

**SHELL CENTER
FOR SUSTAINABILITY**

YEAR END REPORT 2004

**Environmental & Energy Systems Institute
Rice University**



Message from Mark R. Wiesner,

Director

Environmental & Energy Systems Institute

Rice University's faculty, staff and students are committed to developing new ways to contribute to the sustainability of our planet. In so doing, Rice's Shell Center for Sustainability plays a key role in supporting our efforts to benefit our planet's society, economy and environment.

Increasingly, the focus of the Shell Center is on the sustainability of major coastal cities — Houston being one of our nation's largest. By the year 2020, approximately two thirds of the world's population will live within 100 kilometers of the coast. This massive shift in population will present major challenges to the ability of coastal cities to protect their environment and meet the needs of their societies.

We believe that the research, education and outreach activities described in this report will make a significant contribution to helping both Houston and other major cities achieve a sustainable future.

Houston is our home, and the sustainability of Houston is of high priority. In this regard, the Center has: supported research on improving Houston's air quality; undertaken numerous seminars and conferences related to Houston's air and water quality; developed scenarios for the city's future with the Houston community; and provided students with a wide range of opportunities to study Houston's sustainability challenges.

Over time, we also expect that the work of the Shell Center will have global impact. In this regard, the Center is now supporting a Rice faculty team on a joint research effort with Nankai University in Tianjin, China.

The focus of the Shell Center is not entirely on the needs of coastal cities. Ultimately, it is our intention for Rice to make a major contribution to pressing, fundamental problems facing our entire planet. In this regard the Center is supporting Rice research efforts on carbon management, the application of nanotechnology to solar energy and the electricity grid, the development of membranes needed for both energy production and water and air treatment; and the enhanced understanding of methane hydrates, a potential source of energy but also a possible factor in global climate change.

Mission of the Shell Center

Rice University and the Shell Oil Company Foundation jointly launched the Shell Center for Sustainability in 2002. Supplemental funding has been provided by Shell Oil Company. The Center is affiliated with Rice's Environmental & Energy Systems Institute.

The Center's mission is to create an interdisciplinary program of education, research, and outreach to foster sustainability. The Center draws upon the various strengths of the university and collaborates with other highly respected regional, national and global institutions of higher learning as well as nongovernmental organizations (NGOs). In so doing, it seeks to be a hub for collaboration among experts dealing with societal, environmental and financial issues arising from economic activities.

Objectives of the Shell Center

Create new technologies, processes, products and market mechanisms that will advance sustainable economic growth and help build a sound public infrastructure.

Develop new tools in engineering, the social sciences and the natural sciences that enhance the understanding of requirements for sustainability.

Help remove institutional barriers to sensible environmental and social practices and contribute to new policy instruments for achieving sustainability.

Provide society with broadly educated environmental, technical and natural resource experts to mold future decision-making in the private and public sectors to help insure a more sustainable future in both developed and developing nations.

Enhance the exchange of information in the public and private sectors by serving as an independent forum for open discussion and constructive dialogue on sustainable development issues and policies across a broad spectrum of stakeholders including national and international business leaders, academia, NGOs and senior policy makers.

Research issues posed by environmental and societal impacts arising from economic activities.

Develop new engineering and scientific curricula to educate a new generation of scientists who will incorporate sustainability concepts into business plans, designs and processes.

Advance thinking around market-based mechanisms that can be deployed to enhance sustainability.

Develop linkages with other institutions and non-governmental organizations at local, regional, national and international levels.

Message from Christian Holmes

Executive Director

Shell Center for Sustainability

The Shell Center seeks to support the efforts of Rice University's faculty, staff and students to better our planet's economy, society and environment.

We do so by supporting the research of Rice faculty on such critical matters as improving the understanding of: the formation of ozone; the impact of invasive species on biodiversity; the formation of methane trapped within sea floor formations; the interactions between a wide variety of stakeholders engaged in economic development; and the development of new technologies, such as membranes and nanotechnology, which hold great promise for benefiting mankind's future. Sustainability is a broad concept, and increasingly we seek to relate our work to the sustainability of coastal cities.

We also seek to provide the public with information critical to their individual and collective sustainability. For this reason, we have conducted a series of seminars and conferences on such topics as climate change and carbon management; meeting ozone and particulate matter air-quality standards; improving water quality and developing new supplies of water through advances in such technology as desalinization; and the development of scenarios related to Houston's future.

While all of the above activities are important, one of the most enjoyable - and potentially most important - aspects of our work is fostering awareness of sustainability issues among our students. We seek to provide students with unusual opportunities to learn about how different elements within our society - government, business, academia, nongovernmental organizations - may contribute to the sustainability of our planet. Thus, last summer, the Center supported a student team conducting polling in Pinedale, Wyoming on the impact of energy development on conservation. The Center has also supported a student team studying how a Houston-based chemical company converts chemical waste into a profitable product while also developing new ways to protect their surrounding environment.

It is a privilege to be given this opportunity to utilize Rice's impressive faculty, staff and students to help sustain our environment, economy and society.

