

RENEWABLE ENERGY SOURCES

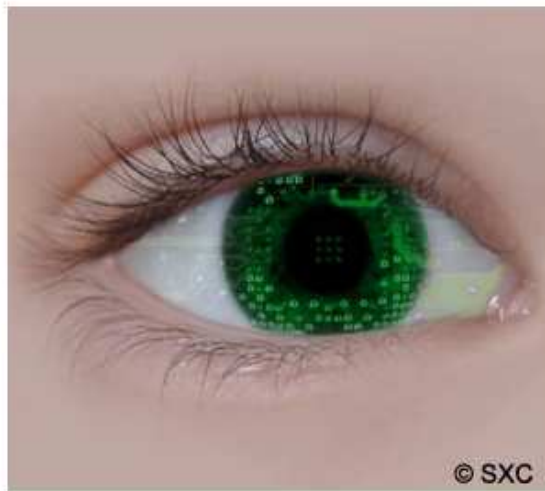


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A 'cyborg' in the dining room

APRIL 14TH, 2011

We humans are a very strange species. Like any other living being, we are biological entities which have come from a long evolutionary process that has shaped our essence, but at the same time we have exceeded the strict limits of biology through our development of culture. The technical aspect of culture has enabled us to constantly improve our quality of life with innovations that affect all areas of our lives. But the innovations we have created have something in common: they all use energy. And this year one of these energy sources has given us a huge scare with the serious and still



unknown consequences of the accident at the nuclear plant in Fukushima, Japan; an accident that should make us meditate on the energy we use and the technical processes used to produce it.

Our body also expends energy. The power of a human body at rest is about the same as a 100-watt bulb. The energy needed to operate all the technology we use daily to make our lives comfortable is more than 100 times greater, the equivalent of 100 100 -watts bulbs per person per day. This includes transport, heating, cooling, lighting, electronics, agriculture and industry that make all the sustenance and materials we use. Some people even say that, conceptually_ not biologically_ our species, *Homo sapiens*, has evolved into "*Homo energeticus*."

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Energy is present throughout the universe in very different forms, and it is even present in all matter, as Einstein explained through his famous formula $E = mc^2$. The Earth itself is full of energy sources, and even the infamous

earthquake in Japan that has served as an excuse for me to talk about energy technology, was caused by the most powerful energy source of our planet, hidden in its geological depths, and indirectly dependent on the nuclear fission of elements in the deep layers of the planet. Usually, we distinguish between renewable energy sources like solar, wind, tidal and wave power, among others, and non-renewable resources such as coal, gas, oil, and also nuclear power. However, most of these energy sources come directly or indirectly from the Sun.

The reason is very simple. Wind and waves are caused by temperature differences on the Earth's surface caused, in turn, by sunlight. Tides also have a cosmic origin in the gravitational pull of the Sun and the Moon on large bodies of water on Earth. Even coal, oil and gas come from large accumulations of organic debris, and the main source of energy that moves ecosystems is the Sun through photosynthesis. One exception is nuclear power, which we get from the fission of the nuclei of uranium and plutonium.

The Sun is a sphere made up mainly of hydrogen and helium, and its energy comes from nuclear fusion reactions. Conceptually, fusion is the opposite of fission. While fission breaks apart the nucleus of large atoms to get energy, fusion energy is obtained by putting together small atoms to make larger ones. Additionally, in fusion the amount of radioactivity that is generated is much smaller than in fission. In fact, the main problem of the nuclear energy we use today is the large amount of radioactive waste it generates.

The question then is why don't we use fusion instead of fission for energy? The answer is because a temperature higher than that of conventional reactors must be reached to start a fusion reaction. However, we are working on so-called cold fusion, which, thanks to the presence of certain magnetic fields, can be possible at reasonable temperatures, not exactly cold ones, but at lower temperatures than regular fusion. The day this is achieved, with just over a cubic kilometer of seawater we can produce as much energy as we would from all known fossil fuel reserves and those we have not yet discovered. But cold fusion will not be possible until mid-century.

What to do in the meantime? How can we generate all the energy we consume? Apart from nuclear energy and the burning of fossil fuels like oil, gas and coal, responsible for the greenhouse effect and climate change, there are several projects that are committed to renewable energy, the most developed of which is wind energy. In fact, about half the energy produced in Spain comes from wind turbines. But it also has its detractors. On the one hand, its strong visual impact makes it less desirable for many because it lowers the quality of life for its inhabitants. They also interfere with the migratory routes of many birds. The energy problem is not trivial, because no matter how many public awareness campaigns are made to reduce our consumption, far from diminishing, it continues to increase.

