ENVIRONMENTALLY SPEAKING

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The sun: an answer to many of our problems

We've heard a lot recently about how we are facing an energy crisis. The price of oil keeps going up and last week reached $100 a barrel on world markets for the first time. Many experts now expect gas to be $4 a gallon at the pump by summertime. Meanwhile, globally, energy consumption is at an all time high and growing extra quickly in some places. Since 1970, overall global energy use has grown by over 70 percent, and, in developing countries, petroleum use has gone up an astounding 300 percent+ (World Watch Institute).

These trends trouble many, especially those on low income who spend a higher proportion of their wages on energy—to power and heat/cool their homes as well fuel their vehicles. The continued expansion of fossil fuel consumption also horrifies environmentally-conscientious people because of the environmental damage associated with fossil fuel burning, which includes, but is not limited to, the scarring of landscapes, the reduction in natural habitat, the creation of climate change, and the poisoning of lungs and brains. These fears are confirmed by a 1992 EPA Report which concluded that, "The energy sector in industrialized societies is probably the single largest economic contributor to global environmental degradation" (in Benyus).

And while there is some attention paid to these concerns, the most obvious solution gets so little press it is mind-boggling. As it turns out, the Sun provides us all the energy will ever need. You see, the Sun puts out so much energy that if we were smart enough to capture just a small fraction of it, we would be able to supply current and future energy demands without all the damaging effects on the environment. Additionally, and perhaps most importantly, current and future energy wars would largely be eliminated. As astonishing as these claims may seem, the evidence supporting them continues to mount. The question is, "Are we listening?"

Before presenting some of the evidence, let's just look at some basic facts. The energy the Earth receives from the Sun in just forty minutes is equivalent to the annual consumption of energy by humans today (Zweibel et al.). (Wow.) Nearly all living things on the planet (the cyanobacteria found along the deep ocean ridges a notable exception) survive entirely on energy coming from the Sun. (So what makes us think we can't/shouldn't?) The only limitless source of energy at the Earth's surface comes from the Sun. (No wonder the ancient peoples demonstrated so much respect and adoration for the nearest star.) And, energy consumption throughout history represents one of the clearest ways to differentiate between modern and pre- (or non-) industrial peoples. In other words, our current lifestyle owes itself to the tremendous availability of fossil fuels, albeit only in the short-term and not without substantial tradeoffs. Future societies will undoubtedly be very energy intensive as well, so we'd better find a way (as soon as possible) to provide a larger energy supply safely and humanely.

Based on these basic observations, the Sun should be where we look for answers to our current energy problems as well as our future needs. Yet, you don't get an "is" from an "ought" (here turning a famous philosophical query inside-out). That is, just because we should get our energy needs directly from the Sun doesn't mean that it is technologically feasible to do so. However, when one looks at the current information available on this subject, it is very difficult to conclude anything but that the Sun can (and will likely) be the primary provider of our energy in the near future; that is, assuming we make decisions based on the health of people and all the ecosystems on which we depend, and not on the extremely powerful interests of the fossil fuel lobby.

Solar energy can fuel our lives here in the United States. We know this now because the three long-running arguments against radically expanding solar energy have largely been turned on their respective heads. First, it was said that solar energy is too diffuse; that is, too many regions receive too weak a sunbeam to make it worthwhile. Second, it has been argued that solar energy is too intermittent; that is, light isn't always available because of day-night cycles or clouds. Both of these criticisms become moot when we incorporate three changes to the current energy system. One, we build large photovoltaic "farms" (tens of thousands of square miles in area) in the largely barren Southwest and other nearly cloudless areas. (Though this sounds like a lot of land, it is actually less than is required to extract and burn coal (Zweibel *et al.*).) Two, we take advantage of existing technologies which enable power to be transported via DC (direct current) lines to locations far from these "farms" with little loss of power. Three, we store the solar energy for times when it is needed. This can be done one of several ways but the best candidate right now is compressed air-storage (which uses the initial solar energy to generate air pressures below ground in caverns and then releases this energized air to drive turbines). This technology has been successfully used in Germany since 1978 and in Alabama since 1991 (Zweibel *et al.*). (And, surprise, but storing volumes of fluid/gas isn't anything new. We currently store trillions of cubic feet of natural gas in underground reservoirs.) These technical "fixes" work (and need not be reserved for sci-fi novels anymore) and there is no doubt that future advancements will make solar energy even more advantageous. Behind the scenes, breakthroughs are happening all the time. Last month it was reported that Nanosolar, a company based in Silicon Valley, figured out a way to reduce the production costs of solar panel manufacturing by 80 percent (Vidal)! (I found out about this by reading a British newspaper. Did this story make it into your local papers? Ever wonder why?) A jump of this magnitude actually makes electricity from solar energy equivalent in price to coal-derived electricity, even using an economics that ridiculously favors fossil fuels (described later). Jobs in the solar sector are also growing quickly suggesting that these "breakthoughs" aren't just taking place in the lab but on the ground as well (Mufson).