Research, Outreach and Education

Supported by the Shell Center

RESEARCH

Gas Hydrates	1
Carbon Sequestration	1
Nanotechnology and Energy	2
Ozone Research	2
Water Membrane Technology	2
Biodiversity - Forestry	2
Biolinguistic Diversity	3
Business Case for Sustainable Development	3
Stakeholder Relations - Pinedale, Wyoming	3
China Sustainability	4

OUTREACH

Texas Water Seminars	6
Climate Change and Carbon Management	7
China and Sustainable Development	7
Meeting the Ozone Standards	8
Particulate Matter	9
Scenarios for Houston's Future	10
Gender, Development & Energy Lecture Series	11

EDUCATION

Houston Ship Channel Case Study	12
CHRONOS Sustainability Module	12
Pinedale, Wyoming Initiative	12

In Fall 2003, the Shell Center committed funds to support several research projects conducted primarily by Rice faculty, staff and students. Work began in 2004 and will continue into 2005. Research falls into these general areas:

- Energy resources, carbon cycle and air quality
- Water
- Biodiversity
- Role of the private sector in fostering sustainability and stakeholder relationships

GAS HYDRATES

Gas Hydrates: Climate Change and Energy Supply

Dr. Walter Chapman, Dr. Gerald Dickens, Dr. George J. Hirasaki, Dr. Manik Talwani, Dr. Colin Zelt, Dr. Brandon Dugan

Gas hydrates are crystalline solids composed of gas molecules trapped inside a rigid lattice of water molecules. These compounds occur naturally in Arctic permafrost at depths greater than 200 meters, and they also form in marine sediments at ocean floor depths greater than 500 meters where temperatures hover near freezing.

Gas Hydrates offer a vast, untapped source of energy, a key element in the global carbon balance and past global warming events and the number one problem for hydrocarbon transmission in deepwater oil and gas production. This research combines Rice University and external expertise in the natural occurrence of methane hydrates, thermodynamics and kinetics of gas hydrates, and transport through porous media. The research will develop mechanistic models to describe the accumulation and dissociation of gas hydrates. Such knowledge is important to understanding the role that gas hydrates might play in energy exploration and production and with regard to climate change. The program supports seminars to address global climate and sustainable energy production and investigate the contribution of gas hydrates to global climate change and future energy supplies. The seminars will bring together researchers from Rice, the University of Houston, Texas Tech University and local companies. Shell Center funds will enable the research team to enlist a graduate student's assistance in modeling the dynamics of the accumulation and dissociation of methane hydrates in deep ocean sediments.

Start-up funding from Shell Center for Sustainability has helped Dr. Hirasaki and Dr. Chapman get established in the geologic accumulation of gas hydrates in marine sediments. They have teamed with Dr. Dickens, Dr. Zelt and Dr. Dugan of Earth Science to submit a proposal in response to a Department of Energy solicitation for Exploration and Production of Methane Hydrate for Energy Production.

CARBON SEQUESTRATION

Carbon Capture and Sequestration

Dr. Jerry Dickens, Dr. Brandon Dugan, Dr. Robert Harris, Dr. Peter Hartley, Ms. Amy Myers Jaffe, Dr. Neal Lane, Dr. Andreas Lutge, Dr. Carrie Masiello, Dr. Ken Medlock, Dr. Ron Sass, Dr. Robin Sickles, Dr. Ronald Soligo, Dr. Kyriocos Zygourakis

A growing concern among scientists and others is that higher concentrations of greenhouse gases (GHGs) will result in unpredictable and potentially dangerous changes in the Earth's climate.

This project will create a study team at Rice University that will explore various environmentally favorable and economically sound ways to control and reduce atmospheric greenhouse gases. The long term goal of this study team is to create an integrated set of Houston-area demonstration projects for carbon capture and sequestration. A series of workshops and meetings with industry will contribute to forming a research agenda, public outreach on the various technologies available to contribute to carbon management, a website on carbon management technologies, and long term demonstration project strategy for Texas.

Because of the concentration of industrial and academic talent in the energy sector, Houston has the potential to become a global leader in developing, demonstrating and carrying out technologically, environmentally and financially sound methods for reductions in greenhouse gas emissions. The Rice carbon management study group is a first step toward developing carbon reduction and demonstration projects, including the possible creation of terrestrial sequestration sites and a FutureGen power generation pilot plant that can establish Houston at the forefront of such development.

Shell Center and Baker Institute funds will enable the research team to organize and convene the workshop at Rice University to discuss the parameters for building a private/public partnership to implement a pilot project in Houston.

NANOTECHNOLOGY AND ENERGY

Nanotechnology and Energy

Dr. Rick Smalley, Dr. Neal Lane, Dr. Wade Adams, Dr. Dagobert Brito, Dr. Steven Currall, Dr. Peter Hartley, Dr. Robert Hauge, Ms. Amy Myers Jaffe

Advancement of nanotechnology solutions can be an integral component in meeting global energy challenges. This project will support three joint science and policy seminars that will investigate the potential for nanoscience to contribute to funding breakthrough solutions, jointly sponsored by the Shell Center, the Environmental & Energy Systems Institute, the Center for Nanoscale Science Technology, and the Baker Institute for Public Policy.

The first seminar investigated the potential for nanoscience to contribute to solar energy. The second seminar will investigate the potential for nanoscience to contribute to enhancing electricity transmission grids, transportation and storage. The third seminar will investigate hydrogen storage problems and possible solutions that nanoscience can offer.

OZONE RESEARCH

Dr. Matthew Fraser, Dr. Gary Morris

This project established an ozone-monitoring program at Rice University with the goal of developing a better understanding of tropospheric ozone pollution. The project acquired a station from which to launch balloons (ozonesondes) with payloads designed to acquire *in situ* profiles of ozone pollution.

Although ozone pollution is a significant problem in Houston, the Houston area has had no established program to monitor ozone concentrations at any altitude in the atmosphere above the surface. By measuring the vertical distribution of ozone as a function of time, we will be able to establish clearly the nature (local vs. transported) and extent and origins (industrial activity vs. mobile sources) of local ozone, thus providing an important step to finding solutions. The establishment of regular profile measurements in Houston is an essential step to assessing issues of sustainability.

