Next energy technologies may mimic nature

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New technologies will play a major role in providing the world's growing population with the energy it will need in the coming decades--that was one of the messages of the MIT Museum's second of three "Soap Box" events devoted to energy.

Daniel Nocera, W.M. Keck Professor of Energy and professor of chemistry, and Angela M. Belcher, professor of biological engineering and materials science and engineering, spoke Oct. 25 about "The Role of New Technologies in a Sustainable Energy Economy."

Before the event, Belcher, who applies natural processes to the creation of new materials, handed out delicate abalone shells lined with iridescent mother of pearl. "Around 500 million years ago, organisms based in changing ocean concentrations starting making hard materials, because all of the sudden, they had the opportunity," she said. "Male and female abalone make millions and millions of baby abalone and build beautiful materials. They don't use any toxic materials and they don't add toxic materials back to their environment.

"Why didn't organisms make solar cells and batteries? They just haven't had the opportunity yet," Belcher said. Belcher engineers bacteria and viruses with the genetic programming to build solar cells and batteries. Given a certain genetic code and the right ingredients, the organisms self-assemble into tiny, nanoscale working devices and structures such as semiconductors. When the process is complete, there is no longer any living entity in the component, although it does contain organic parts.

Human beings are themselves "examples of self-assembling, self-correcting systems," she said, so it's not so far-fetched to think of such systems being put to use. Using the same materials (such as yeast) that produce beer, Belcher aims to create environmentally friendly sources for electronic devices.

Nocera talked about the necessity of finding alternative energy sources.

"What will be the oil of the future?" Nocera asked. "Water plus light."

Mimicking photosynthesis, Nocera proposes to store the high-energy bonds of light for later use. That's what photosynthesis is all about: When we eat plants, we release energy originally gathered from sunlight. "You're getting powered by sunlight. That's where our future has to evolve to," he said.

Photosynthesis splits the hydrogen and oxygen bonds in water and stores the energy as a solid. But currently available photovoltaics, or solar cells, are too expensive, "so science has to deliver new materials," Nocera said. "We would take these materials and store the sunlight in batteries."

A human being, considered as energy over time, uses around the same amount of energy as a 100-watt light bulb. In 2050, Nocera said, an estimated global population of nine billion will consume 28 trillion watts per day. Meeting that demand would require growing energy-dedicated crops everywhere on the face of the earth, a new nuclear plant being built every 1.6 days for the next 45 years, or windmills covering the entire surface of the planet.

"It's got to be the sun," Nocera said, because the sun pours more energy onto the Earth's surface in an hour than the entire planet uses in a year.

Audience questions ranged from the potential dangers of self-replicating

organisms (imagine a science-fiction scenario of being overrun by virus batteries) to whether Nocera's formula of future energy needs took conservation into account.

Belcher said that the organisms in her laboratory self-assemble but do not self-replicate, so there is no danger of them proliferating out of control.

Nocera said the 28 trillion watt (terawatt) figure already assumes "unprecedented conservation" along the lines of the current standard of energy consumption of people in equatorial Guinea, not the current standard for the industrialized world.

"The question is: How much is the human global population really worried about this?" Nocera said. "The real discoveries will come from basic science in academia and the next steps from industry. Funding sources tend to be short-sighted, and this approach will not help us come up with a revolutionary technology to impact energy in the next 50 to 100 years.

"We had better start taking energy as personally as health care. We need to engage everyone," Nocera said.

Source: MIT