

Meeting the Future: A Research Agenda for Sustainability Highlights of International Workshop, May 18-20, 2005

The Office of Research and Development of the U.S. Environmental Protection Agency (EPA) hosted an international workshop on “Meeting the Future: A Research Agenda for Sustainability” in Washington, D.C., from May 18 to 20, 2005. The workshop focused on applied tools, methods, research, and cutting-edge issues on sustainable development. More than 40 speakers in eight panels identified case studies, models, and methodologies for making sustainability operational and highlighted future research needs across a range of sectors and issues.

The more than 170 participants at the workshop represented a broad range of U.S. and international organizations in the public and private sectors. The workshop has contributed to commitments made in the Johannesburg Plan of Implementation at the 2002 World Summit on Sustainable Development (WSSD) to

build greater capacity in science and technology for sustainable development, with actions to improve collaboration and partnerships on research and development and their widespread application among research institutions, universities, the private sector, government and non-government organizations and networks, as well as between and among scientists of and academics of developing and developed countries ...

The eight workshop panels presented a wealth of information, analysis, policy recommendation, and audience participation that have added to our understanding of sustainability research. The paragraphs below offer a few of the panel highlights; you may also view PowerPoint files of the presentations at www.epa.gov/sustainability/Workshop0505.

Keynote Address: Environmental Leadership, Markets and Sustainability

World Resources Institute president **Jonathan Lash**'s keynote address emphasized the increasing world-wide pressures on ecosystems as the global economy expands and business and government develop initiatives to promote innovative approaches to resource management. Mr. Lash believes that these initiatives reflect the growing public pressure observable in both business and financial circles to achieve sustainable economic growth. As an example of business leadership on sustainability Lash cited General Electric's "ecoimagination" initiative, which will double its funding for research in innovative and clean technologies from \$700 million currently to \$1.5 billion by 2010. He also pointed to the need to reduce greenhouse gas emission as an important stimulant for technological innovation. Mr. Lash argued that climate change remains one of the most urgent and challenging issues that societies must address; he suggested that energy and technology decisions made today by China and other developing countries will greatly affect future climate patterns.

I. U.S. and European Sustainability Research Strategies

EPA's **William Farland** outlined the emerging EPA research strategy on sustainability and **Karl Wollin** of the German Federal Ministry of Education and Research described the German government's sustainability strategy. Dr. Farland noted that because the U.S. is facing a different set of environmental issues than existed when the agency was formed 35 years ago, EPA needs a more integrated and system-oriented strategy to identify and address the new environmental issues. According to the German strategy, "Successful research for sustainability brings about advances that benefit humankind, make everyday life easier, protect the environment and tap new employment potential" (for details on the German strategy see www.fona.de/eng). The EPA and German strategies agree in emphasizing significant principal themes:

- the positive benefits that sustainability research can bring to society;
- the value of a systems approach to environmental management that focuses on business and industry, ecosystems and agriculture, the built environment and human health; and
- the importance of developing innovative technologies to enhance growth and employment and manage resources in a more sustainable manner.

II. Future Trends and Frontiers of Science and Technology for Sustainability

David Rejeski of the Woodrow Wilson Center International Center for Scholars chaired the panel of experts reviewing the implications of advances in nanotechnology, biotechnology, information theory, and cognitive sciences. He challenged the group to think about the more extreme effects we are liable to experience in the next 10–20 years due to rapid technological developments and their subsequent convergence. We can't solve new problems with old technology, he pointed out: we're still dealing with diesel and internal combustion engines and the products of chemical synthesis from a process dating back to the 1850s. Predicting that there will be multiple revolutions in science and technology, Mr. Rejeski warned that their unintended consequences will have a greater impact than any environmental policies we can produce.

Brent Erickson of the Biotechnology Industry Organization outlined the broad range of applications for industrial biotechnology, which is the application of life sciences to chemical synthesis and conventional manufacturing. Mr. Erickson presented specific examples in such sectors as the pulp and paper and chemical industries. He summarized the findings of recent OECD-commissioned studies examining how industrial biotechnology has assisted both developed and developing countries to move towards sustainable development. As industrial biotechnology continues to expand in many sectors around the world, it has the potential to be both disruptive and transformative, offering opportunities for industries to reap unprecedented benefits through pollution prevention. Mr. Erickson discussed the development of policy measures to facilitate the expansion of industrial biotechnology and offered recommendations for further research in industrial biotechnology.

