ATTACHMENT C

Expertise of MIT Faculty and Staff Affiliated with the Carbon Sequestration Initiative Research Agenda

Eric Adams is a Senior Research Engineer and Lecturer with MIT's Dept of Civil and Environmental Engineering. He also directs the department's Master of Engineering Program and is an Associate Director for Research with the MIT Sea Grant College Program. His research interests include environmental fluid mechanics, physical and mathematical modeling of pollutant transport and mixing, and hydrologic tracer studies. He has studied fluid mechanical aspects of ocean carbon sequestration for 9 years, supervising students in the environmental impact assessment of various CO₂ injection systems. He serves on the Technical Committee overseeing the international pilot scale field experiment planned for the summer of 2001 in Hawaii.

Lawrence S. Bacow is the Chancellor of the Massachusetts Institute of Technology, and the Lee and Geraldine Martin Professor of Environmental Studies. Prior to being named as Chancellor, he served as Chairman of the MIT Faculty. Professor Bacow's teaching and research span a number of fields including environmental economics and policy, regulation of the development process, bargaining and negotiation theory, and risk assessment.

János M. Beér is a Professor of Chemical and Fuel Engineering at MIT and was the Scientific Director the MIT Combustion Research Facility from 1976 to 1993. He was Professor and Head, Department of Chemical Engineering and Fuel Technology at the University of Sheffield England, 1965-76; Professor of Fuel Science, The Pennsylvania State University, 1963-65; and the Head, Research Station, International Flame Research Foundation, Ijmuiden, The Netherlands, 1960 –63. His research interests include the physics and chemistry of combustion, control of combustion-generated pollution in boilers and gas turbines; electric power generation in coal-fired combined cycles. He is a Fellow of The Royal Academy of Engineering (UK); a Foreign Member, The Finnish Academy of Engineering; and an Honorary member, The Hungarian Academy of Sciences.

Sallie W. Chisholm holds a joint appointment in the Department of Civil and Environmental Engineering and the Department of Biology at MIT, and is the McAfee Professor of Engineering. She is past Director of the MIT/Woods Hole Joint Program in Oceanography. Prof. Chisholm is a biological oceanographer who specializes in phytoplankton ecology. She was co-discoverer of Prochlorococcus, a group of phytoplankton which comprise a significant fraction of the photosynthetic biomass in the oligotrophic oceans. Recently, she has been involved in unenclosed ocean fertilization experiments designed to help us understand the role of the oceans in past and future climate change. The results of these experiments have implications for human intervention in ocean fertility, and the sustainable use of ocean resources. Prof. Chisholm is a Fellow in the American Academy of Microbiology, American Geophysical Union, American Academy of Arts and Sciences, and the International Ecology Institute. She is also the recipient of the Rosenstiel Award in Ocean Sciences, and a Guggenheim Fellowship.
Nazli Choucri is Professor of Political Science and Associate Director of the Technology and Development Program at MIT. She is an analyst of international political and economic change, focusing on potentials for conflict at national, regional, and global levels. She has worked on problems related to conflict minimization in the world oil market, energy and development, and technology exchanges. She is the author of several books in this area, serves as consultant in various policy contexts, nationally and internationally, and is currently serving as Senior Advisor to the directors of two international institutions.

Charles Cooney is Professor of Chemical and Biochemical Engineering and Executive Officer of the Chemical Engineering Department at MIT. After an undergraduate education at the University of Pennsylvania, he received his Ph.D. from MIT. His research interests include biochemical process control with emphasis on the application of expert systems, artificial neural networks, and data reconciliation to fermentation and cell culture. He also works on techniques for biochemical product recovery, including vortex flow filtration in conjunction with membrane separation processes, for applications ranging from protein purification to waste treatment processes. As Co-Director of the MIT Program on the Pharmaceutical Industry, he leads research to better understand the factors which drive and constrain the implementation of new manufacturing technology in the pharmaceutical industry.

Elisabeth M. Drake is Associate Director for New Technologies at the MIT Energy Laboratory, and received S.B. and Sc.D. degrees in Chemical Engineering from MIT. She spent most of her career at Arthur D. Little, Inc., starting a hazardous facilities risk management group and becoming Vice President and leader of their Environment, Health and Safety Practice. From 1982-1986, Dr. Drake was the Cabot Professor of Chemical Engineering at Northeastern University and Chairman of their Chemical Engineering Department. At the MIT Energy Laboratory, she conducts research on new technology development in awareness of the growing importance of environmental sustainability and resource conservation in internationally competitive markets. She is a Fellow of the American Institute of Chemical Engineers (AIChE) and a Member of the National Academy of Engineering (NAE), as well as a Registered Professional Engineer.

