

Discussion Analysis

prepared for willyoujoinus.com by: THE ASPEN INSTITUTE



How do renewable energies become more cost competitive and provide a bigger share of the world's energy mix?



This discussion analysis is based on all of this topic's past user-submitted comments on willyoujoinus.com. The comments and opinions posted on willyoujoinus.com, including those of the Expert Contributors, are the opinions of the individual contributors and may not express the views or beliefs of Chevron Corporation.



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Overview

Discussion Highlights Included:

- How renewable energies can become more cost competitive and provide a bigger share of the world's energy mix
- Challenges to making renewable energy more mainstream
- Proposed steps that government, industry and investors should take to make renewable energies a bigger part of the energy mix
- Individual consumers' influence on the renewable equation

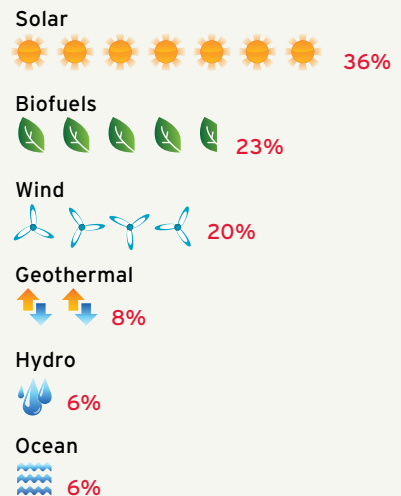
Discussion on this topic began on June 30, 2007 and ended September 4, 2007.

Participants in this discussion saw renewable energy technologies as an important part of the solution to the problem of higher prices and declining availability of fossil fuels.

The nurturing of renewable energy technologies was seen as mainly a government responsibility and, to a lesser extent, an industry responsibility. There were relatively few mentions of steps that individual consumers could take. Government subsidies were the most frequently mentioned policy measures for promoting renewable energy, followed by carbon taxes on fuels or cap-and-trade programs for greenhouse gases.

Respondents often sought to broaden the discussion beyond renewables, to include the need for other long-term energy solutions including greater reliance on nuclear power, conservation, energy efficiency, and lifestyle changes.

Renewable energies most mentioned in this discussion:





Introduction

The main sources of primary energy in large, industrialized countries are fossil fuels (coal, oil, and gas). Renewable energy sources, including hydro, wind, solar, biomass, and geothermal, together supply only about 7 percent of the energy consumed in the United States. In business-as-usual projections by both U.S. and international agencies, roughly the same proportions of fossil and renewable energy sources are projected to be utilized worldwide in the year 2030. Many consider this projection to be unacceptable, for three reasons: 1) the negative economic impacts of excessive reliance on imported fossil fuels; 2) the negative energy security implications of excessive reliance on imported fossil fuels; and 3) the greenhouse gases released by the burning of fossil fuels and their negative impacts on the global climate.

Renewable energy sources tend to be much more widely distributed than fossil resources, and generally have lower emissions of greenhouse gases. However, sources such as wind and solar are currently more expensive than fossil energy sources—though their costs have steadily declined in the past 20 years while the costs of fossil sources have been increasing. Correspondingly, the compound growth rate of deployed renewable technologies such as solar photovoltaic and wind power has recently been on the order of 20%,¹ compared with a few percent for conventional fossil technology growth rates, although the renewables start from a much smaller base.

If the costs of renewable energy technologies can be made more competitive with conventional technologies, many countries have enough renewable capacity to have an impact on all three of the concerns regarding fossil fuel dependence above: economic impacts; energy security; and global climate change. However, to realize these benefits, active steps will have to be taken by governments, corporations, and individuals to change the business-as-usual scenario. These steps comprise the heart of the question posed for this discussion, and the responses are described below.

¹ Presentation by Steve Chalk, Deputy Assistant Secretary for Renewable Energy, U.S. Department of Energy to National Research Council Panel on Renewable Energy, September 18, 2007.