Barbara Karn of EPA presented an overview of nanotechnology, describing its potential to advance the goals of sustainable development. For example, nanotechnology could have positive implications for energy use, by leading to more efficient lighting and electronics, lighter vehicles that use less fuel, and cleaner-burning fuels. Dr. Karn discussed the potential risks from nanotechnology to human health and the environment, as well as current research to achieve better understanding of how nanotechnology can impact environmental health.

Summarizing the technology discussion, **Brad Allenby** of Arizona State University discussed the need for a more sophisticated approach to emerging technologies, citing important trends related to technological evolution. Dr. Allenby described a number of scenarios, some of which are captured in the concept of NBIC (nano, bio, info, cogno) convergence. He discussed several “Trends We Should Care About” in relation to technological evolution, highlighting the increasing complexity at the systems level of information structures, e.g., the concept of the “cognitive city”—a complex of smart materials, smart buildings, and smart integrated infrastructures that are all linked to human systems.

III. Toward a 21st-Century Research Agenda for Sustainable Development at Subnational Levels

John Dernbach of the Widener Law School and the Pennsylvania Department of Environmental Protection noted that environmental improvement thus far has been only modest in the face of growth in consumption and population, relatively weak federal leadership, laws that have subsidized unsustainable practices and grandfathered inefficient facilities, and fragmented decision-making and limited capacity for comprehensive and strategic action at the state and local level. Despite these constraints, Mr. Dernbach argued that many states have become effective laboratories for sustainable development, taking the lead in planning and implementing innovative programs. The best state initiatives, he said, are using interagency coordination to address multi-dimensional problems and are adopting investment criteria for sustainable development grants. He called for further research in such areas as mapping capacity and user-friendly tools for decision-making, as well as education and communication to enhance public awareness and promote sustainable consumption.

EPA’s **Annette Gatchett** reviewed the 15-year history, collaborative approach, and goals of the U.S.–German Bilateral Working Group on Revitalized Contaminated Land, which expanded from an initial focus of sharing information on innovative clean-up technologies to responding to the challenge to redevelop remediated land. This working group has hosted five technology workshops and five international conferences and has developed a feasibility study, a state-led brownfields team, and the SMARTe tool for site-specific redevelopment. Its next phase will evaluate sustainable aspects of revitalization efforts. Future work areas include regional and local land revitalization planning tools, sustainability program management, brownfields communication

networks, and brownscapes design. Among Web sites providing information on the working group are www.smarte.org, www.itrcweb.org, www.bilateral-wg.org, and www.epa.gov/brownfields.

Karl Wollin of the German Federal Ministry of Education and Research reviewed the German national strategy on land use and development. In response to the loss of agricultural and forest land to settlement and transportation uses—which has fragmented ecosystems and undermined biodiversity—the National Strategy for Sustainable Development calls for reducing the loss of green space from 130 ha./day in 2000 to 30ha./day in 2020. Mr. Wollin noted that the German government is addressing urban development issues by developing innovative land use models and a host of sustainable land management practices, including the increased use and redevelopment of brownfields. The “REFINA” research and development program is providing funding to several kinds of efforts: exemplary model concepts in innovative land management for selected regions and area types; analyses, methods, evaluative tools for sustainable land development; and dissemination of knowledge through new information and communication structures. It has received 141 proposals involving 620 project partners and 218 other institutions, representing including mining, industry, military, urban, and agricultural interests.

Betsy Smith of the EPA presented an overview of a project in North and South Carolina featuring federal, state, and private-sector collaboration that is emphasizing community-developed goals and statistically-based decision models to assess impacts of development strategies. Dr. Smith described the application in the greater Charlotte, N.C. area of the Regional Vulnerability Assessment (ReVA) program, which assesses the environmental vulnerability of such systems as water supply, land cover, and ecosystem integrity in the Sustainable Environment for Quality of Life (SEQL) Initiative. Because the area’s growing population and high levels of particulate matter and ozone—air pollutants especially threatening to the health of children—local and state government managers have felt it imperative to both control their environmental problems and foster vigorous economic growth. EPA has collaborated with other federal agencies, more than 100 local jurisdictions, universities, business leaders, environmental groups, and citizens. The project has moved from identifying and tackling regional environmental concerns to focusing on integrated longer-range regional environmental planning and implementation.