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Groundbreaking projects

There are also those who are betting on spectacular projects that sound like science fiction. For example, Japan has initiated a project to capture solar energy directly from space, where it is much more intense because it is not filtered through the atmosphere, with large solar panels, and transport the harvested energy to the surface through a microwave stream, or, according to a similar project of the European Union, with infrared laser. And then there is a company in California that has launched a study to capture wind energy with kites that fly in the upper layers of the atmosphere, between 1,000 and 10,000 meters high, where the winds are stronger. In this case, cables would carry the energy down to the surface. There are also studies in Brazil to suck the power out of the atmosphere, while in Sweden and Great Britain there are initiatives to harness the movement of waves with large platforms located at some distance from the coast. It has even proposed to use genetically modified bacteria and viruses to generate electricity in batteries by researchers at the prestigious Massachusetts Institute of Technology (MIT) in the United States.

But perhaps we should tackle the energy issue from a personal point of view, and instead of planning large, Pharaonic endeavors, we should aim for everyone to generate their own energy, a shift which would contribute to the total production needed to maintain a society in which, although we often complain, we are all relatively comfortable. Is this possible? For starters, a power of this kind should come from a universal source open to all: the Sun. In this regard, researchers at MIT have just made an artificial leaf the size of a playing card that can absorb and transform solar energy into chemical energy, namely hydrogen and oxygen from water, which serves to generate other types of energy. And it produces water yet again as a final product.

In the animal world

There is an animal that in some ways is way ahead of us. Scientists have discovered a species of sea hare, a mollusk whose scientific name is *Elysia chlorotica*, which feeds on algae, but does not completely digest them, instead taking the chloroplasts of the cells and incorporating them into the superficial tissues of its body, where they remain functional. The chloroplasts are organelles typical of plants and algae whose function is to absorb the sun's energy and transform it into the chemical energy they use to survive.

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We consume 100 times more energy than what our bodies strictly need to survive. But would we be willing to follow the example of the sea hare and carry devices in our bodies that capture solar energy for our use? Of course, the idea

of ??MIT's artificial leaf is not to incorporate it into people's bodies, but this can be a good mental exercise to explore how far we are willing to contribute toward a shift to clean and renewable energies. It is, shall we say, an intellectual exercise. Because while it is very easy to criticize nuclear energy, fossil fuel consumption, or the installation of wind turbines on our mountains and platforms off our coasts, it is also very difficult to meet the challenge of reducing energy consumption.

People 'cyborgs'

Imagine, for a moment, that to maintain our current energy consumption rate without using any polluting energy sources or having to interrupt marine currents or migratory routes of birds we could each carry a small solar panel inserted in our bodies. That is, we became cyborgs. A cyborg is a biological organism that has cybernetic or nanotech implants added to it in order to replace, for example, a hand lost in an accident, or to improve its performance.

Sounds like science fiction as well? Well, it's not. A few months ago, Neil Harbisson, an 29-year-old artist whose father is British and mother is Catalan (and resident of Mataró) with a condition called achromatopsia that inhibits him from seeing colors, was legally recognized by the UK government as a "cyborg." The reason is very simple: when he was 20 he had a device installed in his head that allowed him to hear colors. He can never remove the device, and therefore it is regarded as part of his body. This device consists of a sensor implanted in the side of the eye that focuses on the direction he looks and uses a computer to turn the wavelengths of color into sound frequencies he can hear.

A British man had a device installed in his head that lets him 'hear' colors

Energy Concerns

Power consumption and futuristic ideas are not, however, anything new. 102 years ago, on February 20, 1909, the French newspaper *Le Figaro* published an article that set out the bases of futurism, an avant-garde artistic movement that represented a new way of understanding reality. It stated that art's purpose was not just to express what is visible, but also the state of mind, feelings and emotions of the viewer, as well as the perception of time, light, space and movement. The article, entitled *The Futurist Manifesto* and written by Italian novelist and poet Filippo Tommaso, begins:

1. *We want to sing the love of danger, the habit of energy and rashness.*
2. *The essential elements of our poetry will be courage, audacity and revolt.*

[...]

Because, in fact, danger, energy, rashness, courage, audacity and revolt have always been part of the idiosyncrasy of our species. Evolution has provided us with them, and natural selection has favored them. Do we want to continue to consume energy? Well, then we need to produce it. The question is how. And maybe we have to continue taking risks, but with caution, because caution is also part of our species' mentality. If not, we might fulfill the prophecy of the second song from the new album by the Catalan group Antònia Font, *Lamparetos*, entitled "Coses modernes" ("Modern Things"), in which a robotic chorus announces: "All the modern things have gotten really angry".