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Here Comes the Sun

Photo by US Department of Energy, via Wikipedia.

A New York City rooftop with solar panels.

The Solar Energy Revolution

Though there are many different ways of generating energy, all energy on earth can ultimately be traced back to a single source: the sun. It is the energy of the sun that fuels all life on earth and it is this solar energy that powers all human activities as well. Fossil fuels, like coal, oil, and natural gas, for instance, are the decaying remains of plants and animals that grew and reproduced and proliferated across the earth, thanks to the energy of the sun. This means that even when humans derive energy by burning fossil fuels, they are still using solar energy, only in a form that is generated over millions of years of deposition and decomposition. In addition to the pollution produced by using fossil fuels, fossil fuel is also a finite resource that will eventually be exhausted. Even before fossil fuels became the backbone of the global economy, however, researchers were trying to find ways to harness the power of the sun more directly, to power the many machines and processes essential to human life. This effort is not only essential to providing humanity with an unlimited source of energy, but is also essential if humanity is going to avoid the most devastating effects of environmental pollution caused by the burning of fossil fuels.

History of Solar Energy

The idea of capturing light from the sun for various applications is quite ancient, likely beginning in prehistory when the first human learned that reflective materials could be used to focus light from the sun to create fire. Fire, then, became humanity's first working fuel, producing light, heat, and the potential to power devices and machines. However, to make better use of the energy of the sun, it is necessary to find ways to extract the potential energy from sunlight more efficiently, and this history begins with the discovery of the photoelectricity.

It was French scientist Edmond Becquerel who, in 1839, discovered what is known as the "photovoltaic effect," which is a process in which voltage or electric current is generated by sunlight. This phenomenon, and the unit of electrical energy called the "volt," were named in honor of Italian physicist Alessandro Volta, a pioneer in electrical research. Becquerel's experiment utilized a primitive electrolytic cell composed of two electrodes suspended in a conductive solution. He discovered the conductivity increased when the cell was exposed to light. French mathematician August Mouchet drew on Becquerel's work to create what were, essentially, the world's first solar powered engines, using solar energy to power a steam-generating reaction. By the 1880s, engineers in France, England, and the United States were all working on developing solar-powered engines of various kinds and a variety of different patents were recorded from this early period of development.[1]

One of the most productive arenas of inquiry in this vein came through the discovery that the material selenium is sensitive to solar power. This discovery was actually made by English electrical engineer Willoughby Smith in 1873, but it was American inventor Charles Fritts who produced the first functional selenium solar cells in 1883. This development is often seen as the beginning of the modern solar cell revolution, though it took many years to develop. Fritts solar cells were made by coating selenium in a patina of gold, which resulted in a conversion rate of 1 to 2 percent, which meant that around 1 to 2 percent of the energy from solar radiation was converted to electrical energy.[2]

American inventor Edward Weston is credited with the invention of the "thermopile," which was essentially a mechanism that could generate electricity from solar energy and then use electrical energy to create mechanical energy. The process described by Weston in his 1888 patents was simple, using light to heat solar cells, which caused electrons to be released, creating heat, which could then be used to generate mechanical force. At the same time that inventors like Weston were working on solar power in the states, Russian scientists were also working on creating electrical systems using solar energy, and Russian scientist Aleksandr Stoletov created a cell that used the "photoelectric effect," which occurs when light causes a material to release electrons. This was the basic mechanism developed for use in modern solar cells, and in the 1890s, American and Russian inventors created a variety of these electricity-generating cells based on Stoletov and Weston's ideas.

Ways of generating electricity from sunlight were becoming more advanced, but this energy was only available in limited quantities and still needed was a way to store and preserve energy gathered through these cells. This came in the form of the first "thermal batteries," devices that could store energy as potential energy and could then be tapped later to produce electricity. The first patent for a solar battery was filed by American inventor Harry Reagan in 1897 and this set the stage for the modern field of battery and energy storage development, which remains one of the most important areas of development in the realm of renewable energy.

Small-scale development continued through the early 1900s, but the selenium cells of the era were not yet efficient enough to be developed into commercial products. It was in the 1950s that Bell Laboratories began working with semiconducting materials other than selenium, developing silicon-based cells that were able to capture 6 percent of incoming solar energy. Engineers Daryl Chapin, Calvin Fuller, and Gerald Pearson were the ones who invented the first silicon solar cell for Bell laboratories, representing perhaps the first device of its kind efficient enough to be marketable, though the cost of building the cells made it prohibitive for most applications. It was another two decades before the first solar building was created, an experiment by the University of Delaware named "Solar One." This was officially the first house powered by photovoltaic cells.[3]

The Arab oil embargo of 1973 changed the landscape with regard to solar power. While the National Aeronautics and Space Administration (NASA) had been extensively working with solar energy for space applications, the technology was

never sufficiently developed to produce realistic alternatives for general consumers, but the sudden hike in petroleum prices and decrease in petroleum supplies that occurred during the oil embargo stimulated intensive interest in alternative energy. In 1974, the US Congress passed five separate energy bills, two of which included investment in solar power as an alternative to petroleum-based power. The Solar Heating and Cooling Demonstration Act of 1975 resulted in the installation of solar systems on federal buildings, in hopes that demonstrating the function of this technology would stimulate public interest. Further the Solar Energy Research, Development, and Demonstration Act of 1974 provided grants and funding for researchers investigating solar energy.