IV. Urban Sustainability

Eric Ponthieu of the European Commission reviewed the history of research over the past three European Union urban research strategies. Following the holistic effort in City of Tomorrow and Cultural Heritage in the Fifth Framework Programme (FP5, covering 1999-2002), the FP6 on Urban Research (2002-06) has taken a more diffuse and detailed approach to the effects of urban sustainability. A renewed focus on urban issues is proposed in the FP7 strategy on Environment and Urban Sustainability (2007-13), which identifies urban sustainability as one of ten emerging environmental themes—

which also include sustainable growth, tourism, environmental health, population, globalization, and the increasing vulnerability of ecosystems.

Volker Hartkopf of Carnegie Mellon University highlighted the relationship between sustainability and basic human needs for survival, which he listed as nourishment, shelter, health, freedom, mobility/accessibility, and communities with diversity. Prof. Hartkopf's presentation focused on urban sprawl and built environments; as our urban communities face increasing sprawl, they must use and adapt planning that uses land, transportation, and energy more efficiently than in the past. This thinking, he emphasized, must also be incorporated into the design of buildings and houses, the selection of construction materials, and daily use of buildings and homes. Prof. Hartkopf presented examples of methods for increasing energy efficiency in new construction, including intelligent workplace design, systems integration, and improved construction materials.

Donna N. Myers of the U.S. Geological Survey described USGS research concerning stream and ecosystem urbanization and its influence on sustainable development. This research effort has worked to develop a methodology to generate metrics that can measure the effects of urbanization on streams and ecosystems. Decision-makers can use these metrics to determine whether alterations in the surroundings are improving or are having deleterious effects on a stream or ecosystem, and to inform their decisions. The ultimate goal of this research is a decision support system which can aid in identifying the best management practices for stream and ecosystem maintenance and restoration. Ms. Myers presented results from pilot studies in Boston, Salt Lake City, and Birmingham, Alabama.

EPA's **Jerri-Anne Garl** provided a regional perspective on how the agency uses experience from urban centers to provide valuable information for addressing sustainability in our cities. EPA's Region 5 includes six Midwestern states with a number of industries in the pharmaceutical, automotive, and chemical sectors; it includes cities with diverse population and growing development issues which must be addressed. These development issues include urban air and water problems (such as surface runoff quality), lead poisoning concerns, and energy consumption. To assist EPA in addressing these concerns, a partnership at the local level with six "Great Cities" was developed in 2002. This partnership has led to the sharing of results, leverage of funding, and platforms for the exchange of information related to sustainable development.

V. Frontier Issues in Sustainability Research (Part 1)

Dr. **Howard Frumkin** of Emory University laid out the case that, because sustainability and human health support each other in diverse and powerful ways, health research needs to be integrated into sustainability research. Dr. Frumkin emphasized that sustainable consumption and healthy lifestyles are compatible, arguing that increased wealth above the poverty level and unsustainable consumption do not advance human happiness. He listed some of the health services provided by sustainable ecosystems:

supporting human nutrition and respiratory and cardiovascular health; reducing the threat of infectious disease, flooding, and drought; and providing sources of new medications. Among the multiple domains of health research that should be integrated into sustainability research are epidemiology, health indicators and health impact assessments, and social marketing for sustainable consumption practices.

Dennis L. Hjeresen of Los Alamos National Laboratory explored the impact of green chemistry on water quality and supplies. Given the “negative chemical legacy” in industrial nations of nuclear waste and thousands of tons of abandoned pesticides, together with projected population and economic growth in developing countries, Dr. Hjeresen insisted that we must replace habits of “pollute and clean up” with green chemistry practices that reduce or eliminate the use or generation of hazardous substances in the design, manufacture, and application of chemical products. He noted that chemistry can both support and threaten water, agriculture, and energy—which are all at the heart of sustainability, and he illustrated green chemistry’s potential to advance sustainability in processes involving photographic processing, marine antifoulants, biomimetic pesticides, molting accelerators, and harpin protein. Dr. Hjeresen concluded that green chemistry is a viable approach to global environmental problems, one that must be included in a complex blend of technical, social, economic and political contributions.

