CEP Chemical Engineering Progress

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The Sustainability Challenge:
You Gotta Be in It to Win It

Almost without exception, the chemical engineers attending the 2006 AIChE Annual Meeting in San Francisco last month seemed excited about the future of our profession. They cited energy and sustainability as the most engaging challenges to come along in recent years. And they are excited about the opportunity to use their knowledge to address some of the most profound and fundamental issues that affect society today.

Energy issues are central to concerns about sustainability. Several years ago, Nobel chemist Richard Smalley described the greatest challenges of sustainability — Number one on his list was energy. Number two was clean drinking water. He then explained that if he had sufficient energy, he could design a technology to provide sufficient drinking water in any location on the planet.

Chemical engineers know sustainability works: We understand the power of material and energy balances, and know that if we consume hydrocarbon resources faster than they are produced, eventually they will be completely consumed.We understand that the carbon liberated from these resources in the production of energy must go somewhere, and that much of it will end up in the atmosphere as CO_2 and dissolve into the oceans. We can use a material balance to describe how carbon derived from biomass and then returned to the atmosphere does not add to the accumulation of carbon in the atmosphere, but rather just closes the carbon cycle. And we understand the second law of thermodynamics, which informs us that we need to consume energy in order to put energy into a form that we can conveniently use for our societal needs.

We also possess the know-how to develop "sustainable" solutions. In a 2004 issue of *Science*, Pacala and Socolow described about 15 major opportunities to affect the way we produce energy and the impact of our hydrocarbon economy on the environment, all based on current technologies. Their suggestions dealt with increased energy efficiencies in transportation, electricity production and buildings, the use of biofuels and renewable resources, and carbon sequestration. While none of these technologies could singlehandedly sustain our energy demands, their collective implementation would create a carbon-neutral energy system. Another striking aspect of the proffered solutions is their underlying basis in sound chemical engineering fundamentals.

Our chemical engineering community is already addressing these energy needs and the impact of global climate change on the environment — by applying engineering principles to develop new routes for converting biomass-derived resources into chemicals and energy; by innovating more-efficient use of today's hydrocarbon resources; by investigating carbon sequestration processes; and by exploring the global issues to identify the best opportunities for research and development.

I am optimistic that our profession will rise to the technical challenges that lie before us and mobilize whatever solutions are necessary to ensure a sustainable future.

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