WATER MEMBRANE TECHNOLOGIES

Dr. Andrew R. Barron, Dr. Vicki L. Colvin, Dr. Matteo Pasquali, Dr. Michael Wong, Dr. Mark Wiesner

This project brings together expertise from several Rice departments in the area of membrane fabrication and use to examine applications where membrane science is likely to enable game-changing innovations in water management and energy production. Leveraging expertise in membrane processes, water treatment, catalysis and nanochemistry, the team addresses priorities in the areas of desalination, water supply in remote or developing areas and managing produced waters and brines in energy production.

Fundamental research addresses the development of new materials and processes, specifically in the areas of reactive membranes, nanostructured membranes, membranes for proton transfer in fuel cells and gas separation membranes.

BIODIVERSITY-FORESTRY

Invasive Species Control in Floodplain Forests

Dr. William E. Rogers, Dr. Evan H. Siemann, Dr. Dale S. Sawyer

The Chinese Tallow Tree (*Sapium sebiferum*) invades many habitats throughout the Texas Gulf Coast and the southeastern United States. In the absence of an effective management strategy, this non-native tree will likely continue to displace the native flora and fauna, resulting in biologically impoverished, economically degraded woodlands. This research addresses the effects of removing an invasive plant in native plant and animal communities.

BIOLINGUISTIC DIVERSITY

Dr. Matt Shibatani, Dr. Gail M. Coelho, Dr. Stephen Tyler

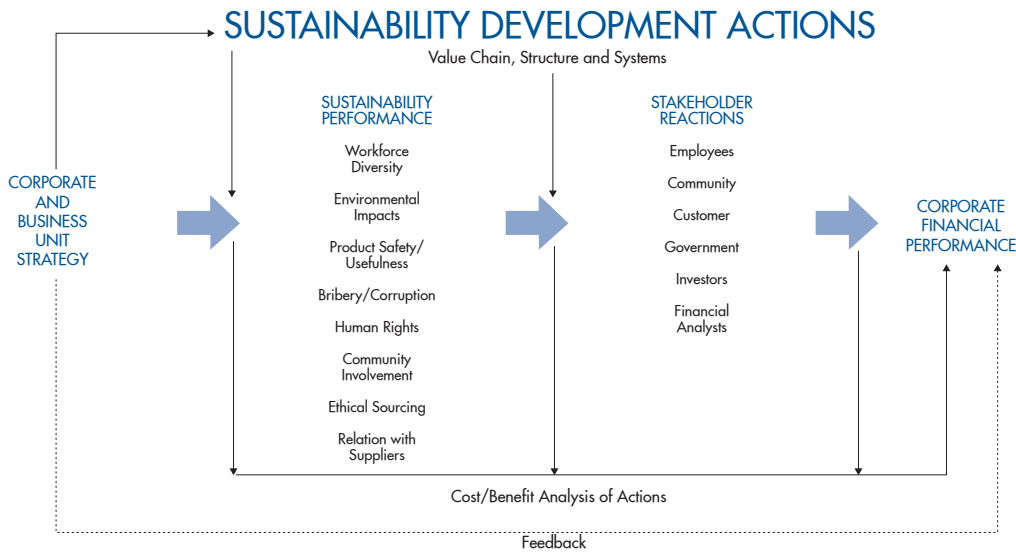
There is accumulating evidence that biodiversity and linguistic diversity go hand-in-hand, and that one cannot be studied separately from the other. Where there is the greatest biodiversity, the highest linguistic diversity tends to be found, e.g. New Guinea.

This project analyzes the relationship between language and the traditional ecological knowledge it encodes. The goal is to gain an understanding of the role of language in the maintenance of symbiotic human-environment relationships, the role of language in the acquisition, accumulation, maintenance, and transmission of traditional

ecological knowledge and the way language loss affects these processes.

Research will be carried out in the Nilgiri Mountains of southern India, an area rich in biological as well as linguistic diversity. Shell Center funds will enable the research team to work with members of the Beta Kurumba community, an ethnic group who lives in the Montane tropical forests of Nilgiris. The research team will document the language and lifestyle of the group through audio recordings of oral narratives in the native language and video recordings of community activities and gather information about the group's utilization of natural resources and their traditional methods of resource management.

The Role of the Private Sector in Sustainability



Drivers of Sustainability Model Source: Epstein and Roy (2000)

BUSINESS CASE FOR SUSTAINABLE DEVELOPMENT

Dr. Marc Epstein

This project concentrates on the need of companies to integrate social and environmental impacts into management decision-making. The measurement and reporting of these impacts are key to corporate accountability.

The project will develop the tools and techniques to evaluate effects of company products, processes and activities on both the company and society and will provide for a more complete analysis of all capital and operational investments. By ignoring future social and environmental impacts, company capital resource allocation decisions are flawed. The project will also examine company operational and capital investment decisions and the impact of these investments on financial performance through both earning and share price.

PINEDALE, WYOMING: ENERGY AND CONSERVATION/CONTINGENT VALUATION ANALYSIS

Dr. Marc Epstein, Dr. Sally Widener, Mr. Nicholas Lacouture, Ms. Rachel Gelman

This project analyzes trade-offs to public priorities which are given to conservation and energy development in Pinedale, Wyoming, an area located in the Rocky Mountains gas fairway. The project presents an unusual opportunity for Rice to focus on the role of the private sector in sustainable development. Dr. Marc Epstein has led a student project to undertake a contingent valuation analysis to determine the priorities of major stakeholders regarding such matters as energy production, conservation, and employment.