Why pursue renewables

Answers to the topic question were more focused on the economic and energy security motivations for pursuing renewable energy sources than on global climate change impacts. The idea that world oil production is near its peak and will decline in the future (with associated high oil prices and energy security implications) was often cited as a reason for considering alternative energy sources. The notion that renewable energy sources are widely available and therefore can contribute to energy independence, and become a new income source for rural communities, is also appealing to many of the respondents.

Some respondents mentioned climate change as a reason to pursue renewable energy but, as in previous discussions, they were immediately challenged by a vocal group of skeptics who question the now widely accepted proposition that human activities—specifically fossil fuel use—are contributing to global climate change. This group believes that the observed warming is due to natural cycles that occur over geologic time and to which we must adapt. The passion with which these skeptics expressed their views may have discouraged further dialogue on this subject.



Types of renewable energy²

Technologies ordinarily considered to be renewable are: hydroelectric; solar (both photovoltaic and thermal); wind; biomass; geothermal; and ocean (wave, tidal, thermal/electric). One discussion sidelight, however, challenged the conventional definition of “renewable,” noting that in fact the sun is burning out and therefore ultimately not renewable, while other technologies such as nuclear (particularly breeder reactor technology) exhibit certain renewable characteristics in that fuels could be regenerated and used for a long time. Thus, according to this argument, the definition of renewable is somewhat fuzzy, and it has more to do with the timescale on which a resource is available rather than whether it is technically regenerable. Using the more conventional definition of renewables, those most frequently mentioned in a favorable light by the respondents are given below.

Hydroelectric

Hydroelectric technology is mature in the U.S. and presently accounts for over 80 percent of all electric power generated from renewable sources. Perhaps because of its maturity, hydro was only mentioned by 4 respondents. A somewhat related technology involving the placement of turbines underwater in rivers to harness the energy of the current received an additional 2 mentions. The U.S. Department of Energy has funded the development of turbines that can harness river currents efficiently while allowing fish to pass through unharmed, and further development work is underway.

Solar

Solar energy was mentioned positively by 34 respondents, including 29 mentions of solar photovoltaic and 5 mentions of solar thermal. This breakdown is interesting because solar photovoltaic technology is more expensive and is believed to have less near-term potential for power generation than solar thermal technology. The explanation is probably that solar photovoltaic technology is more familiar to most people, who have seen gadgets such as solar powered calculators or solar panels on rooftops, while concentrated solar thermal technology has not been as widely considered. There was considerable discussion about how to reduce the costs of solar cells. Ideas included more R&D, subsidies, and the likelihood that manufacturing costs would come down as production volumes increase.

² In this analysis, a “mention” refers to a positive mention in a comment. One respondent could mention a number of different technologies or policy instruments, but multiple mentions of the same technology or policy instrument by the same individual were not counted separately.



Respondents recognized that intermittent power sources such as solar photovoltaic require a storage medium to provide power when the sun is not shining. Suggested storage technologies included batteries and hydrogen gas derived from electrolysis of water. One rather speculative technology suggested to avoid the need for storage was to use satellites or the space station to collect solar energy continuously; it was noted, however, that the problem here would be getting the energy back to Earth. Suggestions included microwave or laser beams or extremely lightweight carbon nanowire.

Wind

Wind generation of electricity received 19 positive mentions in the discussion. One respondent noted that Germany is leading the world in the deployment of wind generators, and Denmark receives 20 percent of its electricity from wind. Wind energy is currently less than 1 percent of the U.S. energy mix, but in 2006, 19 percent of all new generating capacity came from wind.³ Wind generation has benefited from a 2 cent per kilowatt-hour federal tax credit in the U.S., and also from renewable portfolio standards for electric utility generators in 25 U.S. states and the District of Columbia.

As with solar energy, respondents noted that wind resources are intermittent and therefore need a storage medium such as a battery to provide backup when the wind is not blowing.

