Energy for the Long Haul

Perhaps the greatest challenge in realizing a sustainable future is energy consumption. It is ultimately the basis for a large part of the global economy, and more of it will be required to raise living standards in the developing world. Today, we are mostly dependent on nonrenewable fossil fuels that have been and will continue to be a major cause of pollution and climate change. Because of these problems, and our dwindling supply of petroleum, finding sustainable alternatives is becoming increasingly urgent. This special issue focuses on some of the challenges and efforts needed to harness renewable energy more effectively at a sufficient scale to make a difference and some of the people who are working on these problems. As introduced in the first News article (p. 782), the Editorial by Holdren (p. 737), and the Perspective by Whitesides and Crabtree (p. 796), many of the outstanding questions require major research efforts in underfunded areas.

Much of the focus on sustainable energy is aimed at different ways of tapping into the most abundant renewable resource: solar energy. Lewis (p. 798) points out that the direct conversion of sunlight with solar cells, either into electricity or hydrogen, faces cost hurdles independent of their intrinsic efficiency. Ways must be found to lower production costs and design better conversion and storage systems. In the short term, utilization of biomass relies mainly on sugar fermentation; Goldberg (p. 808) discusses how Brazil’s use of ethanol from sugarcane has greatly reduced its need for imported oil. Many long-term goals have been set for biomass utilization; for example, the European Union (EU) hopes to produce a quarter of its transportation fuels from biomass by 2030, as discussed by Himmel et al. (p. 804). Better ways are also needed for processing the available sugars, and conversion to higher alcohols or even alkanes is desirable. Stephanopoulos (p. 801) explores the options afforded by reengineering biosynthetic pathways in microbes.

How we tackle energy problems will turn on a number of policy issues. Potocnik (p. 810) discusses how the EU is setting targets and allocating funding for alternative energy. Finally, Schrag (p. 812) explores the feasibility of sequestering carbon dioxide from fossil-fuel use and our technological readiness and willingness to implement such schemes.

The News section profiles national lab directors, computer modelers, captains of industry, and bench scientists who are writing the early chapters of the next book on energy research. Some of them are developing better plants to grow as fuel or ways to convert them into ethanol. Others are developing catalysts to extract hydrogen from water or generate electricity from hydrogen. What they all share is a desire to find new ways to power the future. ScienceCareers.org takes a look at three young scientists, a particle physicist designing solar energy systems, and a Ph.D.-level engineer integrating sustainable electricity supplies into the power grid.

— Phil Szuromi, Barbara Jasny, Daniel Clery, James Austin, Brooks Hanson

Sustainability and Energy

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See also related Editorial page 737; Science Careers section page 868; Podcast: www.sciencemag.org/sciext/sustainability