CHINA NANKAI UNIVERSITY PARTNERSHIP FOR SUSTAINABLE DEVELOPMENT

Dr. Pedro Alvarez, Dr. Philip Bedient, Dr. Mason Tomson, Dr. C. Herb Ward, Dr. Mark Wiesner, Mr. Christian Holmes

This project involves a partnership between Nankai University and Rice University which will seek to identify and solve energy and environmental problems important to today's needs and to future developments in China and the United States. Projects will be identified in multiple disciplines including science, engineering, and technology, that will require research. Emphasis will be placed on education at all levels from preschool to professional. Output will include scholarly papers, books, training materials, patents, and technology. A major source of technology exchange will be via visiting scholars and exchange students from both directions. The proposed collaboration will address these principal themes:

- Reducing the environmental impacts of energy production
- Water treatment
- Policy and institutional barriers related to technology development and application

Faculty and administrators from Rice and from Nankai University met for two days in plenary formal presentations and smaller work groups to identify plan-common research. Letters of cooperation, signed by both university presidents, were exchanged and thirteen specific joint research projects were identified.

A Rice undergraduate student, Alison Harris, is spending ten weeks in Tianjin at Nankai University as an outreach exchange student working on environmental technology under the direction of Professor Wei Chen; she will also take Mandarin language classes.

Research Supported by Shell Center for Sustainability

Project	Faculty and Staff
Gas Hydrates: Climate Change and Energy Supply	Dr. Jerry Dickens, Dr. Walter Chapman, Dr. George J. Hirasaki, Dr. Manik Talwani, Dr. Colin Zelt, Dr. Brandon Dugan
Carbon Capture and Sequestration	Dr. Jerry Dickens, Dr. Brandon Dugan, Dr. Robert Harris, Dr. Peter Hartley, Ms. Amy Myers Jaffe, Dr. Neal Lane, Dr. Andreas Luttge, Dr. Carrie Masiello, Dr. Ken Medlock, Dr. Ron Sass, Dr. Robin Sickles, Dr. Ronald Soligo, Dr. Kyriocos Zygourakis
Nanotechnology and Energy	Dr. Richard Smalley, Dr. Neal F. Lane, Dr. Wade Adams, Ms. Amy Myers Jaffe, Dr. Robert H. Hauge, Dr. Dagobert Brito, Dr. Peter R. Hartley, Dr. Steven C. Currall
Ozone Research	Dr. Gary Morris, Dr. Matthew Fraser
Water Membrane Technologies	Dr. Mark Wiesner, Dr. Andrew R. Barron, Dr. Michael Wong, Dr. Matteo Pasquali, Dr. Vicki L. Colvin
Invasive Species Control in Floodplain Forests	Dr. William Edward Rogers, Dr. Evan H. Siemann, Dr. Dale S. Sawyer
Biolinguistic Diversity	Dr. Matt Shibatani, Dr. Gail M. Coelho, Dr. Stephen Tyler
Private Sector in Sustainability	Dr. Marc Epstein
China Sustainability	Dr. Mason Tomson, Dr. Mark Wiesner, Dr. Phil Bedient, Dr. Herb Ward, Dr. Pedro Alvarez, Mr. Christian Holmes
Gas Hydrates Visiting Faculty	Dr. Walter Chapman
Pinedale Wyoming	Dr. Marc Epstein, Dr. Sally Widener

The Shell Center serves as a forum for addressing critical issues related to local, regional, national and global sustainability. An important focus is on the sustainability of urban areas and major coastal cities. A number of Shell Center events have related directly to Houston, including seminars and conferences on water quality, flooding, air quality, scenarios for Houston's future, and the impact of climate change and extreme events on coastal cities.

The Center has also focused on critical global issues, including seminars dealing with carbon management, climate change, and China and sustainable development. In these events, the Center draws upon the expertise of representatives from nongovernmental organizations, business, government, and academic sectors. The table to the right provides an overview of the Center's outreach activities since its inception in 2003. This report concentrates on events in 2004 and early 2005. For additional information on the seminars and conferences, please see the Center's web site where copies of PowerPoint presentations are available.

Event	Rice Faculty and Staff
March, 2003 Inaugural Global Sustainability Conference	Dr. Mark Wiesner, Dr. Kyriacos Zygourakis, Dr. Malcolm Gillis, Dr. Matthew Fraser, Mr. Christian Holmes, Ms. Amy Myers Jaffe
Fall 2003 Houston Air Quality Seminars	Dr. Matthew Fraser, Dr. Kathy Ensor, Mr. James Blackburn, Dr. Alvin Tarlov, Mr. Christian Holmes
Fall 2003 Methane Hydrates Conference	Dr. George Hirasaki, Dr. Walter Chapman, Ms. Amy Myers Jaffe, Ms. Jillene Connors
Spring 2004 Texas Water Seminars	Dr. Mark Wiesner, Dr. Phil Bedient, Mr. James Blackburn, Dr. Herb Ward, Mr. Christian Holmes
June 2004 China and US Business Councils on Sustainable Development	Dr. Malcolm Gillis, Mr. Christian Holmes
July 2004 PESA Foreign Service Officer's Training Program	Ms. Amy Myers Jaffe, Mr. Wallace S. Wilson, Mr. Christian Holmes, Mr. Peter Hartley
Fall 2004 China Sustainable Development Seminar	Dr. Steve Lewis, Dr. Ken Medlock, Mr. Christian Holmes
Fall 2004 Energy and Nanotechnology Workshop	Dr. Richard Smalley, Dr. Wade Adams, Ms. Amy Myers Jaffe
Fall 2004 Particulate Matter Seminars	Dr. Matt Fraser, Mr. Christian Holmes
Fall 2004 Houston Ozone Conference	Dr. Gary Morris, Mr. Christian Holmes
Fall 2004 Climate Change and Carbon Management	Dr. Neal Lane, Dr. Ron Sass, Dr. Ken Medlock, Mr. Christian Holmes
Fall 2004 Houston Scenarios Workshops	Dr. Joan Neuhaus, Dr. Wade Adams, Dr. Steve Klineberg, Dr. Lars Lerup, Dr. Mark Wiesner, Dr. Ron Sass, Dr. Gordon Wittenberg, Mr. James Blackburn, Dr. Mark Oberholzer, Ms. Amy Myers Jaffe, Ms. Maryana Iskander, Mr. Christian Holmes
February 2005 U.S. Energy Scenarios for the 21st Century	Dr. Neal Lane, Ms. Eileen Clausen, Ms. Helen Howes, Mr. Andrew Slaughter
February 2005 Coastal Cities and Climate Change	Dr. Ron Sass, Dr. Neal Lane, Ms. Amy Myers Jaffe, Mr. Christian Holmes, Mr. Gary Marfin
February 2005 Lessons Learned: History of Ozone Standards Implementation	Dr. Steve Klineberg, Dr. Bob Stein, Dr. Matt Fraser, Mr. Christian Holmes
March 2005 Winning the Oil Endgame: Innovation for Profits, Jobs, and Security	Dr. Amory Lovins
March 2005 Gender & Energy for Sustainable Development: Fueling the Fight Against Poverty	Susan McDade