Biomass/Biofuels

Biomass can be burned directly to generate heat and electricity or converted into gaseous or liquid fuels. A related energy source is gases such as methane that may be generated by the biological decomposition of solid waste or sewage. In all, there were 22 positive mentions of bio-related energy in the discussion. Biofuels dominated with 14 mentions, followed by biological energy production from waste (5) and direct use of biomass (3).

Most of the discussion of biofuels centered around the production of ethanol and biodiesel. Echoing the earlier discussion of biofuels many of the respondents questioned the wisdom of using corn or other foodstuffs to produce ethanol, citing concerns about its effect on food availability and prices in a hungry world, environmental impacts of monoculture farming, and increased use of fertilizers and water. However, they viewed the potential of ethanol production from cellulosic biomass as much more promising and appropriate. This could include such sources as corn stover (stalks and leaves), crops such as switchgrass, and wood waste.

³ Presentation by Steve Chalk, Deputy Assistant Secretary for Renewable Energy, U.S. Department of Energy, to National Research Council Panel on Renewable Energy, September 18, 2007.



Most in this group favored increased investment in R&D to develop more robust enzymes to produce cellulosic ethanol, as well as the possibility of developing genetically engineered organisms that would be able to produce fuels more effectively from landfills, animal wastes, or sewage.

Geothermal

Geothermal energy was mentioned positively by 8 respondents. It was noted that unlike solar and wind, geothermal is a continuous energy source, although its availability is highly regional. Some respondents suggested that more should be done to tap into the geothermal energy of volcanoes. Most respondents discussed the conventional geothermal technology that involves injecting water into hot rock underground and using the resulting steam to drive a turbine. However, there was one thread that discussed using the temperature difference between the surface and hot rocks underground to generate electricity via a thermocouple circuit.

Ocean

Ocean energy consists of three basic technologies: wave, tidal/current, and ocean thermal energy conversion (OTEC), which uses the difference in water temperature between the surface and the deep ocean to generate electricity in a thermocouple circuit. In the discussion there were 3 positive mentions of the potential of wave energy, 2 for tidal/current technology, and 1 strongly in favor of OTEC.

Other Technologies

Although the question posed dealt specifically with renewable energy technologies, the discussion often expanded toward what many respondents saw as the larger question—how to respond to the finite nature of fossil fuel resources. For example, many mentioned the need to extend the availability of fossil resources through conservation and energy efficiency by, for example, improving the efficiency of gasoline and diesel engines and improving public transit and intercity rail systems. Several mentioned what they saw as the potential synergies or complementary characteristics of renewable resource programs and energy efficiency programs: energy efficiency savings are available now while renewable energy technologies will take time to penetrate markets; and renewable resources are often limited geographically and temporally, while energy efficiency savings are available everywhere and at all times.

Some respondents saw renewable energy technologies as at best a partial or temporary solution to the inevitable decline of fossil resources. This group was more interested in discussing what it saw as more viable long-term solutions, such as nuclear fission, hydrogen-based technologies such as fuel cells, or even nuclear fusion.



Making renewables cost competitive

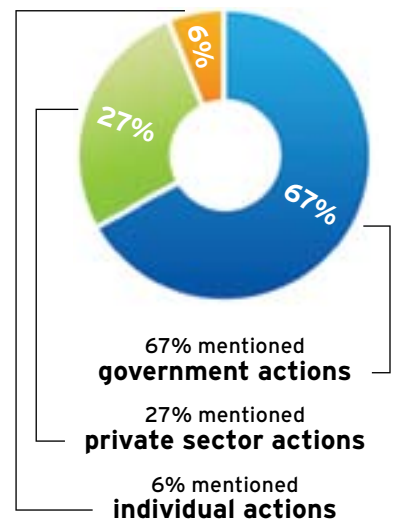
As discussed in the introduction, the current market share of renewable technologies is small, and the business-as-usual projections suggest that without policy changes that would accelerate their market penetration, growth will be slow. In fact, renewable energy sources already benefit from a variety of policies that are aimed at expanding their market share in the United States. These include government-funded research, development, and demonstration programs; subsidies and production tax credits; tariffs on energy imports; renewable portfolio standards for utilities in many states; and a national Renewable Fuels Standards requiring the use of 7.5 billion gallons per year of ethanol and biodiesel by 2012.⁴ There was considerable discussion about what, if any, additional methods should be used to promote the greater utilization of renewable energy.