The problem was, even as the federal government shifted gears and tried to interest the public in alternative energy, the federal government had already spent many years essentially contributing to the myth that solar energy would never be as efficient or cost-effective as remaining on the fossil fuel system. In the early 1970s, environmental awareness was limited and interest in solar power was still mostly about cost saving and reducing American reliance on foreign oil. When oil prices came back down, in the 1980s, thanks largely to developments started under President Jimmy Carter, interest in solar power ebbed.[4]

The Reagan Administration was heavily linked to the fossil fuel industry, as was the Republican Party in general, and this remains true. Republican politicians, like Donald Trump, have repeatedly and consistently promoted further oil excavation and fossil fuel development despite the fact that this development is a key cause of climate change and the dangerous warming trend that threatens all life on the planet. Reagan passed laws that essentially eliminated tax credits and other federal assistance programs aimed at helping homeowners to switch to solar power, and thus the industry languished for some time, with solar power still in existence, but largely as an option for the wealthy rather than a practical alternative to fossil-fuel based power.

This system began to change in the 2000s with the establishment of new tax credits for solar energy available to a larger proportion of the American people. By the late 2000s, solar energy had reduced in cost to the point that middle-class homeowners and building owners in many parts of the country were able to access solar energy options for their buildings. However, even with tax credits and state/federal assistance, solar energy remained out of reach for many Americans. The goal of modern solar energy companies is to make this technology more widely available and affordable for Americans at various places in the income spectrum, while also working towards the development of more efficient solar systems and batteries for storing and distributing the energy generated by photovoltaic systems.

Growing the Solar Industry

The Obama Administration's $787 billion economic stimulus package of 2009, an effort to help the nation recover from the Great Recession, resulted in more than $100 billion in investment for renewable energy. The Department of Energy initiated

policies that drastically reduced the cost of solar energy and funded research into ways of further reducing barriers to commercial solar power usage. Despite a 2 percent default rate, the program was enormously successful at promoting the growth of renewable energy—including solar power. For instance, it was the federal government, not the private sector, that provided seed capital for Tesla, which became a dominant renewable energy leader. In addition, this Obama-era investment also resulted in the construction of thirty-five solar energy plants capable of delivering electricity sufficient to operate as utility providers, where there were no such plants in the United States prior to the Obama Administration's investment program.[5]

Since 2010, there has been a 70 percent reduction in the cost of solar power, and it is believed that solar energy will continue to become more affordable. This progress stalled when conservatives again gained control of the government, under Donald Trump, who increased prices on solar panels by imposing new restrictions and tariffs on Chinese products. This effort was not successful, however, as investment in the industry had already reached a critical stage, with too many Americans and companies invested for the nation to abandon the effort to shift to renewable energy sources. In the 2010s and 2020s, many US states established policies to promote renewable energy and to achieve reduced carbon emissions, expanding well beyond federal levels of investment and encouraging citizens to take part in this difficult but necessary transition away from fossil fuel energy.

While solar energy solves many of the problems with utilizing fossil fuels—producing reduced emissions and not contributing to global warming—solar power generation does not entirely eliminate environmental concerns. As the solar power industry grows, for instance, there is increasing concern about the waste that the industry produces and how to safely manage this waste. Another major problem with solar power is that poor and working-class Americans are still unable to afford to shift to solar or other kinds of renewable energy. Experts in renewable energy have argued that the United States needs to invest in expanding access and making renewable options more affordable for a larger number of Americans at the lower end of the income spectrum. Achieving this, however, is largely a matter of political power.

While President Joe Biden's administration has invested heavily in renewable energy, this investment only reverses the course set by Donald Trump, who reduced investment in renewable energy in keeping with the conservative alliance with the major fossil fuel companies, and enriching Trump who owns stock in many of the companies that benefitted from his proposed policies. Despite the lack of support under Trump and Trump's federal investment in the coal industry and other measures designed to increase petroleum industry profitability, the renewable energy industry grew much faster than the petroleum industry in the late 2010s and early 2020s. A 2022 report from the Department of Energy found that every sector of the renewable energy industry added new jobs in 2021, while jobs in the petroleum industry declined by 12 percent despite the fact that the petroleum industry saw record-breaking profits. This shows why the strategy of further investing in petroleum

production does not actually benefit job seekers, because petroleum hiring practices are not based on the level of profit. In other words, just because petroleum companies make more money doesn't mean they need to hire more workers. In fact, it may mean just the opposite. By contrast, solar energy is the fastest-growing segment of the energy sector, and growth in this industry does translate into job growth, because the industry is expanding, not simply maintaining its existing level of profit and control.

The future of solar power is in question, but it has become clear that the American people are far too invested in this field of energy development to either abandon solar energy or to move away from this avenue of investment in any significant way. While the fortunes of solar companies may rise and fall, solar energy has become an indispensable part of the American energy sector and one that promises benefits in terms of jobs and energy savings, if America can continue to invest in development and can find ways to open up solar options to a larger portion of the American people.

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Notes

1. "A Brief History of Solar Energy," *Trvst*.
2. "The History of Solar," *US DOE*.
3. Chu and Tarazano, "A Brief History of Solar Panels."
4. Sabas, "History of Solar Power."
5. Halloran, "Solar Energy's Untold History and the Factors Driving Its Growth Today."