TEXAS WATER SEMINARS

A series of four seminars addressed key issues affecting supply, quality, and flood management in Texas:

Water Supply: Where will Houston and Texas obtain future water supplies?

Coastal and Surface Water Quality: How can adequate coastal and surface water supply be guaranteed?

Flooding and Watershed Management: How can flooding risk in populated areas be minimized?

Potable water quality: What are the limits and quality of the potable water supply?

Participants noted that:

- As demand for water increases and fresh water resources become depleted and/or more expensive to treat, desalinization will become increasingly more important and competitive in providing the needed water supplies. The improvements in the technology and the lowering of the cost make desalinization an attractive addition to the Texas water supply portfolio.
- New developments in ultraviolet light and membrane technology hold the promise for treating multiple contaminants.
- Industry is taking new approaches to preserve surface water through eliminating the need for water, reuse and recycling of water, developing alternatives to water, and protection of wetlands.
- Estuarine productivity is threatened by reduced inflows from the Colorado River.
- Houston, having had in 2001 the most damaging flood in U.S. history (Tropical Storm Allison), is reducing the risk through a combination of advanced warning systems and new flood control construction.

TEXAS WATER

Supply - Quality - Management

February 10, 2004

WATER SUPPLY

Where will Houston and Texas obtain future water supplies?

Speaker:

Rod Pittman, Chair, Texas Water Development Board

Panelists:

Andy Shea, Poseidon Resources

Brad Brunett, Lower Basin for the Brazos River Authority

Allan Jones, Texas Water Resources Institute

Mary Kelly, Environmental Defense

Mark Wiesner, Rice University

February 24, 2004

POTABLE WATER QUALITY

What are the limits on the quality of the potable water supply?

Speaker:

Roger Hulbert

Public Utilities Division, City of Houston

Panelists:

Blake Atkins, Environmental Protection Agency

Doug Owen, Malcolm Pirnie Company

Mark Wiesner, Rice University

March 11, 2004

COASTAL & SURFACE WATER QUALITY

How can adequate coastal and surface water supply and quality be guaranteed?

Speaker:

Larry Soward, Commissioner, Texas Commission on Environmental Quality

Panelists:

James Blackburn, Blackburn & Associates

Karl Fennessey, Dow Chemical

C. Herb Ward, Rice University

March 23, 2004

FLOODING & WATERSHED MANAGEMENT

How can flooding risk in populated areas be minimized?

Speaker:

Philip Bedient, Rice University

Panelists:

Burton Johnson, Harris County Flood Control

Kevin Shanley, Bayou Preservation Assoc.

Jim Thompson, J.F. Thompson, Inc.

Charles Penland, Walter P. Moore & Assoc.

CLIMATE CHANGE: MAGNITUDE OF THE PROBLEMS AND POTENTIAL SOLUTIONS

Experts from business and academia addressed key questions related to climate change including:

- How can the business-as-usual (BAU) CO₂ emissions trends projected by the intergovernmental panel on climate change (IPCC) be altered to reduce atmospheric carbon loading?
- What are the prospects for responding to climate change predictions?
- What are the prospects for carbon sequestration?
- To what extent has science served as a foundation for climate change policy?

Presentations on the above subjects were made by:

Charles Christopher, CO₂ Project Manager in the Exploration & Production Technology Group of BP Americas-Houston

Neal Lane, University Professor and Senior Fellow of the James A. Baker III Institute for Public Policy

Michael Moore, Managing and Co-founding Partner of GHG Partners, LLC and Falcon Environmental Services.

Ronald L. Sass, Professor of Natural Science at Rice University.

The presenters noted that:

- Humans will either mitigate the problem by reduction of greenhouse gas emissions or adapt by changing their life style. Other species will not have a choice. They cannot mitigate the problem and they cannot easily change their life style. It may be that the ultimate losers in the climate debate will not be the human species but rather all of our fellow travelers.
- Large-scale CO₂ sequestration systems are feasible; a key economic driver for such systems is enhanced oil recovery.
- Policymakers have not adequately taken into account sound science in the development policy programs related to climate change in carbon management.
- A massive change will be required in the way in which we produce and consume energy if we have a hope of significantly reducing business as usual carbon emissions projections.

