

Increasing the Role of Economics in Environmental Research (or Moving beyond the Mindset That Economics = Accounting)

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Decisions regarding society's most challenging environmental problems are made with attention to both scientific and economic arguments, with economic criteria playing an ever-larger role. Economic terms and concepts are ubiquitous in environmental policy debates, with discussions over climate change mitigation revolving around "discount rates" and "cap-and-trade", while concerns over "equity" are part of any discussion of sustainability. With respect to more traditional regulatory themes (e.g., drinking water standards), benefit–cost analysis has emerged as a common, often mandatory, part of policy-making. Meanwhile, regulatory schemes employing market- or incentive-based approaches are receiving greater attention (e.g., nutrient trading), financial theory is being used to devise strategies for addressing environmental risks (e.g., drought) and developing world challenges (e.g., microfinance), and "green" technology" has

become one of the fastest growing sectors of investment. Together these trends reveal tremendous opportunities for environmental engineers and scientists to expand into new areas involving the integration of technical and economic expertise. At present, however, much of this potential remains unrealized, raising questions as to why our community has failed to pursue these opportunities more aggressively, as well as how we can better position ourselves to do so in the future.

The National Science Foundation recently sponsored a workshop (organized in cooperation with the Association of Environmental Engineering and Science Professors) to explore these questions, as well as to identify promising areas of interdisciplinary environmental research involving engineers, scientists, and economists. The discussion revolved around several general collaborative themes,¹ including the following:

Innovation in Environmental Regulatory Institutions through Engineering Research: Scientists and engineers can play an important role in overcoming regulatory challenges associated with identifying, monitoring, and enforcing performance standards, a major hurdle in the drive to develop more effective and efficient regulatory institutions.

Informing Design of Environmental Engineering Solutions using Benefit–Cost Analysis: Benefit–cost analysis has become a common part of many environmental decisions, but a major shortcoming is often incomplete knowledge in areas involving science and engineering.

Using Economic and Financial Concepts to Improve Environmental Risk Management: Risk management innovations from the fields of economics and finance can be combined with scientific and engineering knowledge to significantly improve the characterization and mitigation of environmental risks.

Assessing Actions and Investments that Promote Sustainability: Although scientific information is critical to the formulation of sustainable strategies, behavioral, economic, and financial

principles are often decisive in identifying successful implementation paths.

Environmental Engineering in the Developing World: Technical knowledge is an important factor in improving conditions in the developing world, but it is critical that this knowledge be applied with an understanding of the social, economic, and institutional context.

So what stands in the way of the environmental engineering and science community accelerating its movement into these (and related) areas? When considering this question, two primary issues emerged: (i) the paucity of environmental engineers and scientists who are conversant in economics and related social sciences, and (ii) the limited funding available for this type of interdisciplinary research.

With regard to the first issue, our community must overcome the notion, widely held, that economics is merely a form of accounting, an impression often reinforced by the “engineering economics” courses still required in many engineering curricula. We need to make a very clear distinction between the types of management and accounting principles (e.g., discounted cash flow) that form the basis of engineering economics, and the broader conceptual framework that underlies the discipline of economics (e.g., incentives, efficiency, externalities, information, social determinants of preference and valuation). This is critically important as many engineers and scientists are unaware that such a distinction exists. To collaborate effectively with their colleagues in the social sciences, environmental engineers and scientists need to appreciate economics as a discipline concerned with understanding and improving the institutions and processes that influence human behavior. Such activities might involve designing and comparing different institutional arrangements for limiting carbon emissions (e.g., command-and-control vs cap-and-trade vs taxes/subsidies), or developing new methods to assess the value (i.e., benefit) people assign to improved water quality, or designing novel tools to mitigate the financial risks of extreme environmental events, just to name a few. Environmental engineers and scientists have much to contribute to the exploration of such issues, but to do so we will need to understand that economics is something more than adding up costs and benefits. This is not an insurmountable task. A 2–3 course regimen involving exposure to microeconomic theory, along with a course or two applying that theory to resource/environmental problems, can quickly enable engineers and scientists to begin effectively interacting with economists. Exposure to courses addressing human behavior, risk perception, and the social dimensions of environmental policy would further broaden the capacity to address interdisciplinary issues. This regimen may not be appropriate for every student, and greater depth will be required to engage in more detailed research endeavors, but providing curricular alternatives that foster greater cross-disciplinary understanding (among both students and faculty) will allow our community to more effectively address many of the planet’s most pressing problems. If we are to increase our influence on society’s environmental decisions, more of us will need to learn the language of economics.

Another challenge is the lack of substantial funding sources for interdisciplinary research involving engineers, scientists, and economists. Although many acknowledge the value of such research, most environmental funding still focuses on advances in a single discipline. Opportunities for interdisciplinary collaboration are sometimes available through agencies such as NSF,

USEPA, and NOAA, among others, but represent a small fraction of total funding. Greater interest in interdisciplinary topics seems to be slowly leading to more dependable sources of support, but the pace of growth must increase, and we can collectively influence this trend through review panels, advisory committees, and other mechanisms.

There is an increasing call for environmental solutions that involve elements of engineering, science, and economics. This demand offers tremendous opportunities to expand into intellectually stimulating and socially relevant areas of research, but changes will be required if environmental engineers and scientists are to play a more significant role in meeting that demand.

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■ ACKNOWLEDGMENT

Thank you to all workshop participants for their contributions. The ideas that served as the foundation for this workshop were brought together during a session at the 2009 Association of Environmental Engineering and Science Professors (AEESP) and the Tribute to Bill Glaze at the 2009 Annual Meeting of the American Chemical Society.

■ REFERENCES

- (1) *Integrating Economic and Financial Principles into Environmental Engineering Research and Education: Final Workshop Report*; National Science Foundation: Arlington, VA, January 27–28, 2011; www.aeesp.org/pdf/publications/IntegratingEcon_FinanceWorkshopReport.pdf.