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# CLOSING REFLECTIONS

## I.

The two-day conference brought together a number of environmental scientists, jurists and policy analysts from a broad spectrum of disciplines. The common thread uniting them was their intense curiosity which places them at the forefront of their respective fields of inquiry. They presented and discussed—each from his/her specific point of view—two dynamic and extremely complex systems: energy and the environment. The global interactions of these systems will probably have far-reaching influences on the human society and the world economy.

The opening address by the U.S. Senator from Colorado, Timothy E. Wirth, set the tone of the conference by emphasizing, among others, two major points. First, the development and utilization of energy resources have a direct impact on regional and national economics which, in turn, significantly influence the environment, world peace and security.

For example, for almost half a century, we witnessed a tremendous transfer of wealth, probably the greatest transfer of wealth in human history, to the Middle East to pay for energy resources. A small part of it remained there to improve the lot of the people. Most of it came back to the industrialized world to buy weapons. That is a major cause of instability in that part of the world. Thus, the energy policy of one country affects the stability, peace and security of people more than 10,000 miles distant.

Second, in order to avoid or to counter undesirable outcomes of the energy-environment interactions on a global scale, one has to discard preconceived ideas and enhance critical thinking. In this respect, one would do well to follow Buddha's advice:

> "Believe nothing, no matter where you read it, or who said it,
> no matter if I have said it,
> unless it agree with your own reason and your own common sense."

## II.

Session I raised the question whether we know enough about global change to justify action. Curiously enough, the December 31, 1991 issue of *EOS, Transactions of the American Geophysical Union* featured articles under the heading "The Greenhouse Debate: Time for Action?" In two of

these papers, Michael E. Schlesinger and Xingjian Jiang of the University of Illinois made a compelling argument for delaying by ten years a 20-year transition from the current "business as usual" situation to any other scenario.[1] They claim that the penalty for a 10-year delay is very small compared with the benefit of arguing additional data and increasing the knowledge and understanding of climate processes. The opposing view was espoused by James S. Risbey, Mark David Handel and Peter H. Stone of MIT who base their conclusions on a number of climate models of various degrees of complexity.[2] It is regrettable that none of the participants in Session I made any references to this debate published in one of the most prestigious scientific periodicals.

The first keynote paper introduced a number of concepts and raised several questions. For instance, what are the costs, due to climate change, and what would be the cost of response to such change? To paraphrase the first question is equivalent to asking what is the cost of *not* responding to the global change, the same as the cost of the change itself?

Another point made in the keynote paper, was the question of what are the most prudent actions to be taken today. Let's interpret the term "prudent" to mean minimizing risk. One definition of "risk" is the ratio between hazards and safeguards. According to this definition, in order to have zero risks, we need to have zero hazards or infinite safeguards, implying that there is always a certain level of risk. The problem then is that of the acceptable risk level. The public deserves a clear explanation of the U.S. policy vis-à-vis the global climatic change and an end to pretending that we have zero risk policies.

Session I included presentations of two scientists attempting to answer the question whether we know enough about global change to justify action. The emphasis of each presentation was different; one stressed data, the other models of climate. There is nothing sacred about data; quite the opposite, data raise many questions and doubts. For example, what is it that we measure? Where are the measurements taken? How do we know that we measure what we want to measure? How accurate is the measurement? In general, data are notorious for being accurate less than 100%, in particular data related to economics, to behavior, and to the manner in which people respond to stimuli. Models are abstractions of reality. As such, they cannot fully represent reality in all its intricacies—some details are always left out. It is important, therefore, that the modeler should state explicitly the portion

1. Michael E. Schlesinger and Xingjian Jiang, *A Phased-in Approach to Greenhouse-Gas-Induced Climatic Change*, 72 EOS 593, 596 (1991); Michael E. Schlesinger and Xingjian Jiang, *Climatic Responses to Increasing Greenhouse Gases*, 72 EOS 597 (1991).

2. James S. Risbey, Mark D. Handel and Peter H. Stone, 1991, *Should We Delay Responses to the Greenhouse Issue?*, 72 EOS 593 (1991); James S. Risbey, Mark D. Handel and Peter H. Stone, 1991, *Do We Know What Difference a Delay Makes?*, 72 EOS 596 (1991).

of reality not included in the model. In other words, the boundaries of the system under consideration must be clearly defined.

Both data and models are important in order to understand phenomena in nature. Data have problems regarding their accuracy; the problem with models is their credibility. Both these sets of problems could be handled with improved communication between the two groups of scientists.

There seems to be a divergence in the interpretation of possible climatic changes—their extent and the rate at which they will occur—between modelers and those relying primarily on data. To overcome this divergence, it seems that high quality data could be used for improving the estimates of the parameters included in models. High quality data are expensive; however, they are essential in order to have more credible models that will yield better projections of future climate.