Meredith Whiting of The Conference Board presented a report, prepared with Charles Bennett, on the Board’s three-year cooperative agreement with EPA’s Energy Star program on “Business & Energy in the 21st Century.” The project was based on the assumption that improving energy efficiency and diversifying supply contributes to business sustainability and societal/environmental well-being. Ms. Whiting described its key findings: that management priorities, approaches, motivations and drivers (business opportunities, company “image,” and avoiding liability), perceptions regarding control over energy cost and supply, and degree of accountability for energy management are “truly diverse” across American business. The project’s “Roadmap for Business: Planning for and Managing Energy for Results” offers a comprehensive and adaptable management system designed to help firms use energy more sustainably, produce products that will enable energy sustainability, and develop more sustainable sources of energy.

Tim Jackson of the University of Surrey described research on sustainable consumption and behavior change, including theories of interpersonal behavior and consumer choice. Prof. Jackson criticized reliance on the notion of consumer sovereignty, which he said regards choice as entirely individualistic and fails to unravel the social and psychological influences on behaviour. Citing the limitations of rational-choice and market-failure models, he said that personal habits and routines and the symbolic role of consumer goods can “lock in” unsustainable consumption patterns. He argued that consumption is influenced by social norms and lifestyle choices and also by the institutions and structures of society, and that policy intervenes continually in consumer behaviour by influencing the social and institutional context. Prof. Jackson suggested that policy can encourage, enable, engage and exemplify consumer behaviour more consistent with sustainability, with the most appropriate approaches evolving as attitudes and behaviours change over time.

VI. The Business and Social Case for Sustainability

John Mizroch of the World Environmental Center argued that the private sector will lead the way to sustainability, as it faces and meets the challenges of a century dominated by the explosion of the world’s human population, especially its urban population. Mr. Mizroch contrasted the leading role of the legal profession in discussions of environmentally-related risks in the U.S., in contrast to the leading role of the insurance sector in other nations. In addition to reducing material and manufacturing costs, he predicted that a sustainable approach will provide other valuable benefits, such as reduced worker attrition.

Dow Chemical Company’s **Scott Noesen** explained his firm’s accomplishments toward meeting the 10-year goals it set in 1995 to reduce injuries, harm to the environment, and such incidents as leaks, breaks, and spills. For a decade Dow focused on “doing less bad”—efforts that more than paid for themselves in reduced costs, Mr. Noesen said; it is now setting goals for 2015 that emphasize “doing more good.” While testifying to the excitement at Dow as it moves towards progress in safety and good stewardship (including “getting the talk/do ratio right!”), he cautioned that the public sector also must also play its crucial role for sustainability (“Business cannot succeed in a society that fails”).

Swiss Re’s **Adrienne Atwell** told the workshop that sustainability is a core value of that company, which recognizes that environmental and social performance, like economic performance, generates value. Among the drivers of value for Swiss Re, Ms. Atwell listed risk management and cost reduction, new products (such as emission trading and “green investments), employee motivation, and the firm’s reputation as a “knowledge company” recognized for ethical behavior.

Roby Muntoni of FTSE Americas described the FTSE4Good index series—which identifies companies that have good stockholder relations, support human rights, and work toward sustainability—as a response to the increased interest among investors

in social and environmental responsibility, extra-financial risk, and shareholder rights. Ms. Muntoni noted that FTSE4Good's selection process and criteria for inclusion in the index have become tougher: the index introduced supply chain labor criteria in 2004 and plans to add criteria on bribery and corruption. She observed that firms are improving their practices in sustainability reporting, thereby assisting investors to identify companies with good governance and lower risks.