CHINA, ENERGY AND SUSTAINABLE DEVELOPMENT: BENEFITING FUTURE GENERATIONS

Experts from industry and academia addressed three issues critical to China's sustainability:

China, Energy and Environment Awareness:

How has China's awareness changed?

Economic Development, Energy and the Environment:

What are the prospects for improvements in China's environment?

Sustainable Development and Petrochemical Production in China:

How can industry and government develop industry in a sustainable fashion?

Presentations on the above subjects were made by:

Steven W. Lewis, Director of the Transnational China Project at the James A. Baker III Institute for Public Policy, and Director of Asian Studies at Rice University

Kenneth B. Medlock, Senior Research Fellow in Energy Studies at the James A Baker III Institute for Public Policy and Visiting Professor of Economics at Rice University

Joseph Machado, Technology Strategy and Innovation, Shell Chemicals

The presenters noted that:

- Environmental issues rank highly among urban Chinese, above economic development and medical care.
- In the short-term, major consumer nations should help China develop a national energy policy and increase energy security and environmental awareness through:
 - Coordinated use of petroleum and product stockpiles
 - Coordinated negotiations with major oil producers to eliminate Asian premiums
 - Standardization of fuel and fuel consumption measures in Northeast Asia
 - Comparative studies of energy and environment awareness in China
- The China National Oil Company is competitive with their privatizing peers and with some of the multi-national oil and gas companies in many measures of operating and financial performance.
- Sustainable development in the petrochemical sector is a product of effective departmental and social impact assessment built around strong partnerships between joint-venture parent companies, local government, contractors, communities, and local and international technical experts.
- Per capita energy use in China is only one-tenth of that in the US, but an enormous population means that total energy use is just under one-half of that in the U.S.
- China is at the base of the energy-development curve. Current pollution problems must be addressed. Per capita energy use in China will increase as economic growth progresses. However, there is no reason that energy-use patterns in China must follow those of the industrialized world, particularly in transportation and electricity generation.

MEETING THE HOUSTON OZONE STANDARDS

This daylong conference focused on three areas: reducing emissions, attaining the one-hour and eight-hour ozone standards, and enforcing the standards. Four critical questions were addressed:

- How can highly reactive volatile organic compounds (HRVOCs) be reduced through monitoring, modeling, measurements systems and rule making?
- What is the ability of the Houston-Galveston area to meet the one-hour ozone standard by 2007?
- How can efforts related to meeting the 2007 standard and reducing variable emissions help meet the 2010 eight hour standard?
- How adequate has the enforcement effort been? What is needed to develop an improved enforcement effort?

The presenters noted that:

- HRVOCs arise from such critical sources as flares, cooling towers, and vents.
- It will be very difficult for the Houston-Galveston area to meet the 2007 and 2010 standards.
- It will be critical to apply knowledge from Texas Air Quality 2000 Study regarding information sources and emissions to the compliance effort.
- Enforcement has been limited due to inadequate authority provided to the City by the Texas Commission on Environmental Quality.
- The Houston-Galveston area is a severe ozone non-attainment area. The current EPA State Implementation Plan (SIP), approved in 2000, calls for significant NO_x emission reductions (approximately 70 percent of the 2007 inventory; 90 percent for point sources). The proposed new plan adds emission reductions for highly reactive volatile organic compounds (VOCs) from industrial facilities and applies 80 percent, rather than 90 percent, industrial NO_x emission reductions.
- The approach of setting short and long term limits on organic compounds appears to be an excellent approach for dealing with the uncertainties and complexities of modeling of short episodic releases vs. continuous, steady emissions.
- The episodic releases of certain classes of highly reactive volatile organic compounds create a phenomenon known as transient high ozone events (THOEs), which play a major role in the formation of high levels of ozone.

HOUSTON AIR QUALITY: MEETING THE OZONE STANDARDS

October 6, 2004

REDUCTION OF HIGHLY REACTIVE VOLATILE ORGANIC COMPOUNDS (HRVOCs) & VARIABLE EMISSIONS IN HOUSTON/GALVESTON

Speaker: David Allen, University of Texas

Panelists

Ramón Alvarez, Environmental Defense
Daewon Byun, University of Houston
Walt Crow, URS

CHALLENGES FOR MEETING THE 2007 ONE-HOUR OZONE STANDARD

Speaker: Larry Soward, Texas Commission Environmental Quality

Panelists

Matt Kuryla, Baker Botts
John Wilson, GHASP
Harvey Jeffries, University of North Carolina
Steve Hupp, Harris County Pollution Control

HOW MEETING THE 2007 STANDARD & REDUCTION OF VARIABLE EMISSIONS WILL HELP MEET THE 2010 EIGHT-HOUR STANDARD

Speaker: Guy Donaldson, U.S. Environmental Protection Agency

Panelists

Neil Carman, Sierra Club
Doug Deason, Exxon Mobil
Jay Olaguer, Houston Advanced Research Center (HARC)
Gary Morris, Rice University

HAVE ENFORCEMENT EFFORTS BEEN ADEQUATE? WHAT'S NEEDED FOR IMPROVEMENT?

Speaker: Mayor Bill White, City of Houston

Panelists

Paul Newman, Harris County Pollution Control
John Wilson, GHASP
Nancy B. Rapoport, University of Houston Law Center
Pamela M. Giblin, Baker Botts

HOUSTON AIR QUALITY: PARTICULATE MATTER

A series of three seminars addressed critical questions related to the reduction of particulate matter:

- What are the composition and sources of particulate matter?
- What is the health impact of particulate matter?
- What has been and will be the regulatory response?