## III.

Session II attempted to answer the question whether it is more prudent to concentrate on the effects and not on the causes of global warming. Important discussion focused on the hydrosphere. About 97% of the water on planet Earth is in oceans and an additional 25% is locked in polar caps and glaciers. The remaining quantity, which is minuscule by comparison, is available for use to satisfy human needs. Allegorically, if we were to represent all the water on this planet by a 55 gallon drum, the amount of fresh water available for development would be represented by a little more than a tablespoon. Furthermore, more than half of it is below the ground surface in aquifers. Also, the fresh water on the surface in lakes or flowing in rivers is distributed very unevenly among the continents. For example, about 15% of all the water flowing in the rivers on earth is in the Amazon system in Brazil. The current economics and the existing technology do not allow us to move large quantities of water over long distances. One of the longest aqueducts in the world is in California, transporting water from the delta of the Sacramento and San Joaquin rivers to the Los Angeles conurbation.

Large scale water transfers can have disastrous ecological consequences. In Central Asia of the former Soviet Union, two major rivers flowing into the Aral Sea were diverted for irrigation. As a result, the Aral Sea shrank considerably, its flora changed radically, human settlements which thrived on fishing became almost ghost towns tens of miles from the receding shores, and much of the dry land which emerged became a saline desert. This example indicates that in the case of a change in climate in the direction of greater aridity, water resources in many parts of the world, including the southwestern United States, will become more scarce and their quality will degrade.

## IV.

Session III asked the question whether primary emphasis should be placed on reducing the carbon-dioxide emissions alone. The answer seems to be negative since other "greenhouse" gases are also continuously discharged into the atmosphere, e.g. methane, $NO_x$, and chlorofluorocarbons. A possible approach to this problem is that of trading quid pro quo. For example, country A invests in energy-efficient projects in country B and gets credit to offset the liability of its own "greenhouse" gas emissions. If this alternative is accepted, an international exchange could be established for the trading of this type of credits and liabilities which could be preferable to an international environmental regulatory agency.

## V.

Session IV dealt with human behavior and global change. Even without the argument of the undesirable effects of climatic change, there are logical reasons for reducing the use of energy with a consequent reduction of emissions into the atmosphere. The two major reasons are the finite supply of energy resources and the finite capacity of the environment to assimilate waste.

Waste is produced inherently by any production process (e.g., industry, agriculture) and by service activities; it is that by-product which we do not need and/or do not want at that particular place at that particular time. This definition of "waste" may be reduced to a residual which is perhaps easier to handle.

Human behavior includes lifestyles. A powerful motivation of current lifestyles is derived from the maximization of present value of net profits. This method of discounting the future places practically no value on it, maximizes current consumption with little, if any, regard for future generations. Indeed, human behavior may influence global climatic changes, for varying one component of lifestyles has a ripple effect throughout the entire socio-economic system.

## VI.

Session V asked whether cutting down of carbon dioxide emissions is economically feasible for the developing world. One definition of "development" is the substitution of human and animal energy with other energy sources. Currently, the less developed countries have a very low base of energy consumption. The demand for energy, however, grows rapidly and it is estimated that it will surpass that of OECD in a few years. As a consequence, it is certain that carbon dioxide emissions will increase.

Shall restrictions be placed on the developing world while the industrialized countries continue their relentless march forward? Such restrictions will

increase the already steep social gradient existing in the world which may lead to mass migrations of people, to conflicts, or both.

It seems that a reasonable objective is to maintain globally environmental standards and prevent their worsening. Some of the policies that could help in this direction are population control, reforestation, and a change in the energy mix by decreasing the use of coal and increasing the use of gas and hydropower.

## VII.

The last session of the conference dealt with the issue of decision making in the face of uncertainty. It seems that climate is undergoing a change at a rate faster than ever since the pleistocene period, and the change may be irreversible. To evaluate the direction and magnitude of the climatic change, data are necessary. How much data? Most scientists, engineers and scholars seem never to have sufficient data. However, one can determine, conceptually at least, a level of information that is adequate for a specific purpose.

A project, of whatever type, will probably cost less if more data is available; thus, the cost of a project is a diminishing function of the amount of information available. At the same time, acquiring additional data incurs additional expenses so that the cost of data is an increasing function of the amount of information. Of interest is the sum of these two functions which plots as a U-shaped curve. The minimum of this curve represents an adequate level of information. Quantifying these functions may not be easy; however, a conceptual approach is offered to a very important practical problem.