One view was that market forces alone will solve this problem: as oil and gas become scarcer and prices of gasoline and electricity increase, renewables will naturally become more cost-competitive. A countering view was that fossil fuels also enjoy a number of favorable government policies, both explicit and implicit. Furthermore, the true cost of fossil fuels (including, for instance, the climate impacts of greenhouse gas emissions) are not included in their price, and therefore the proper price signals needed for markets to be effective are not present. Respondents had a number of suggestions for additional steps that governments (federal and state), corporations, and individuals can take to promote the greater utilization of renewable energy.

Government Actions

Respondents discussed four kinds of policies that could be implemented by governments (they generally did not distinguish among national/state/local governments) to promote renewable technologies: (1) subsidies of various

Respondents discussed who would be responsible for making renewable energy usage more competitive.



⁴ Presentation by Jacques Beaudry-Losique, Program Manager of U.S. Department of Energy Biomass Program, to National Research Council Panel on Renewable Energy, September 18, 2007.



kinds (including consumer tax credits and production tax credits, and funding for research, development, and demonstration projects); (2) regulations, including renewable portfolio standards for electricity generators; (3) carbon taxes or other actions that would make nonrenewable energy more expensive; and (4) education and public awareness programs. Overall, there were 32 positive mentions of government actions, which are discussed below.

Subsidies

Subsidies were the most commonly mentioned policy instrument, receiving 18 mentions overall: 7 for funding of research, development, and demonstration programs in renewable energy, 6 for production tax credits, and 5 for retail tax credits. Respondents differed on whether the government should stick to funding only basic research—so as not to substitute for what the private sector should be funding—or to support full-scale demonstration projects such as “local energy farms.” Ideas for retail tax credits included not only credits for individual consumers who purchase say, solar cells, but also for providers of infrastructure services to consumers such as service stations that offer biofuels or hydrogen as well as gasoline and diesel.

Most advocates of subsidies for renewable energy also favored subsidies for conservation and energy efficiency, and for programs such as public transit and improving the freight rail system.

Raising the Price of Nonrenewable Energy

Taxes or other restrictions on non-renewable energy sources, such as carbon cap-and-trade systems, received 8 positive mentions. These steps were advocated as an attempt to bring the cost of fossil energy resources more in line with their true social and environmental costs, and thus to provide a more competitive playing field for renewables. Many advocates of this approach were concerned about the impact of these new taxes on the economy and argued that they should be offset by a decrease in other taxes, such as income taxes. Others felt that revenues raised from such taxes should be used to increase funding for renewable energy development, conservation, or energy efficiency programs.

Regulatory Approaches

Regulations promoting renewable energy technologies (such as renewable portfolio standards) received only 2 positive mentions, although one respondent stressed that European Union regulations, as well as regulations within individual European nations such as Germany and Denmark, are largely responsible for the more rapid market penetration of renewable energy technologies. These countries have surpassed the United States in both renewable technology development and market share of renewable energy in several areas, with targets of 20 percent by 2020.



Renewable energy regulations aside, several respondents mentioned the importance of regulations having to do with conservation and energy efficiency, such as meeting renewable portfolio standards required in some U.S. states in part by improvements in energy efficiency, and building and appliance codes that promote energy efficiency.

