

Energy and the Environment: Scientific, Economic and Legal Issues*

Hawking Auditorium, Mitchell Institute

Texas A&M University

April 18, 2016

Morning Sessions

- 8:00 AM – 8:30 AM Breakfast
- 8:30 AM – 9:00 AM Welcome and Introductions
Marlan Scully, Director, IQSE
John Junkins, Director, TIAS
David M. Lee, Nobel Laureate in Physics, 1996
- 9:00 AM – 10:00 AM Chair: Sheridan Mitchell Lorenz, Mitchell Foundation
Carbon Capture, Utilization and Storage: A Multi-scale Grand Challenge
Christodoulos A. Floudas
Director, Texas A&M Energy Institute, TAMU
- 10:00 AM – 10:30 AM Break
- 10:30 AM – 11:30 AM Chair: David M. Lee, Distinguished Prof. and Nobel Laureate in Physics, 1996
Climate Change, Energy and a Sustainable Low Cost Path Forward
Steven Chu
Nobel Laureate in Physics, 1997
Former U.S. Secretary of Energy
- 11:30 AM – 12:30 PM Chair: Gerald North, Distinguished Prof. of Atmospheric Sciences & Oceanography
Energy and the Environment: Concerns for the Future
Bruce A. McCarl
Nobel Peace Prize, 2007
- 12:30 PM – 1:30 PM Lunch

*Sponsored by the Texas A&M University Institute for Advanced Study
and the Institute for Quantum Science and Engineering

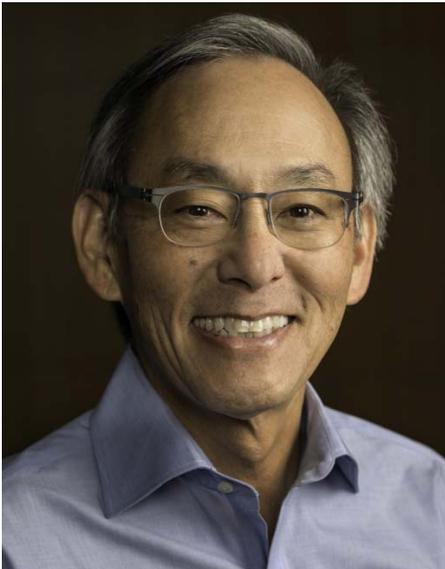
Afternoon Sessions

- 1:30 PM – 2:30 PM Chair: Charles Schwartz, Regent, Texas A&M University System
Science, Policy and Power: The Supreme Court and Climate Change
Kenneth W. Starr
President and Chancellor, Baylor University
- 2:30 PM – 3:30 PM Chair: Charles Schwartz, Regent, Texas A&M University System
Energy Alternatives in the Economy of Texas
Michael K. Young
President, Texas A&M University
- 3:30 PM – 4:00 PM Break
- 4:00 PM – 5:00 PM Chair: Judy Morgan, Regent, Texas A&M University System
A Medley of Molecular Parables
Dudley Herschbach
Nobel Laureate in Chemistry, 1986

Reception and Dinner for Registered Guests at the Clayton W. Williams, Jr. Alumni Center

- 6:30 PM Reception
- 7:00 PM Dinner
John Sharp
Chancellor, Texas A&M University System
- John Nielsen-Gammon
Regents Professor, Texas State Climatologist

Distinguished Speakers



Steven Chu

Climate Change, Energy and a Sustainable, Low Cost Path Forward

The industrial and agricultural revolutions have profoundly transformed the world, but there have been unintended consequences. I will briefly describe the recent climate monitoring data and the rapidly changing energy landscape before turning to how energy efficiency and clean energy sources are becoming the low cost option to our energy needs.

Biography

Steven Chu is the William R. Kenan, Jr., Professor of Physics and Professor of Molecular & Cellular Physiology in the Medical School at Stanford University. He has published 260 papers in atomic and polymer physics, biophysics, biology, biomedicine, batteries, and holds 10 patents.

