

The future of energy

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In all these columns of alleged pontification, I have given you almost no grandiose predictions about the future. There was the loom, the printing press, the internal combustion engine, electricity, the digital computer. What is next to completely revolutionize how human civilization looks?

Solar power.

Or, more specifically, the gathering of ambient energy into useful form. This is not a new idea. Millennia ago, people worked out that their bodies produce heat, so if they put on a blanket, then they can retain that heat and put it to useful purpose. The water wheel went along similar lines: hey, there's energy in that water flow, and it could be put to good use. A hundred years later, that water wheel turned into the Three Gorges D*m.

Or if you'd like to be a little more technical about it, there is the Seebeck effect: if there is a temperature differential between two sides of a system, then current can be produced from that differential.

So what's the revolution? Why am I talking about solar power instead of more water wheels or wind farms? Because light is everywhere power-sucking devices can be found. Your solar calculator from high school didn't need batteries, wires, or petroleum. It just sucked in energy from the world, and converted it into a useful form. You carried it around, and it ran itself. When all our appliances, houses, and transportation are capable of that self-powering trick, that will be a revolution.

Your laptop is not too far from that right now: you can already buy solar panels that will power your laptop that are about twice as big as your laptop. With a not-insane amount of work, we could get those solar panels down to the size of the back of your laptop screen. And forget laptops: the real victory will be when your car and house take in as much energy as they put out.

A square meter of the earth is beaten with about 1000–1500 watts of solar energy all day long—and thanks to greenhouse gasses, there's only more watts to be had¹. For comparison, my fridge is sucking down a maximum of 3 kWh per day = a constant rate of 125 watts. You can check your laptop's power supply, but I'm guessing it's somewhere around 50 watts—but it won't need to be plugged in anyway. A space heater runs at around 1500W. So you can see that the typical house's energy needs are likely smaller on average than the solar energy hitting the roof.

¹http://www.junkscience.com/Greenhouse/What_Watt.htm

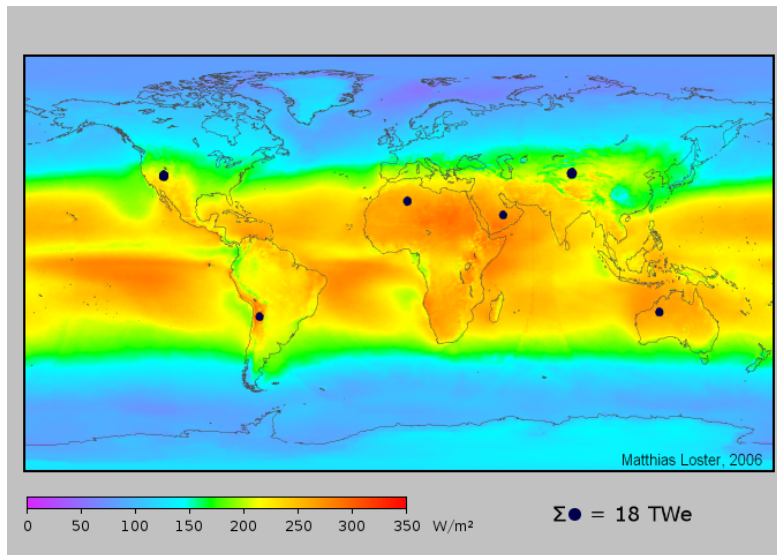


Figure 1: A square meter of solar panel could produce about 150–250 watts of energy, depending on where it is. Black dots indicate the surface area one would need to meet all expected energy needs in 2010.

The Honda EV Plus² (PDF) uses about 500 watt-hours per mile—and that’s 1999 figures from the DoE’s Idaho National Laboratories; we can only presume that they’re doing even better now. So mean demand is about 500 watts, and the 2 m² of car-top is warming up with 3000W of energy.

And hey, where is a great deal of the energy in driving the car’s motor going? That’s right: heat. Add some tricks to use the heat differential between the top of the hood and the bottom of the hood to reclaim electricity (that Seebeck effect again), and you’ve got an even more robust self-sufficient system.

Reality There are two dovetailing problems keeping us from a wireless future.

The first is cost. Those nifty solar panels for the laptop will cost you \$250, so they’re not going to make sense to anybody but total hippies and those who are frequently off-grid. Putting a solar array on your house’s roof will still be in the ballpark of \$40,000, which will pay for itself in electricity saved and/or sold to the grid in, oh, a decade.

But burning dinosaurs is not going to work forever. As China and India start buying SUVs, oil in the USA and Europe is going to become more expensive, and that means people who were once on the fence will be buying more solar. Expect gradual reductions in prices as a result. [The offset, though, is that silicon is getting expensive, due to increasing demand for electronic toys.]

²http://avt.inel.gov/pdf/fsev/sce_sum/honda.pdf

The other problem is in efficiency. The 3000 watts of power in the sunlight hitting the roof of your car still needs to be converted into useful electric power, and that conversion is still inefficient. One firm recently announced that it got its solar panels up to 22% efficiency. For solar panels, this is amazing, but to the rest of the energy world, this is ho-hum. Other forms of energy extraction typically get up to around 80% efficiency.

But I read that not to mean that solar power is hopeless, but that there's a lot of room for improvement. When a solar panel is twice as efficient and costs half as much per square whatever, then you're down to \$50 for the solar collector on the back of your laptop screen—that's the price of a new battery.

[8 December addendum: Silly me—the future arrived the day before I wrote this: the DoE announced on 5 December that one of its contractors had achieved 40.7% efficiency by stacking several types of photovoltaic cell on top of one another. It's still more than twice as expensive than the half-as-efficient versions, but we'll see where it goes.]

So, back to pontification: what will the world look like in thirty years? It won't have wires, because we'll have moderately-sized electricity-generating gadgets to complement our ever-expanding array of electricity-consuming gadgets. The top of your car and house will have solar panels that just sit there and store up charge for your air conditioner. The whole greenhouse thing won't be an issue at all, except in terms of dealing with our predecessors. We won't be importing energy from remote locales, but just pulling it in from around us.