EPA's **Sol Salinas** related how public-private sector dialogue has achieved higher energy performance through what he identified as the three major drivers of corporate sustainability: the business case, NGO/institutional and individual demand, and public sector recognition. Mr. Salinas related how corporate leaders have responded to metrics comparing their firms' energy use as a fraction of revenue with that of their competitors. He presented data showing that in REIT, food retail, and merchandise retail sectors, the stock value of partners in EPA's Energy Star program significantly exceeded that of other firms, thus indicating that energy performance is a good proxy for management quality.

Matthew Clark, also of EPA, argued that policy approaches to encourage sustainable behavior must relate to corporations' prime motivation, which is the "bottom line" of profitability. Since business models and management structures vary across firms and sectors, Dr. Clark called for a variety of policy approaches in order to align government interventions with the motives of different companies. He pointed out that corporations may expect sustainable practices to lead to increased profits through eco-efficiency, reduced "friction costs" (such as litigation expenses), and increasing market share due to new product lines.

Concluding the session, panel members responded to the challenge from panel chair **Paul Portney**, of the Resources for the Future, who asked why a company should receive special praise for "going beyond compliance" if its actions were directed towards improve its own profitability.

VII. Frontier Issues in Sustainability Research (Part 2)

The final day of the international workshop explore additional "frontier issues" in sustainability research. **Kenneth Ruffing** of the Organization for Economic Cooperation and Development (OECD) noted that in the past two decades the material intensity of the European economy has declined in relation to both GDP and population. Dr. Ruffing described how OECD's approach to sustainable materials management draws upon a materials flow accounting policy framework which advocates making wider use of markets, forging stronger policy coherence, harnessing science and technology, and managing links to the global economy. This framework enables the design of policies such as subsidy reform, environmentally based taxes, permit systems, and voluntary agreements, with the overall objective of decoupling material flows from the economy and minimizing waste. He concluded that in its examination of company behavior, the OECD has found that superior environmental performance of firms has a positive impact on profitability.

Donald Rogich, a World Resources Institute consultant, described a materials account database for the U.S. that WRI has been continuing to assemble since a 1997 report. He noted that the total material requirement per person in the U.S. has been increasing since 1975, falling short of Europe's successes in this regard. Mr. Rogich presented trends in the use of mineral and metals, such as the increasing use of lead (increasing due to batteries), arsenic (growing due to pressure-treated wood but expected to decline under new regulations), and mercury (decreasing). Dominated by steel, U.S. recycling rates peaked in the 1990s. Gasoline consumption per capita dropped dramatically in the 1970s, but has risen steadily since about 1990. Mr. Rogich pointed to research priorities and technical issues, such as improving materials flow data and correlating it with environmental impacts, as well as better handling of data on the import and export of finished goods.

Thomas Dunne of EPA emphasized the importance of “managing materials and not waste.” Acknowledging that the U.S. trails other nations in materials management, Mr. Dunne advocated an approach relying more on voluntary action than that of the OECD. He argued that over the long run it will be smarter to manage materials ranging from coal ash to electronics rather than to simply manage their waste. Mr. Dunne pointed to EPA's WasteWise program as an existing waste reduction production whose voluntary and flexible nature addresses some of the key issues and approaches, but indicated that EPA's best future role will be to encourage materials management and then “get out of the way.” He expressed the hope that materials management will be at the top of his career accomplishments at EPA.

Bradley Raffle of Baker Botts LLP argued that in many situations, while neither regulatory constraints nor economic incentives alone are effective, mitigation-based revenue streams can encourage limited development that is compatible with conservation. He advocated “stacking” ownership of ecosystem services as a way to provide the owners of ecologically valuable land with an economic incentive to preserve or enhance the land's natural functions. For example, a piece of property in Texas could provide aesthetical value, storm water mitigation, sustainable timber harvesting, and mineral rights. Mr. Raffle suggested that enabling a landowner to sell these services individually could produce win-win-win outcomes for the landowner, for people purchasing benefits at lower costs, and for the public benefiting from conservation and land preservation. Such an approach, he noted, requires additional supportive programs, such as third-party audits of commitments for conservation.