Dr. Chu was the 12th U.S. Secretary of Energy from January 2009 until the end of April 2013. As the first scientist to hold a Cabinet position and the longest serving Energy Secretary, he recruited outstanding scientists and engineers into the Department of Energy. He began several initiatives including ARPA-E (Advanced Research Projects Agency – Energy), the Energy Innovation Hubs, the U.S. – China Clean Energy Research Centers (CERC), and was tasked by President Obama to assist BP in stopping the Deepwater Horizon oil leak. Prior to his cabinet post, he was director of the Lawrence Berkeley National Laboratory and Professor of Physics and Molecular and Cell Biology at UC Berkeley. Previously he was the Theodore and Francis Geballe Professor of Physics and Applied Physics at Stanford University, and head of the Quantum Electronics Research Department at AT&T Bell Laboratories.

Dr. Chu has numerous awards including the 1997 Nobel Prize in Physics for the laser cooling and atom trapping, shared with Claude Cohen-Tannoudji and William Phillips. He holds 26 honorary degrees and is a member of the National Academy of Sciences, the American Philosophical Society, the American Academy of Arts and Sciences, the Academia Sinica, and is a foreign member of the Royal Society, the Royal Academy of Engineering, the Chinese Academy of Sciences, and the Korean Academy of Sciences and Technology.



Carbon Capture, Utilization, and Storage: A Multi-scale Grand Challenge

Fossil fuels supply more than 85% of the current energy consumption worldwide, and contribute to the anthropogenic CO₂ emissions. In the United States, large stationary sources such as power plants, cement production, iron and steel industries, refineries, petrochemicals, and gas processing plants emit more than 60% of the total emissions. Stationary sources are point sources with large CO₂ emissions, and provide a realistic opportunity to reduce CO₂ emission. In this presentation, I will introduce a multi-scale energy systems engineering framework for addressing the

Christodoulos A. Floudas grand challenge of CO₂ capture, utilization, and sequestration (CCUS) at an individual process level and at the supply chain network level. Depending on the selection of CO₂ sources, utilization and/or sequestration sites, CO₂ capture technologies, processes and materials used, CCUS costs vary. Key decisions involve the identification of the best capture materials, and the selection of source plants, capture processes, CO₂ pipelines, locations of utilization and sequestration sites, amounts of CO₂ storage, as well as the optimization of each CO₂ capture process. Computational results will be presented for individual carbon capture processes, as well as optimized supply chain networks which can reduce 50% of the total stationary CO₂ emissions.

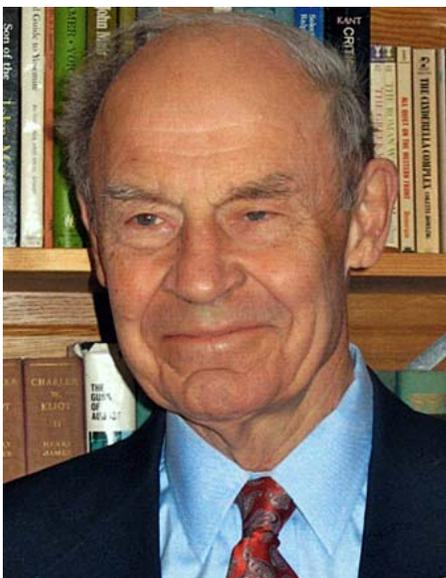
Biography

Dr. Floudas is the Director of the Texas A&M Energy Institute, and the Erle Nye '59 Chair Professor for Engineering Excellence at the Artie McFerrin Department of Chemical Engineering at Texas A&M University. Dr. Floudas served Princeton University for 29 years and is the Stephen C. Macaleer '63 Professor in Engineering and Applied Science, Emeritus, and Professor of Chemical and Biological Engineering, Emeritus at Princeton University.

Professor Floudas is a world-renowned authority in mathematical modeling and optimization of complex systems. His research interests lie at the interface of chemical engineering, applied mathematics, and operations research, with principal areas of focus including multi-scale systems engineering for energy and the environment, chemical process synthesis and design, process operations, discrete-continuous nonlinear optimization, local and global optimization, and computational chemistry and molecular biology.