The presenters noted:

- Particulate matter, consisting of coarse and fine particles, has significant impact on human health, especially the cardiovascular and respiratory system.
- Houston appears near an attainment of the present regulations related to 10 µm and will probably meet the 2.5 µm standards. However, even with the attainment of the 2.5 µm standard, significant residual health effects remain.
- In reducing particulate matter, it is important to take an integrated approach to reducing haze, ozone and particulates. Advances in modeling and data mining tools are needed as well as a better understanding of the impact particulate matter from Mexico and the Sahara region has on Houston.

HOUSTON AIR QUALITY PARTICULATE MATTER: SOURCES, HEALTH IMPACTS, AND RESPONSE

November 9-10-11, 2004

November 9

THE COMPOSITION AND SOURCES OF PARTICULATE MATTER

Matthew Fraser, Rice University
Alex Cuclis, Houston Advanced Research Center
Winifred Hamilton, Baylor College of Medicine

November 10

THE HEALTH IMPACTS OF PARTICULATE MATTER

Stewart Abramson, Texas Children's Hospital
Ramon Alvarez, Environmental Defense
Nathan Pechacek, Texas Commission on Environmental Quality

November 11

THE REGULATORY RESPONSE TO PARTICULATE MATTER

Mayor Bill White, City of Houston
Candy Garrett, Texas Commission on Environmental Quality
Karl Loos, Shell Oil
John Wilson, Galveston Houston Association for Smog Prevention (GHASP)

SCENARIOS FOR HOUSTON'S FUTURE

December 7- 8- 9-10, 2004

Workshop on Houston's Future: Trends, Challenges and Scenarios

Scenario workshops were conducted by the Shell Center for Sustainability and scenario planning experts from Shell International's Global Business Environment Team.

The aim of the four-day workshop was to build a set of plausible scenarios addressing Houston's development over the next 15-25 years. The scenarios were not to be predictions, preferences or projections, but rather challenging descriptions of what might happen in the form of a set of stories about alternative futures informed by many perspectives. The objective of the workshops was to explore what might happen to the urban environment, and to better position Houston to understand the steps that may be taken to ensure a more sustainable journey towards whatever future should unfold.

Several matters were considered: international economics, international trade flows, nanotechnology, health services and technology, high-tech businesses, biotech, immigration flows, education, urban sociology-development, workforce development, transportation, national security, energy, and environment.

The workshops focused on three possible scenarios:

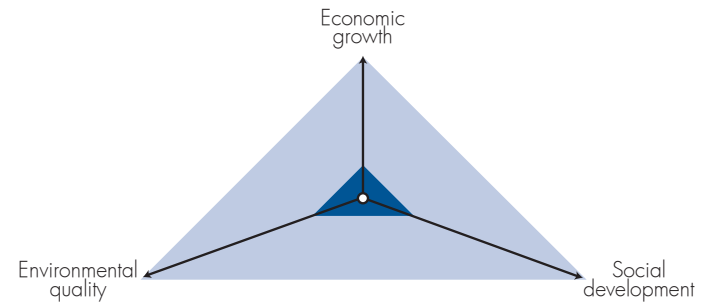
- The "Houston Solution," concentrating on Houston's ability to meet its pressing environmental challenges.
- The "Tale of Two Cities," which envisions Houston as a city with two disparate economies: high-technology and a separate economy with relatively little access to high technology.
- The "La Puerta Abierta" scenario, which envisions Houston becoming a prosperous multicultural gateway to Latin America.

Approximately 70 representatives from nongovernmental organizations, government, academia, and business participated and were briefed by a number of experts on trends affecting Houston's sustainability, including:

Gordon Quan, Houston City Council
James Blackburn, Blackburn and Carter
Amy Myers Jaffe, Rice University Energy Program
Tim Hopper, US Federal Reserve
James Glassman, JP Morgan-Chase
John Jacob, Texas A&M University
Stephen Linder, University of Texas School of Public Health.
Shirley Neff, Goldwyn International Strategies
Larry Payne, Houston Habitat for Humanity
Steven Klineberg, Rice University
Jacqueline Northcutt Vaughn, BioHouston
Joan Neuhaus, James A. Baker III Institute for Public Policy

Visualizing sustainability:

... an external triangle



GENDER, DEVELOPMENT & ENERGY LECTURE SERIES

Gender & Energy for Sustainable Development: Fueling the Fight Against Poverty

Susan McDade

March 31, 2005

As part of the Gender, Development and Energy lecture series, sponsored by the Baker Institute Energy Forum, Shell Center for Sustainability and Rice's Program for the Study of Women and Gender, Susan McDade, Manager of the Sustainable Energy Programme at UNDP, spoke on the impact of energy services on women in developing countries. She presented findings from UNDP's latest publications on the topic: Gender & Energy for Sustainable Development: A Toolkit and Resource Guide and Generating Opportunities: Case Studies on Energy and Women.

The lecture series, Gender, Development and Energy, is an opportunity to draw attention to issues relating to gender, poverty and economic development in international energy policy debates. By bringing together social scientists, industry experts, economists, non-governmental agencies and policy makers we hope to forge a better understanding of the synergies and trade-offs among the three main dimensions of sustainable development: economic efficiency, environmental sustainability and social equity.

Winning the Oil Endgame: Innovation for Profits, Jobs, and Security

Lecture and Booksigning

Amory Lovins

March 30, 2005

Dr. Amory Lovins, CEO of the Rocky Mountain Institute and Chairman of Hypercar, Inc., spoke about the themes of his latest publication, Winning the Oil Endgame: Innovation for Profits, Jobs, and Security. He proposed a new strategy for ending oil dependence starting with the United States but applicable worldwide, on the basis of a solution that would be led by business for profit and markets, and not dictated by government intervention.