EPA's **Gary Foley** spoke on the Global Earth Observation System of Systems (GEOSS), a major international effort to collect, integrate, and synthesize data that monitor the condition of earth systems. Dr. Foley stated that GEOSS can play a strong role in informing and monitoring progress towards sustainability. GEOSS is using its data and indicators to support a wide range of decision-making and is working on approaches to enable policy makers, environmental managers, and other potential users to influence data collection so that investments in GEOSS will lead to a system enabling “a healthy public, economy, and planet.”

Timo Makela of the European Commission began his presentation by stating that we are entering “a new industrial revolution of sustainable production and consumption.” Two million people in the European Union (EU) are employed in industries related to sustainable production and consumption, and a new Sustainable Development Strategy (SDS) that the EU will consider for approval in December 2005 aims to address unsustainable trends in climate change, public health, natural resources use, transportation, aging population, and social exclusion. Mr. Makela said that the strategy calls for “doing things differently”—increasing policy coherence, public participation, and the role of science and knowledge (such as through indicators). He noted the important challenge of integrating the SDS into other EU strategies, particularly the Strategy for Growth and Jobs: “We cannot afford to focus on growth now and take care of environment later,” he insisted.

VIII. Frontier Issues for Sustainability Research Agendas and Links to Policy and Regulatory Issues

David Stanners of the European Environment Agency (EEA) introduced and chaired this concluding panel, eliciting the liveliest interaction of the workshop. Dr. Stanners contended that “sustainable development” belongs in the essential, normative but always contestable, category of concepts like democracy, liberty, and social justice. He described EEA’s Guideline for Environmental Assessment and Reporting in the context of sustainable development (GEAR-SD), calling it “a checklist, a guideline, [and] a tool . . . towards an improved reporting framework useful for different actors at different levels.” GEAR-SD’s eight points include inter-generational equity, decoupling, sector integration, adaptability, avoiding irreversible damage, distributional equity, global responsibility, and governance.

Alain Vidal of France’s Agricultural and Environmental Research Institute (CEMAGREF) described the Partnership for European Environmental Research (PEER), a network of large research centers focused on the interaction between human society and the environment. Dr. Vidal sees development indicators as communication tools that are central to a sustainability research agenda. He maintained that while they must be based on objective data, they will inform decisions that are also affected by values. He underlined that it is worth the effort to assemble multiple stakeholders (including indicator users as well as scientists who gather and synthesize data) to develop appropriate indicators; it is also essential, he stressed, that indicators be transparent and that uncertainty be explicitly recognized.

The World Bank’s **Kirk Hamilton** made the case that changes in real wealth (produced, natural, and human) lead to changes in future welfare. Dr. Hamilton distinguished between weak sustainability (which assumes that produced assets can be substituted for natural ones) and strong sustainability (which assumes that natural capital must be preserved or conserved). He called attention to the role of an array of sparse information on economic values ranging from ecosystem services to biodiversity. He

underlined importance of understanding “safe minimum” levels for conservation, as well as non-linearities or “tipping points,” and suggested that weak sustainability may work well enough until we reach a safe minimum or a tipping point.

J. Todd Mitchell of the Houston Advanced Research Center (HARC) drew upon his experience in refining HARC’s vision and also described activities of the Mitchell family foundation, which is committed to sustainable development. Mr. Mitchell has led the reshaping of HARC into a “boundary organization” which aims to link science producers with users by focusing on user-driven science, influencing technology and policy as they relate to sustainability. Although this field of work, which follows research and early development but precedes widespread application of technology, has been called a “valley of death,” HARC has found an effective niche in this zone for its work in both technology and policy.

E. Donald Elliott of Willkie Farr & Gallagher LLP posited that sustainability can be accomplished under current U.S. legislation, although certain laws occasionally present obstacles to sustainability: improvement and coordination of legislation could smooth the transition to sustainability. Mr. Elliot stated that arguments over nuances in cost-benefit analysis and the “precautionary principle” sometimes cause us to lose focus on the larger goal of achieving sustainable development. While some observers believe that regulatory agencies such as EPA are overly constrained by existing legislation, he argued that the “Chevron decision” has given EPA substantial flexibility in meeting the intent of environmental statutes, disagreeing with those who claim that such a flexible approach can weaken environmental protection.