Professor Floudas is the author of two graduate textbooks, *Nonlinear Mixed-Integer Optimization* (Oxford University Press, 1995), and *Deterministic Global Optimization* (Kluwer Academic Publishers, 2000). He has co-edited ten monographs/books, has over 300 refereed publications, delivered over 330 invited lectures, seminars, and named lectureships. He is the recipient of numerous awards and honors for teaching and research that include the NSF Presidential Young

Investigator Award, 1988; the Engineering Council Teaching Award, Princeton University, 1995; the Bodossaki Foundation Award in Applied Sciences, 1997; the Best Paper Award in Computers and Chemical Engineering, 1998; the Aspen Tech Excellence in Teaching Award, 1999; the 2001 AIChE Professional Progress Award for Outstanding Progress in Chemical Engineering; the 2006 AIChE Computing in Chemical Engineering Award; the 2007 Graduate Mentoring Award, Princeton University; Member of National Academy of Engineering, 2011; One thousand Global Experts, China 2012-2015; SIAM Fellow, 2013; TIAS Fellow and Eminent Scholar, 2013-14; AIChE Fellow, 2013; National Award and HELORS Gold Medal, 2013; Honorary Doctorate, Abo Akademi University, Finland, 2014; Thompson Reuters Highly Cited Researcher, 2014 (for 2002-2012, 11 years); Member of TAMEST (The Academy of Medicine, Engineering, and Sciences of Texas), 2015; Corresponding Member of the Academy of Athens, 2015.



Dudley R. Herschbach

A Medley of Molecular Parables

In science, dramatic advances often spring from elementary ideas taught in introductory courses. Those episodes have the character of parables, in that they offer lessons that transcend the technical particulars. Here four such molecular parables, featuring carbon chemistry, are presented: (1) “Climbing the Mt. Everest of Chemical Synthesis”—Making just one desired structure of a molecule which has 10^{21} distinct structures. (2) “Sex and the Single Methyl Group”—The profound impact of adding or subtracting a CH_3 group. (3) Discovery of “Buckyball”— C_{60} , nearly adopted as the “State Molecule” of Texas. (4) “Making gas from wet rocks,” producing methane and higher hydrocarbons in diamond-anvil cells at high pressures (>20 kbar) and temperatures (>600 C), conditions expected deep (>60 km) in earth’s

upper mantle.

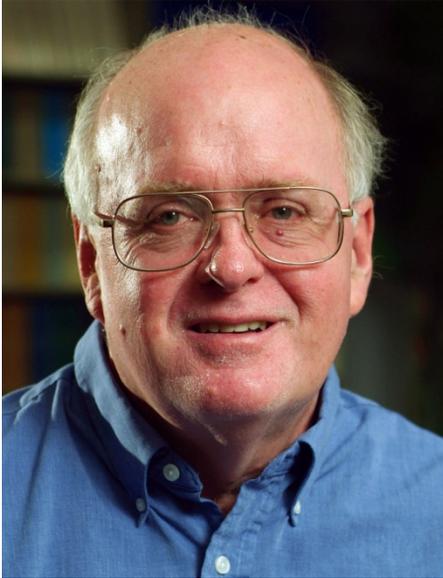
Biography

Dudley Herschbach was born in San Jose, California (1932) and received his B.S. degree in Mathematics (1954) and M.S. in Chemistry (1955) at Stanford University, followed by an A.M. degree in Physics (1956) and Ph.D. in Chemical Physics (1958) at Harvard. After a term as Junior Fellow in the Society of Fellows at Harvard (1957-1959), he was a member of the Chemical Faculty at the University of California, Berkeley (1959-1963), before returning to Harvard as Professor of Chemistry (1963), where he is now Baird Professor of Science (since 1976). He has served as Chairman of the Chemical Physics program (1964-1977) and the Chemistry Department (1977-1980), and Co-Master with his wife Georgene of Currier House (1981-1986). His teaching includes graduate courses in quantum mechanics, chemical kinetics, molecular spectroscopy, and collision theory, as well as undergraduate courses in physical chemistry and general chemistry for freshmen, his most challenging assignment. He is engaged in several efforts to improve K-12 science education and public understanding of science. He serves as Chair of the Board of Trustees of Science Service, which publishes Science News and conducts the Intel Science Talent Search and the Intel International Science and Engineering Fair.