Education

The importance of public education and public information campaigns about alternative energy sources and environmental issues was stressed by 4 respondents. In general, this was seen as a way to promote a demand pull for renewable technologies, though not strictly a government responsibility. Rather, it was seen as an appropriate area for public-private partnerships.

Private Sector Actions

Overall, there were 13 mentions of actions that corporations could take to promote the use of renewable energy. Respondents noted that the renewable energy area has attracted large amounts of capital investment in recent years; one claim was that investment in renewable energy rose from \$80 billion in 2005 to \$100 billion in 2006.

The most common suggestion, with 5 mentions, was for industry to increase its funding for R&D. Focus areas suggested included improved enzymes for converting cellulose into ethanol, genetically engineered organisms to produce biofuels and, although not a renewable, carbon sequestration technologies. Four respondents stressed the importance of oil companies diversifying their portfolios to include more renewable energy sources. Respondents were divided over whether oil companies would make significant investments in renewable technologies in their own self interest (preserving their resource and positioning themselves to compete more effectively in a future in which renewable energies were more prominent) or whether government incentives such as tax credits should be offered.

One respondent encouraged utilities to invest in smart metering and other demand side management technologies, as well as to conduct research into possible synergies among various renewable technologies, such as combined wind and solar, e.g., wind generators could be operating at night when solar generators were idle. Another respondent suggested that through “industrial ecology,”—better coordination of materials and waste flows in related industries (e.g., agriculture, forestry products, biofuels)—it would be possible to optimize the efficiency of materials use over the larger system through recycling and energy production.



One of the bolder recommendations was that oil companies such as Chevron, which are currently enjoying healthy profits from high oil prices, should fund the establishment of a model residential community dedicated to the extraction and use of renewable energy, with its own renewable energy grid and advanced energy storage system. This community, with its own renewable energy grid, would gradually expand outward and create more demand for renewable technologies, bringing prices down. While this proposal was recognized as an interesting contribution to the discussion, several commenters noted that oil companies have no incentive to fund such a project and expecting them to do so is inappropriate. Finally, one respondent made the general recommendation that corporations should change their decision making processes to include the health of the biosphere at the highest levels.

Individual Actions

Respondents tended to see the promotion of renewable energy technologies as mainly a government responsibility and, to a lesser extent, an industry responsibility. There were only 3 mentions of steps that individual consumers could take: one recommended investing in renewable energy companies, and two suggested purchasing power from renewable energy collectives—even if it cost more. There was a general feeling that consumers did have responsibility for being aware of their options (see the discussion of education programs and public information campaigns discussed above under “Government Actions”), but that either market forces or government policies would be needed to bring prices down to a more reasonable level.

Respondents in this discussion tended to look at the broader picture. They suggested that individuals educate themselves not only about renewable energy but also about better choices with regard to avoiding wasteful lifestyles. These suggestions included such things as taking public transport, buying more fuel-efficient vehicles, and changing driving habits.



Areas of consensus

There appeared to be a broad consensus that fossil fuels will continue to become more expensive as readily available sources are depleted and environmental concerns such as global climate change are addressed. Thus alternative fuel sources, including renewables, need to be developed.

Perhaps not surprisingly, the discussion tended to focus on renewable technologies that capture most of the media attention, such as solar cells and biofuels such as ethanol. More mature technologies, such as hydropower and geothermal, or technologies such as solar thermal, which are less in the public eye but may have greater potential in the near term, received less attention here. Very few respondents saw renewables as a complete solution to the problem; most viewed them as likely to contribute only a fraction of future energy needs, along with other technologies such as nuclear fission.

In some ways, respondents seemed to chafe at the narrowness of the topic question. While the main focus here was on renewable energy sources, the discussion often strayed onto other energy sources and to making better use of the energy resources we have through conservation, energy efficiency, and lifestyle changes. A representative statement: “Coordinating policies on renewable energy and energy efficiency would help reduce greenhouse gases; efficiency and renewables together pack a powerful punch, but more overlap is needed.”

About the Aspen Institute:

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