## VIII.

The conference touched, perhaps for the first time, on a set of issues which arise at the intersection of energy and the environment in a broad interdisciplinary setting. The hope is that there will be additional opportunities for similar meetings.

It is important to continue to discuss and clarify issues of energy and the environment. The echo that the perceived climate change reverberates today is reminiscent of the concern produced about twenty years ago when the book *Limits to Growth* appeared. We may be in a similar situation, not necessarily facing an impending catastrophe, yet sufficiently concerned about the future of energy resources and the quality of the environment. We need to continue to study these issues so that we can develop relevant policies. "What here shall miss, our toil shall strive to mend."[3]

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3. Shakespeare, *Romeo and Juliet*, prologue.

## *APPENDIX*

# ENERGY AND THE ENVIRONMENT: INTERSECTING GLOBAL ISSUES

Conference Director
**Lakshman Guruswamy**, Professor of Law

Research Coordinator
**Brent Hendricks, J.D.**

Dean of the College of Law
University of Arizona
**E. Thomas Sullivan**

Conference Manager
**Mary N. Greene,** Extended University

### *Welcome*

**E. Thomas Sullivan**
Dean, University of Arizona College of Law

**Lakshman Guruswamy**
Professor of Law, University of Arizona; Conference Director

### *Opening Address*

**Timothy E. Wirth,** United States Senator, Colorado

### *Do We Know Enough About Global Change to Justify Action?*

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|---|---|
| *Chair:* | **Peter Carruthers,** Head, Physics Department, University of Arizona |
| *Keynote Paper:* | **Nancy Maynard**, Assistant Director, Environmental Affairs, Office of Science and Technology Policy, The White House |
| *Discussants:* | **Robert E. Dickinson,** Professor, Atmospheric Sciences, University of Arizona<br>**Patrick Michaels**, Professor, Environmental Sciences, University of Virginia |

### *Is it More Prudent to Concentrate on the Effects and Not the Causes of Global Warming?*

*Chair:* **Edward Knapp**, President, Sante Fe Institute; Former Director, National Science Foundation

*Keynote Paper:* **Paul Waggoner**, Distinguished Scientist, Connecticut Experimental Station; Chairman, Adaptation Panel, NAS, NAE, IOM

*Discussants:* **Earnest T. Smerdon**, Dean, College of Engineering and Mines, University of Arizona
A. Dan Tarlock, Professor of Law, Illinois Institute of Technology, Chicago-Kent College of Law
**A. Dan Tarlock**, Professor of Law, Illinois Institute of Technology, Chicago-Kent College of Law

### *Should Primary Emphasis be Placed on Reducing Carbon-dioxide Emissions Alone?*

*Chair:* **Steward T. Udall**, former Secretary of the Interior and former Member of Congress, Arizona

*Keynote Paper:* **Richard B. Stewart**, Visiting Professor of Law, Georgetown University Law Center; former Assistant Attorney General for Environment and Natural Resources, U.S. Department of Justice

*Discussants:* **Lakshman Guruswamy**, Professor of Law, University of Arizona
**Howard Gruenspecht**, Associate Deputy Under-Secretary, U.S. Department of Energy
**Dan Becker**, Director, Sierra Club

### *Human Behavior and Global Change*

*Chair:* **Helen M. Ingram**, Director, Udall Center for Studies in Public Policy, University of Arizona

*Keynote Paper:* **Blair T. Bower**, Senior Fellow, Conservation Foundation

*Discussants:* **Ralph D'Arge**, Professor of Economics, University of Wyoming
**Paul Slovic**, Professor of Psychology, University of Oregon

**Robert Williams**, Professor of Law,
University of Arizona

### *Is the Cutting Down of Carbon Dioxide Economically Feasible for Developing Countries?*

*Chair:* **Blair T. Bower**, Senior Fellow, Conservation Foundation

*Keynote Paper:* **Robert J. Saunders**, Chief, Energy Development Division; Chairman, Task Force on Energy Conservation, World Bank

*Discussants:* **Victor Hugo Paramo Figueroa**, Assistant Director, Air Quality Management, Urban Development and Ecology Secretariat, Republic of Mexico
**Zhou Dadi**, Head, Energy Systems Analysis Division, Energy Research Institute, People's Republic of China

### *Decision Making in the Face of Uncertainty*

*Chair:* **Murray Gell-Mann**, Nobel Laureate in Physics, California Institute of Technology

*Keynote Paper:* **John H. Gibbons**, Director, Office of Technology Assessment, U.S. Congress

*Discussants:* **Victor Baker**, Professor of Geosciences, University of Arizona
**E. Donald Elliott**, Professor of Law, Yale University; former General Counsel, EPA
**William Rodgers**, Professor of Law, University of Washington

### *Closing Reflections*

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