He is a Fellow of the American Academy of Arts and Sciences, the National Academy of Sciences, the American Philosophical Society, and the Royal Chemical Society of Great Britain. His awards include the Pure Chemistry Prize of the American Chemical Society (1965), the Linus Pauling Medal (1978), the Michael Polanyi Medal (1981), the Irving Langmuir Prize of the American Physical Society (1983), the Nobel Prize in Chemistry (1986), jointly with Yuan T. Lee and John C. Polanyi, the National Medal of Science (1991), the Jaroslav Heyrovsky Medal (1992), the Sierra Nevada Distinguished Chemist Award (1993), the Kosolapoff

Award of the ACS (1994), the William Walker Prize (1994); and named by Chemical Engineering News among 75 leading contributors to the chemical enterprise in the past 75 years (1998), and the Council of Scientific Society President's Award for Support of Science (1999).

Professor Herschbach has published over 400 papers. His current research is devoted to methods of orienting molecules for studies of collision stereo dynamics, means of slowing and trapping molecules in order to examine chemistry at long deBroglie wavelengths, reactions in catalytic supersonic expansions, and a dimensional scaling approach to strongly correlated many-particle interactions, in electronic structure and Bose-Einstein condensates.



Bruce A. McCarl

Energy and the Environment: Concerns for the Future

Energy and the environment are highly intertwined. Many issues have been posed regarding the energy environment intersection. But comprehensive treatment of the full spectrum of these issues is beyond the time allotted for this presentation. Consequently the presentation will focus on: a) energy, greenhouse gas emissions and climate change; b) renewable fuels - agriculture and the environment; and c) minor treatment of air quality involving mercury and ozone. Coverage will involve: a) energy interactions in these arenas, b) effects on society, c) policy needs and challenges, d) potential or emerging policy, e) policy design, and f) energy related adaptation and mitigation. Due to my background the coverage will exhibit a partial

agricultural, economic and data driven analytical bias.

Biography

Bruce A. McCarl is a University Distinguished Professor of Agricultural Economics at Texas A&M University. His work areas include climate change, bioenergy, water economics, agricultural policy, and quantitative analysis. Dr. McCarl has worked on water and bioenergy issues for 35 years and climate change issues for 25 years. Bioenergy related projects include water allocation tradeoffs in the Columbia River Basin, and agricultural effects of EPA Renewable Fuel Standard rules. Climate change related projects include work on agricultural vulnerability, adaptation and greenhouse gas mitigation. Water related projects have involved the effect of water regulations and climate change on water use values, implications for aquifer levels and stream flow, income positions of farmers and urban dwellers, role of water markets, effects of ocean related variability among other items. He has been involved in many policy analysis and environmental policy analysis roles including being lead agricultural economic analyst on the 2001 US National Climate Change Assessment, author on the 2010 National Academy America's Climate Choices study and lead author on the 2007 and 2014 Intergovernmental Panel on Climate Change assessment reports. Dr. McCarl is Associate Editor of Climatic Change and previously was associate editor of Water Resources Research and the American Journal of Agricultural Economics. In recognition of his work he is a Fellow of three Agricultural Economics Associations and was a participant in the 2007 Nobel Peace Prize to the IPCC. He is the author of over 250 journal articles and 400 other papers/presentations. He has been involved with over \$62 million in sponsored research.



Kenneth W. Starr

Science, Policy and Power: The Supreme Court and Climate Change

Alexis de Tocqueville famously observed that in America most questions of significant moment invariably become legal issues to be addressed by courts. In the Age of Innovation, that insight seems hopelessly out of date. Save for intellectual property issues (and routine commercial law questions), science and technology in the 21st Century would seem by their nature to be happy exceptions to the imperialistic reach of law's domain.

Not so. To illustrate the sweeping scope of American law and regulation, this talk will focus on the controversy swirling around climate change, and analyze how even globally significant policy questions find their way into American courtrooms

– and ultimately to the Supreme Court of the United States. Specifically we will examine the unratified Kyoto Protocol (the debate over climate change) and the Supreme Court's 2007 decision in *Commonwealth of Massachusetts v. EPA*. (a.k.a. the *Climate Change Case*) and how this case is not just about global warming, but about power, in particular, judicial power.

We will find, in short, that even with respect to a policy question of undisputed global significance, both practically and diplomatically, the Supreme Court demanded – and secured – its own place at the decision-making table. By doing so, the nation's High Court gave fresh meaning to the Toquevillian insight of almost two centuries ago – in America, great questions of policy inexorably are drawn into the vortex of American constitutional adjudication.