U.S. Energy Scenarios for the 21st Century

February 16, 2005

The event, sponsored by the James A. Baker III Institute for Public Policy, the Shell Center for Sustainability of Rice University and the Pew Center on Global Climate Change, featured a briefing on the Pew Center's report, "U.S. Energy Scenarios for the 21st Century" and an open discussion about how future energy and climate policy might affect the competitiveness of companies in the energy sector and across other diverse business sectors. Speakers included, Dr. Neal Lane, Senior Fellow in Science and Technology and University Professor, Rice University; Eileen Clausen, President, Pew Center on Global Climate Change; Helen Howes, Vice President, Environment, Health & Safety, Exelon; and Andrew Slaughter, Senior Economic Adviser, Shell Global Business Environment.

PESA Foreign Service Officer's Training Program

July 27, 2004

The Baker Institute and the Shell Center provided a training session on energy policy and environmental policy for U.S. State Department Officials, sponsored by the Petroleum Equipment Suppliers Association (PESA). Keynote speakers, Amy Myers Jaffe, Wallace S. Wilson Fellow for Energy Studies, Baker Institute; Chris Holmes, Director, Shell Center for Sustainability; and Peter Hartley, Chairman, Department of Economics, Rice University.

The Shell Center for Sustainability has three key sustainability-related education initiatives:

- Support of interdisciplinary research related to sustainability
- Development of course materials and approaches to education at the high school, undergraduate, graduate and corporate education levels
- Linkage of Rice students to opportunities both within and outside of Rice that enhance their knowledge of sustainability
- Development of student internship opportunities on and off campus

The Center seeks to introduce Rice students to the work of Houston-area businesses that are developing and applying sustainability-related practices. To illustrate, two Rice students created a case study on a Houston Ship Channel chemical recycling facility that is developing cutting-edge approaches to reducing emissions and improving energy efficiency.

The Center has also introduced a new sustainability education module known as "CHRONOS"- developed by Cambridge University and the World Business Council for Sustainable Development - to various levels of education, including use at Pinedale High School in Pinedale, Wyoming.

Houston Ship Channel Case Study

Students in Rice's Professional Science Masters' "Environmental Analysis and Decision-Making Program" embarked on a Fall 2003 case study of the Keeshan & Bost Chemical Company, owned and operated by two Rice alumni. Since the late 1970s, the business has focused on buying co-product streams from other chemical processors and converting them into marketable materials. These streams would otherwise become wastes. The business owners granted a series of interviews and tours that allowed the students open access to information regarding their operations and business objectives - in this way offering insight into real-world applications of sustainable development innovations.

CHRONOS Initiative

The World Business Council on Sustainable Development is a global organization comprised of approximately 175 member companies. It has teamed with Cambridge University to develop an E-based learning tool focused on teaching approaches to sustainability to entry-level employees and middle managers, with strong emphasis on stakeholder relationships. The Shell Center has introduced the module as a learning tool at the high school, university and corporate education levels.

Pinedale, Wyoming Initiative

Pinedale, Wyoming is located between the Wind River Mountain Range, the Green River, and the Pinedale Anticline - the site of a major natural gas production field. It also hosts the largest migration of large game in the lower forty-eight states, where some 30,000 pronghorn antelope and 43,000 mule deer migrate south from Yellowstone through the energy production area. The region presents numerous sustainability challenges with a full range of economic, social and financial considerations. The Shell Center is working with the Pinedale High School on development of an educational program focused on sustainability and stakeholder relationships.

Student	Status	Project
Will Conrad	Undergraduate	Developed a background paper for the Exxon funded Clean Air act Conference Participated in Scenarios Conference; attended Duke Energy Conference; networked with undergraduate and graduate students from several universities at the conference
Andrea Crumpacher	Professional Masters in Science	
Clayton Forswall	Undergraduate student research assistant following graduation	Organized and developed a background paper for the Air Quality conference; researched gas hydrates
Rachel Gelman	Undergraduate	Prepared contingent valuation analysis poll in Pinedale, Wyoming on the trade-offs between conservation and gas drilling. Project supervised by Dr. Marc Epstein
Katie Beth Higgins	Research assistant following graduation	Delivered a presentation on Health Impact Analysis at a major conference. Organized and developed a background paper for the Air Quality conference
Matt Hoetze	Professional Masters in Science student	Developed a case study on the sustainability practices of a chemical plant Prepared contingent valuation analysis poll in Pinedale, Wyoming on the trade-offs between conservation and gas drilling. Project supervised by Dr. Marc Epstein
Nicholas Lacouture	Rice MBA graduate	
Karen Mascarenhas	Undergraduate	Conducted research on the Clean Air Act Participated in the Air Quality Conference and the Scenarios Conference Prepared background materials for water seminars Prepared a case study on sustainability practices of a chemical plant. Developed a course on Sustainable Development Education. Participated in the Houston Scenarios conference and the Duke Energy Conference Participated in the in Houston's Scenarios Conference Developed background information on the Coastal Cities Conference Participated in the Houston Scenarios Conference; Prepared a proposal for the funding of the Air Quality project. Participated in the Duke Energy Conference. Prepared materials for a sustainable development course Prepared a proposal to Exxon for the funding of the Air Quality Project
Sarah Mason	Professional Masters in Science student	
George McGuirk	Research assistant following graduation	
Christine Robichaud	Professional Masters in Science student	
Avanti Tamhane	Professional Masters in Science student	
Stephanie Taylor	Undergraduate	
Doug Thompson	Professional Masters in Science student	
Abby Watrous	Research assistant following graduation	

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