Fuel economy is considered the single most important step for cutting oil dependence in the near to medium term. Hybrids reduce global warming emissions and air pollution. Japanese and US manufacturers successfully brought vehicles to market. Combined with efficient ethanol, Hybrid electric vehicles cost consumers less overall. <b>Highly viable</b> as a transitional technology, immediately produces lower carbon emissions.</p>	<p>Hybrids are currently the largest transitional technology for transport. Unlike battery electric vehicles, hybrids generate storable electricity not requiring “refueling” at “fuel” stations. As oil prices increase, consumers of hybrids may acculturate more easily to newer technologies. Federal funding of research and development can accelerate the transition.</p>



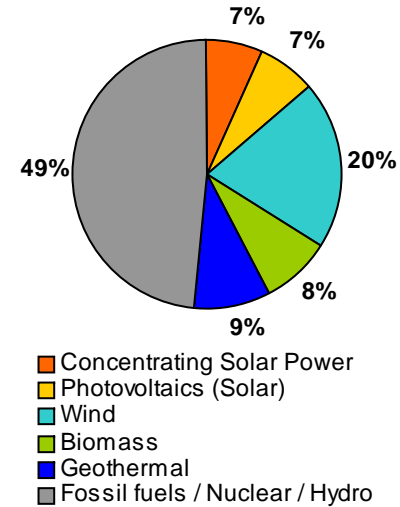
# Deployable Energy Sources in The United States

**Graph 1.** Potential CO2 Reductions from Efficiency and Renewable Energy by 2030



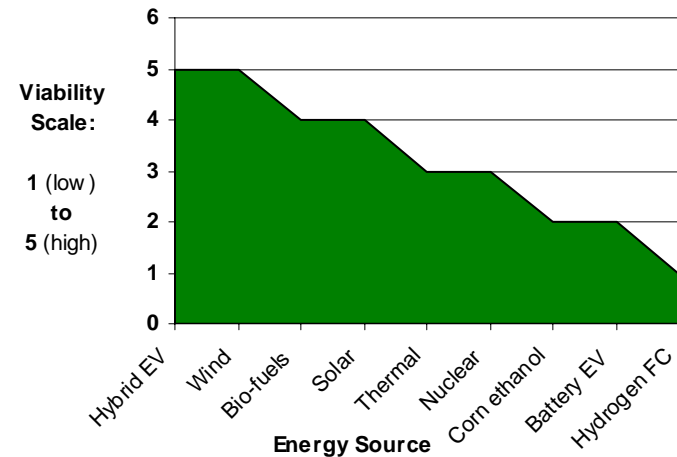
source: ASES: Tackling Climate Change, figure 28 p36, Jan 2007

**Graph 2.** Energy Sources as Percentage of National Electrical Grid by 2030



data source: ASES:Tackling Climate Change, based on table 3 p34 Jan 2007

**Graph 3.** Alternative Energy in US by 2030  
 based on 2007 Alt. Energy Matrix assumptions



source: UNA -SA Alternative Energy Matrix May, 2007



## Topical References

The Alternative Energy Matrix drew information from two main sources: The American Solar Energy Society's (ASES) book Tackling Climate Change in the U.S. (Emissions Energy Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030) , and the Union Of Concerned Scientists website section on Energy (see. [www.ucs.org](http://www.ucs.org)). Both institutions document extensive research based findings. The ASES book is also available in full text and in summary online (see:[ases.org](http://ases.org)). *Acknowledgements:* All websites accessed April, 2007. Graphics attribution from Rini Templeton ([www.riniart.org](http://www.riniart.org)). Special thanks to Ardeth Barnhart and Brad Collins for critical comments. Matrix available at: [www.untucson.org](http://www.untucson.org).

### Alternative & Renewable Energy

[ases.org](http://ases.org) (American Solar Energy Society)

[renewableenergyaccess.com](http://renewableenergyaccess.com)

[eere.energy.gov](http://eere.energy.gov) (Energy Efficiency and Renewable Energy, Department of Energy)

[epa.gov/climatechange](http://epa.gov/climatechange) (Environmental Protection Agency)

[fueleconomy.gov](http://fueleconomy.gov)

[nrel.gov](http://nrel.gov) (National Renewable Energy Laboratory)

[ucsusa.org](http://ucsusa.org) (Union of Concerned Scientists)

### Climate Change and Environment

Arizona Daily Star newspaper ( 3/11/07)

Financial Times newspaper FT: 3/20/07

[socialfunds.com](http://socialfunds.com) 3/27/06

USA Today 5/31/06

### State Energy Policies

[westgov.org](http://westgov.org) (Western Governors Association)

[azcommerce.com](http://azcommerce.com) (Arizona Department of Commerce)

### Federal Energy Policies

Tucson Citizen newspaper (4/3/07) r.e. US Supreme Court decision.

Worldwatch magazine (Nov./ Dec. 2006) r.e. state energy policy initiatives.