I N T R O D U C T I O N

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; Goldenberg (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 private-sector scientists who are on their first steps to careers in energy R&D: a consultant helping Israel meet its obligations under the Kyoto Protocol, a former 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

CONTENTS

News
782 A Sustainable Future, If We Pay Up Front
784 STEVEN CHU Steering a National Lab Into the Light
785 ANDREW BLAKERS AND KLAUS WEBER Eureka Moment Puts Sliced Solar Cells on Track
786 CLINT CHAPPLE How to Make Biofuels Truly Poplar
787 DEBRA ROLISON Small Thinking, Electrified Froth, and the Beauty of a Fine Mess
788 A Fuel for Small Farms
788 Wiring Up Europe’s Coastline
789 DANIEL NOCERA Hydrogen Economy? Let Sunlight Do the Work
790 STEVE KOONIN Guiding an Oil Tanker Into Renewable Waters
791 TARIQ RAUF Treading the Nuclear Fuel Cycle Minefield
792 Norway: A Nuclear Demonstration Project?
792 Photovoltaics in Focus
793 JAY KEASLING Rethinking Mother Nature’s Choices
794 RICHARD MARTINEAU Former Marine Seeks a Model EMPRESS
795 JAMES DUMESIC Catalyzing the Emergence of a Practical Biorefinery

Perspectives
796 Don’t Forget Long-Term Fundamental Research in Energy
G. M. Whitesides and G. W. Crabtree
798 Toward Cost-Effective Solar Energy Use
N. S. Lewis
801 Challenges in Engineering Microbes for Biofuels Production
G. Stephanopoulos
804 Biomass Recalcitrance: Engineering Plants and Enzymes for Biofuels Production
M. E. Himmel et al.
808 Ethanol for a Sustainable Energy Future
J. Goldenberg
810 Renewable Energy Sources and the Realities of Setting an Energy Agenda
J. Potocnik
812 Preparing to Capture Carbon
D. P. Schrag

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

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