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Citizen Engineers in Action

"We package engineers as problem solvers rather than creators and innovators who address the grand challenges of our time—environmental contamination, world hunger, energy dependence, and the spread of disease . . . How did we let this happen?"

—Jacquelyn F. Sullivan,[1] co-director of the Integrated Teaching and Learning Program at the University of Colorado at Boulder

Around the world, Citizen Engineers are making a real difference in improving the quality of life. Some are working in the companies you pass by every day, making a difference in the products that we use in our daily routines. Others are applying their passion and expertise to solving fundamental problems that people face. As a conclusion to this book we thought we'd highlight a few inspiring examples of the kinds of things real-world Citizen Engineers are working on today.

Engineers Without Borders (EWB), a nonprofit humanitarian organization, is partnering with developing communities worldwide in order to improve their quality of life. This partnership focuses on the implementation of sustainable engineering projects, while involving and training internationally responsible engineers and engineering students. Here are just a few of their recent projects.

- In Bulandshahar, Uttar Pradesh, the student-teacher duo of Niruttam Kumar Singh and Harvansh Yadav have made a cow dung battery that lights up electric bulbs, charges mobile phones, and brings alive radios.[2]
- Undergraduate engineering students are currently building a bridge across a gorge in a small town in Nicaragua. The students have surveyed the entire project site and are now in the process of designing a bridge to span the gorge and allow for pedestrian travel during the rainy season.[3]
- Thousands of residents of rural villages in India are receiving quality eye care thanks to a collaborative effort between an Indian hospital

network and the researchers at the University of California, Berkeley, and at Intel Corporation who have developed a new technology for low-cost rural connectivity.[4]

- Engineers at PlayPumps International designed the PlayPump[5] water system, which provides easy access to clean drinking water, brings joy to children, and leads to improvements in health, education, gender equality, and economic development. Installed near schools, the PlayPump system doubles as a water pump and a merry-go-round. It also provides a way to reach rural and peri-urban communities with potentially life-saving public health messages.

In Panama, students and researchers are using small wireless sensors to help answer big environmental questions. Warren Wilson College and CREA, a nonprofit organization in Panama, are implementing a geographic information system (GIS) and wireless sensor network on the 1,000-acre Cocobolo Nature Reserve in Panama. Tiny Sun SPOT sensors[6] will provide an inexpensive, easy-to-program platform for monitoring all kinds of things: the impact of deforestation on an ecosystem, plant and insect activity in a rainforest canopy that's 60 feet off the ground, or small changes in local atmospheric conditions that reveal broader meteorological patterns. "This network will allow students to ask big questions and get meaningful answers," says Warren Wilson College Geography Professor David Abernathy, who is overseeing the implementation of the sensor network. "We're extremely excited about the possibilities for our research."

At Rice University, graduate students are using nanotechnology and biotechnology to create high-performance and cost-effective water treatment systems and create the information needed to ensure that emerging technologies evolve in an environmentally responsible and sustainable manner.

Engineers at Tesla Motors will have a profound impact on the environment—whether or not their start-up company succeeds in the marketplace. By proving that a high-performance electric car with zero exhaust is now technologically feasible, Tesla engineers have already radically altered consumer attitudes about electric vehicles and accelerated industry-wide development of new energy-efficient technologies.

Engineers at Global Research Technologies (GRT), a technology research and development company, and Klaus Lackner from Columbia University have demonstrated a new technology that captures carbon from the air. In the "air extraction" prototype, sorbents capture carbon dioxide molecules from free-flowing air and release those molecules as a pure stream of carbon dioxide for sequestration.

This new technique has met a wide range of performance standards in the GRT research facility. "This is an exciting step toward making carbon capture and sequestration a viable technology," said Lackner in an interview with The Earth Institute at Columbia University. "I have long believed science and industry have the technological capability to design systems that will capture greenhouse gases and allow us to transition to energies of the future over the long term."[7]

And you don't have to be an international conglomerate to practice the lifecycle approach to engineering. As showcased in an issue of *Newsweek* magazine, a small-scale project in Brazil shows how collaborative engineering can create an environmentally responsible business that also benefits the environment.[8] José Roberto Fonseca, an engineer and environmentalist, found an opportunity for farmers to grow their way out of poverty. He devised a scheme for using solar power in a desolate, semidesert area of Brazil to irrigate suspended gardens of red, orange, and yellow hot peppers, which could then be chopped, bottled, and exported as gourmet vinaigrette.

Fonseca's solution was based on hydroponics. The pepper plants are grown in water laced with nutrients on a wooden trellis crisscrossed with ultrathin irrigation tubes. At first, his team drew well water and filtered away the salt using a solar-powered desalinator. Now the community taps a natural spring and lets gravity bring the water to the plants. A bank of photovoltaic (PVC) panels powers pumps that keep the water flowing. A "daisy chain" of inventors and entrepreneurs are involved in the production process. An agronomist and an engineer designed the hydroponic gardens; a nutritionist taught villagers the secrets of making spices and condiments; an economist worked up a business plan; and Fonseca built a distribution network with start-up money from international benefactors. "He thought it through, from the soil down to the dinner table," says John Ryan, head of the Virginia-based Institute for Environmental Development.

Today 11 family businesses in Baixas are making a good part of their income from the peppers, and economic prosperity has come to one of the poorest places on Earth—without harming the environment.

In another example, a partnership between Audi and UC Riverside (along with UC Berkeley) has resulted in a project called "Clean Air, a Viable Planet," announced in fall 2007 at the Los Angeles Auto Show. The goal of this project is to reduce CO_2 emissions by allowing drivers to determine the greenest route possible in current traffic conditions. The theory is that any vehicle, regardless of its fuel economy rating, will use less fuel getting from point A to point B if it can cruise at a constant speed rather than if it is constantly speeding up, slowing down, and idling in traffic. "Our goal is to be part of a real solution to the constant dilemma commuters face: What is the best way

to get there?" said Matt Barth, professor of electrical engineering and director of the College of Engineering Center for Environmental Research and Technology (CE-CERT), in an interview published on the UC Riverside Newsroom Web site.[9] "Sometimes the best way to get there is the one that causes the least damage to the planet."