Biography

A distinguished academician, lawyer, public servant and sixth-generation Texan, Judge Ken Starr serves as the chief executive officer of Baylor University, holding the titles of President and Chancellor. On June 1, 2010, Judge Starr began his service as the 14th president to serve Baylor University and was named to the position of President and Chancellor on November 11, 2013. In providing the additional title, he is charged with the task of increasing Baylor's influence in the nation and around the world.

Judge Starr also serves on the faculty of Baylor Law School as The Louise L. Morrison Chair of Constitutional Law and teaches a seminar on current Constitutional issues. Judge Starr is a member of the Board of Directors for the National Association of Independent Colleges and Universities (NAICU) and currently serves as President of the Southern University Conference. In addition, he serves as a member of the Board of Trustees for the Baylor College of Medicine and the Board of Trustees for Baylor Scott & White Health.

Judge Starr has argued 36 cases before the U.S. Supreme Court, including 25 cases during his service as Solicitor General of the United States from 1989-93. He also served as United States Circuit Judge for the District of Columbia Circuit from 1983 to 1989, as law clerk to Chief Justice Warren E. Burger from 1975 to 1977 and as law clerk to Fifth Circuit Judge David W. Dyer from 1973 to 1974. Starr was appointed to serve as Independent Counsel for five investigations, including Whitewater, from 1994 to 1999.

Prior to coming to Baylor, Judge Starr served for six years as The Duane and Kelly Roberts Dean and Professor of Law at Pepperdine, where he taught current constitutional issues and civil procedure. He has also been of counsel to the law firm of Kirkland & Ellis LLP, where he was a partner from 1993 to 2004, specializing in appellate work, antitrust, federal courts, federal jurisdiction and constitutional law. Judge Starr previously taught constitutional law as an adjunct professor at New York University School of Law and was a distinguished visiting professor at George Mason University School of Law and Chapman Law School. He is admitted to practice in California, the District of Columbia, Virginia and the U.S. Supreme Court.

Judge Starr is the author of more than 25 publications, and his book, "First Among Equals: The Supreme Court in American Life," published in 2002, was praised by U.S. Circuit Judge David B. Sentelle as "eminently readable and informative...not just the best treatment to-date of the Court after (Chief Justice Earl) Warren, it is likely to have that distinction for a long, long time."



Michael K. Young

Energy Alternatives in the Economy of Texas

Biography

Michael K. Young became the 25th President of Texas A&M University on May 1, 2015, bringing a proven track record of academic leadership.

As president and tenured Professor of Law at the University of Washington from 2011 to 2015, he led the nation's top public university in competing for federal research funding, as well as its ambitious plan to double the number of new companies based on UW research. He also launched the Global Innovation Exchange, a partnership in the State of Washington between the University of Washington, a major Chinese university and European universities. The University also more than doubled its fundraising during his tenure. Prior to that, he served as President and Distinguished Professor of Law at the University of Utah. Under President Young's leadership, Utah raised its stature nationally and internationally, including becoming the nation's top university in the number of new companies generated from university research. The University also built over a million square feet of academic and research space under President Young's leadership.

Before assuming the presidency at Utah, he was Dean and Lobingier Professor of Comparative Law and Jurisprudence at the George Washington University Law School, and he was a professor at Columbia University for more than 20 years. He also has been a visiting professor and scholar at three universities in Japan.

A graduate of Harvard Law School, President Young has broad experience across legal, public service, and diplomatic arenas. He served as a law clerk to the late Chief Justice William H. Rehnquist of the U.S. Supreme Court, and he has held a number of government positions, including Deputy Under Secretary for Economic and Agricultural Affairs, and Ambassador for Trade and Environmental Affairs in the Department of State during the administration of President George H.W. Bush. Among many other international agreements, President Young worked extensively on the treaties related to German unification, as well as the North American Free Trade Agreement (NAFTA) and Uruguay Round negotiations leading to the World Trade Organization, and the U.N. Conference on Environment and Development. Subsequently, President Young served eight years on the U.S. Commission on International Religious Freedom, which he chaired on two separate occasions.

He is a member of the Council on Foreign Relations and a fellow of the American Bar Foundation.

Notes



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