

## last few decades, surprises on each side the energy debate.

oday about 20 percent of electricity in America is generated by nuclear power, which is about 20 times the cost of power from solar and wind. Nuclear power also costs less, according to Gilbert Metcalf, an economist at the University of California. After estimating the costs and factoring out the hefty tax breaks for different forms of low-carbon energy, he estimates that new nuclear plants could produce electricity more cheaply than windmills, solar power or "coal" plants. The outlook could change, of course, if new nuclear plants turn out to be more expensive than expected, or if engineers make breakthroughs in other

technologies. (To debate these possibilities, go to [www.nytimes.com/tierneylab](http://www.nytimes.com/tierneylab).) Given the uncertainties, Dr. Metcalf cautions, it would be risky to bet everything on nuclear power as the answer to global warming.

But it seems even riskier to bet on just the soft path, as so many greens are doing, either by flatly opposing nuclear power or by setting so many conditions that no plants could be built for decades, if ever. (Mr. Obama says nuclear power is necessary but should not be expanded until security and safety issues are addressed.)

"The nuclear debate is still stuck back in the 1980s," says Mr. Tucker, the author of "Terrestrial Energy," the new book he's trying to affix to nuclear power. If people started associating nuclear plants with natural radioactive processes in the Earth instead of atomic bombs, he says, they might be persuaded that it's the most environmentally

friendly of radiation emitted during the normal operation of a nuclear plant, Mr. Tucker says, greens have effectively encouraged the construction of coal plants that actually release more radiation because of the traces of uranium in coal dust. He argues that the risks of terrorist attacks and nuclear waste have been exaggerated, particularly by the environmentalists who objected when the Yucca Mountain nuclear-waste depository was being designed to guarantee a level of safety for only 10,000 years.

They successfully sued to enforce a safety standard extending one million years — which, in an ideal world, would be a very nice standard. But if you believe global warming is a planetary crisis that must be addressed immediately, should you really be obsessing about hypothetical dangers near one mountain in A.D. 1,000,000? If there's already a proven technology that doesn't spew carbon dioxide into the atmosphere, why fiddle while coal burns?

## Evolution | Henry Fountain

### Of Fish and Fish

Evolution is a driving force. If there's a change of water or other conditions between two populations, then chances are they will diverge over time. In a species that can interbreed, each other can find ways — behavioral, physiological, sensory — to sense the differences. Evidence for speciation has been increasing. In the case of the Uni-Union, the Swiss Federal Institute of Aquatic Science and Fisheries Research, genetic and behavioral data for speciation in Lake Victoria show how they perceive related species. The fish mates based on color. In one, found in the shallow waters, the fish is blue. What's more, in the deeper waters, the fish is blue. The two are separate species, but they are related. The water is cloudy and blue. That's why the fish is blue. Removing the blue from the water shifts toward the

red end of the spectrum. "We wondered if perhaps the split of the original species into these two is driven by adaptations in their visual system due to light at different water depths," Dr. Seehausen said.

Their new research, published in *Nature*, shows that in the species with red males, over time, in a deeper, red-shifted environment, the gene responsible for color perception had changed to perceive red better. So females were more likely to choose red males.

They also found that in some extremely cloudy parts of the lake, the red-shift was so sharp and sudden that the water was essentially uniform in terms of the wavelength of light. In those areas, Dr. Seehausen said, there is really only one, intermediate species. "All the genes are there, but they are not differentiating along the depth axis, because there is really only one light environment," he said.



Color perception in cichlid fish like the *Pundamilia pundamilia* is evidence of speciation, a report finds.



CHRIS GASH

### A New Flexibility With Thin Solar Cells

Photovoltaic cells, the basic building blocks of solar panels, are more efficient and less costly than ever. But manipulating cells (which are usually made of semiconductor materials) and incorporating them into different panel designs is not necessarily easy.

John A. Rogers of the University of Illinois, Urbana-Champaign, and colleagues have come up with a novel method for creating extremely thin solar cells that can be combined in flexible, even partially transparent, arrays. Described in *Nature Materials*, it could be called the rubber-stamp approach.

The technique involves creating a series of precisely spaced "microbars" on a block of single-crystal silicon. These bars, which have a thickness of a few micrometers,

have doped regions that create p-n junctions, the main feature of most photovoltaic cells.

Through an etching process, the bars are undercut so they can be lifted off the remaining silicon using a block of rubbery material. They can be transferred to a substrate of another material, and this transfer-printing process can be repeated many times to build a cell. A metal grid is overlaid to create electrical connections.

The technique may allow the fabrication of solar arrays with a variety of characteristics. For example, the researchers say it would be possible to print the cells on rollable plastic sheets that would be easy to transport and install. Or by printing the cells on glass in different densities, solar arrays could be incorporated into windows that have a specific level of transparency.

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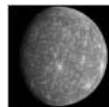
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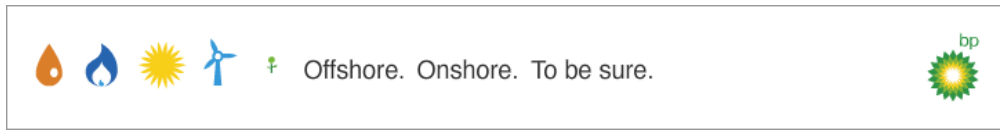
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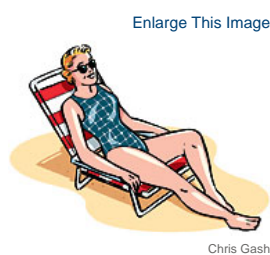
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