

# IDEAS

FOR SOLVING THE

# ENERGY PUZZLE

NINE ALUMNI EXPERTS  
OUTLINE THE  
CHALLENGES AND OPPORTUNITIES.

ENERGY AND CLIMATE CHANGE ARE TWO OF THE MOST PRESSING PROBLEMS IN NEED OF ENGINEERING EXPERTISE. NUMEROUS THAYER SCHOOL ALUMNI ARE WORKING ON A WIDE RANGE OF INTERSECTING AND COMPLEMENTARY SOLUTIONS. WE'VE ASKED NINE OF THEM TO SHARE THEIR EXPERTISE ON TECHNOLOGIES BOTH OLD AND NEW. THEIR VERDICT: TECHNOLOGY, ECONOMICS, AND PUBLIC POLICY ALL PLAY VITAL ROLES IN THE QUEST FOR MORE AND GREENER ENERGY.

BY LEE MICHAELIDES



## RECYCLED ENERGY

SEAN CASTEN TH'98

President and CEO  
Recycled Energy Development (RED)  
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RED captures “waste” industrial energy to produce electricity and thermal power. Casten has worked in the power industry for ten years. He has chaired both the U.S. Combined Heat and Power Association and the Northeast Combined Heat and Power Initiative, organizations dedicated to energy advocacy.

### TOO MUCH ENERGY GOES UP IN SMOKE

Manufacturing processes and electric power generation convert only a portion of their available energy input into useful work. Both discard the remaining potential energy. The U.S. electric power generation system, on average, discards two thirds of its input energy as waste.

### RESCUING ENERGY

Recycled energy is useful energy derived from exhaust heat from any industrial process or from electric power generation; industrial tail gas that would otherwise be flared, incinerated, or vented; or pressure drop in any gas.

### A HOT IDEA

Thermal energy, the form of much of present waste, does not travel far without losing its value. On-site cogeneration converts fuel to electricity and then reuses the “waste” heat.

### POTENTIAL ENERGY

Cogeneration and energy recycling have the potential to generate 40 percent of our nation’s electricity, slashing power costs, and greenhouse gas emissions.

### INCENTIVIZE EFFICIENCY

Our regulations reward monopoly utilities for investing capital, but provide no reward should they find ways to generate cheaper power. We need to confront the elephant in the room: a regulatory model that is hostile to efficient power generation.

### BACK TO BASICS

There is a huge graying-of-the-workforce problem. You can’t hire a mechanical engineer with a good grounding in steam cycles. That is a big problem because 75 percent of our electricity is produced in some variant of the steam-based Rankine cycle—whether powered by coal, nuclear, or biomass—and all our electricity is produced in medium- to high-voltage power plants.



## CARBON REDUCTION

MICHAEL V. DEFELICE '83

CEO  
Carbon Financial, Inc.  
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Carbon Financial is the developing sponsor of a carbon trading platform through which it provides carbon brokerage services and trades carbon as a principal.

### CONNECTING CARBON TRADING AND ENGINEERING

The global carbon market is highly technical at both the financial and technology levels, with extraordinary numbers of variables and participants. Numerous governmental entities—from nations to municipalities—regulate carbon emissions. In the U.S. alone, at least 29 states and more than 100 municipalities have some form of regulation on renewable energy, carbon emissions, or related emissions. As the market develops, there probably will be increased conformity to common standards. Defining those standards in a way that maximizes the overall result requires a depth of understanding of complex, multivariable, dynamic systems. This is an ideal environment for engineers to participate at the policy and regulatory levels to be sure we “get it right.” Ultimately, a credit traded in the marketplace is only as good and as valuable as the underlying technologies and risk variables—factors engineers know how to assess.

### CARBON SEQUESTRATION CAN'T ELIMINATE EMISSIONS

People are exploring a variety of carbon sequestration methods—including diverting carbon into the ground or oceans—that would reduce emissions, but the techniques have not yet been proven technologically or economically. Even under the most aggressive of assumptions, sequestration would only slow the rate of growth of carbon emissions, not stop the growth or reverse the trend. If we’re serious about reducing emissions, we must develop alternative sources of energy that do not have the same kind or level of environmental cost that traditional fossil fuels have.

### PATHS TO CLEANER COAL

A truly clean and cost-effective coal technology could satisfy our energy needs for a long time. Several technologies are in development, but none has yet proven significantly cleaner or cost-effective. The most advanced is Integrated Gasification Combined Cycle (IGCC) power. It is more efficient than conventional technologies in converting the energy content of coal, but is

much more expensive, and there is some controversy over whether it is actually cleaner. In combination with sequestration, IGCC may be a good solution in the medium term. An exciting variation on this concept is still in the early stages of technical testing. We are working with a company in Europe that has developed an underground gasification process that would combust coal in situ to create syngas. The resultant CO2 effluent would be separated and trapped in the combustion “chamber” and the syngas brought out heated and under pressure. We are optimistic about the potential, but we are a long way from proving this out, and it still relies on an as-yet-unproven sequestration technology to reduce carbon emissions.

### ENGINEERS ARE IN DEMAND

Every step along the chain of development from fundamental research to commercial installation and operation is hiring technical talent in thermodynamics, mechanical design, material science, biology, biochemistry, systems and software, transportation, and on and on. The most critical step in each of these areas is in commercial scale-up—transitioning technology from the lab to the commercial marketplace.



## VENTURE CAPITAL FOR ENERGY

SCOTT SANDELL '86

General Partner,  
New Enterprise Associates (NEA)  
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NEA is a venture capital firm with \$8.5 billion in committed capital. Sandell, who majored in engineering and now focuses on investments in information technology and alternative energy, was ranked #41 on Forbes' 2007 Midas List.

### A BRIGHT IDEA

I am a big believer in solar power. Wind is more economical today, and nuclear power is certainly more proven at scale, but only solar power taps an unlimited resource: the sun. There are 89,000 terawatts of solar power hitting the earth’s surface every day, and the entire global consumption of energy is 13 TW. We don’t have to capture much, and the rate of technical innovation to make solar cost-competitive with coal—the prime source of electricity in the U.S. today, and the most polluting—is very high.

### TIMEFRAMES

We have several portfolio companies that