So what would it take to make the switch to a solar economy? Well, in the January 2008 issue of *Scientific American*, three energy experts lay out the details. Using conservative values for all the relevant parameters (for example, including no additional technological advances or cost improvements in the solar energy sector after 2020), Zweibel, Mason and Fthenakis (Z, M & F from now on) are extremely confident that by 2050, solar power could be providing the United States 69 percent of its electricity and 35 percent of all its energy. (Much of remaining energy needs could come from other renewable energy forms—wind, biomass, hydroelectric—and small amounts of natural gas. And, solar energy will also be able to provide power to our future electric cars.) In their scenario, oil use in 2050 would be 31 percent of current levels, natural gas would be 51 percent, and coal would be 42 percent (given current trends in energy consumption, the true reduction in use of these fossil fuels, would be 75 percent, 68 percent and 74 percent, respectively). U.S. emissions of carbon dioxide, the primary gas implicated in future climate change, would be 62 percent lower than today's value (which is an amazing 12,200,000,000 pounds). Not only would our emissions be lower, but by sharing our findings with other industrializing nations, we could "skip a generation" of polluting industries worldwide (Hoagland). In so doing, we would spare the atmosphere tons of excess CO_2. These are extraordinary (and much needed) reductions, and, thankfully, they are now well within our reach.

Still not convinced? I understand. It is hard to swallow something so incredibly enticing yet so foreign to most of us. (Isn't it strange that we don't require our citizens to know anything about energy production and consumption though it is so fundamental to our relationship to the planet and each other.) Perhaps some personal thoughts will help strengthen the argument.

Ever since I was old enough to consider the various means to obtain useable energy, I heard how expensive solar energy was. Now, more informed, I have determined why this is. It isn't because solar energy is inherently more expensive than other forms of energy. Solar energy is deemed more expensive for two reasons, both of which have serious flaws. The first has to do with the technological advancements in the area of converting incoming sunlight into electricity. Apparently, according to the naysayers, solar technology is just not powerful enough yet (and may never be). This is sheer poppycock (i.e., nonsense), as demonstrated above. Currently, there exist actively utilized solar photovoltaic cells that have a solar-to-electric efficiency of 10 percent (and laboratory samples which are now up to 30 percent) (Hoagland). In another renewable energy front, wind experts who once boasted about 0.5 MW (megawatt = million watts) turbines (in 1995), now find 1.2 MW turbines routine; that amounts to a 140 percent increase in turbine capacity in just 12 years! These are tremendous feats and these statistics are growing every year despite very little money set aside for research; the government subsidies given to oil and coal dwarf those given to solar or wind (and it has been this way for a long time). (Is it any wonder why the fossil fuel industry gives so much financial support to presidential candidates, independent of their party affiliation?)

The second reason that solar energy is too "expensive" has to do with the extremely near-sighted version of economics that governs our personal and national decision making. Let me give a person story to illustrate what is going on here. I recently chose not to put solar panels on my house or in my yard. The primary reason was it was too costly (especially given that my south facing roof has very few flat regions and I have many adolescent trees that I don't want to cut down; shading markedly kills efficiencies of solar panels). But, if the price I would pay to install and maintain solar panels were offset by the amount of my tax money that now goes to support military/security operations overseas to secure fossil fuels, to subsidize fossil fuel companies in other ways, and to pay higher insurance premiums (due to the dramatic effects of air pollution on health), I think I would find solar panels a great bargain. However, since these offsets will not be made until we develop a new national policy that is forthright about the true/full costs of the fossil fuel energies that we use, I (and plenty of others) find that the cost for installing solar panels just too high. In a more realistic economic system, massive government support of solar energy would drive prices way down and make them quite affordable to the average homeowner or municipality.

So, how much will Z, M & F's plan cost? All told, $420 billion dollars. This is a huge sum of money until we consider the ways we spend similar amounts. According to the National Priorities Project (www.nationalpriorities.org), we have already spent $483 billion on the Iraq War. Just imagine if we had put this money into revamping our energy system so that: (a) we would no longer depend on foreign oil (we current import about 60 percent of our petroleum); (b) we would no longer have to destroy our mountains and our farmlands (for coal extraction); (c) we wouldn't have to convert fertile farmland into gasoline (rather than food); and, (d) we wouldn't have to breathe in such high amounts of toxic particulates and gases. If we had real leadership in this country, we could have already been a good chuck of the way down the solar pathway. And, for icing on the cake, consider that this solar economy would not only clean the air/rivers/oceans/soils, but also produce millions of new, high-paying, manufacturing jobs in the United States.

Much of the above might sound too good to be true. Don't take my word for it. Do some investigation on your own. Two websites that give you a good start are: www.solarbuzz.com & www.ases.org. Tell us what you find out. We need citizens like you to become leaders in a solar movement. Yes, it is once again time to worship the Sun.

Note: For those interested in my other essays focused on energy, consider these:

1. "Continued Energy Woes or a Secure Energy Future?" *The Zephyr*, August 24/31, 2006.
2. "Take a deep breath. It's time to clean the air." *The Zephyr*, May 25, 2006.
3. "Is nuclear the answer?" *The Zephyr*, May 26, 2005.
4. "Where has all the oil gone? Short term chaos. When will we ever learn?" *The Zephyr*, January 30, 2003.

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Hoagland, W. (1995) "Solar Energy." *Scientific American*, 170-173.

Mufson, Steven. (2006) "A Sunnier Forecast for Solar Energy." *Washington Post*, November 20, D01.

Vidal, J. (2007) "Solar energy 'revolution' brings green power closer." *The Guardian*, December 29.

Zweibel, K., J. Mason, & V. Fthenakis. (2008) "A Solar Grand Plan." *Scientific American*, 64-73.

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