John M. Edmond is Professor of Marine Chemistry in the Department of Earth, Atmospheric, and Planetary Sciences at MIT. He holds a Ph.D. in Marine Chemistry from the University of California, San Diego (Scripps Institution of Oceanography). His research interests include processes and mechanisms controlling the composition of oceanic and continental waters and sediments in space and time. He serves on the editorial board of *Earth and Planetary Science Letters, Chemical Geology/Isotope Geochemistry, and Geochimica et Cosmochimica Acta*. His honors include: James B. Macelwane Award and Fellow, American Geophysical Union, 1978; Fellow, Royal Society of London, 1986; Honorary Research Fellow, Southampton Oceanography Center, 1996; Fellow of the Geochemical Society and the European Association for Geochemistry, 1996.

A. Denny Ellerman is senior lecturer of the Sloan School of Management and executive director of the Center for Energy and Environmental Policy Research, in which capacity he also functions as executive director of the Joint Program on the Science and Policy of Global Change. Ellerman's research interests focus on emissions trading, fuel choice economics, and the
integrated assessment of climate change policies. Ellerman is the author, with colleagues, of *Markets for Clean Air: the U.S. Acid Rain Program*, the most successful emissions trading program to date. He is also author of numerous other articles and a frequent speaker on energy and environmental economics.

**Michael Follows** is a Research Scientist in the Department of Earth, Atmospheric and Planetary Sciences at MIT. His research is aimed at increasing our understanding of biogeochemical cycles in the ocean and atmosphere, using numerical models and data analysis. His recent studies include studies of the feedbacks between carbon cycle and climate in simplified models, and the interpretation of interannual variability ocean biological productivity and its relation to climatic regimes in the atmosphere.

**T. Alan Hatton** is the Ralph Landau Professor and Director of the David H. Koch School of Chemical Engineering Practice at MIT. Research interests include exploitation of structured fluids in chemical processing operations. We have focused most recently on the use of tailored solvents, and of surface-modified magnetic fluid nanoparticles, to enhance reaction and separation processes to minimize pollution.

**Howard J. Herzog** is a Principal Research Engineer at the MIT Energy Laboratory. He received his undergraduate and graduate education in Chemical Engineering at MIT. He has industrial experience with Eastman Kodak, Stone & Webster, Spectra Physics, and Aspen Technology. Since 1989, he has been on the Energy Laboratory staff, where he has led the research program on CO₂ sequestration from large stationary sources. Some specific activities in this area include: primary author of a *DOE Research Needs Assessment on the Capture, Utilization, and Disposal of CO₂* (1993), chairman of the Organizing Committee for the Third International Conference on CO₂ Removal (1996), and primary author of a *DOE White Paper on CO₂ Capture, Reuse, and Storage Technologies* (1997).

**John Heywood** is the Sun Jae professor of Mechanical Engineering at MIT and Director of the MIT Sloan Automotive Research Laboratory, which is a leading center in research on automotive engines and fuels, as well as on critical issues of lubrication system design. He has made several specific research contributions that improved the ability to modify combustion processes to improve efficiency and reduce emissions. He has been recognized by a number of professional society awards and is a member of the National Academy of Engineering. He is currently involved in research relating to future road transportation options in a GHG-constrained world.

**Jack Howard** is Hoyt C. Hottel Professor of Chemical Engineering. His research interests include high temperature chemistry, especially mechanisms and kinetics of reactions in combustion, environmental/emissions control, fuel processing, synthesis of carbon materials, and waste destruction, including: formation and oxidation of polycyclic aromatic hydrocarbons, fullerenes and soot formation in flames; and pyrolysis, gasification and combustion of coal, biomass and solid wastes.

**Henry D. Jacoby** is the William F. Pounds Professor of Management in the MIT Sloan School of Management. He is an applied economist who studies issues of policy and planning in the
areas of energy, natural resources, and environment. He has served as the Director of the MIT Center for Energy Policy Research, and as Associate Director of the MIT Energy Laboratory. At present, he co-directs the MIT Joint Program on the Science and Policy of Global Change. He has written widely on energy and environmental topics, including five books.

**John Marshall** is a Professor of Atmospheric and Oceanic Sciences in the Department of Earth, Atmospheric and Planetary Sciences. His research has been directed at understanding key components of the general circulation of the atmosphere and ocean and the development of models to study them. He is interested in a variety of problems in geophysical fluid dynamics and their role in climate, ranging from rotating convection to the global circulation of the ocean. I also carry out research into the dynamics of anomalous circulation patterns in the atmosphere and climate variability.

**John Reilly** is the Associate Director for Research in the Joint Program on the Science and Policy of Global Change at MIT. Much of his research has focused on the economics of climate change, including modeling of energy use and carbon emissions and on the economic impacts of climate change on agriculture as well as consideration of agriculture and forestry sinks. He has published numerous articles, books, and reports on the economics of climate change and on other issues related to natural resources, technology, and energy use and supply. He was a principal author for the IPCC Second Assessment Report and has served on many Federal government and international committees. Prior to joining MIT in 1998, he spent 12 years with the Economic Research Service of USDA, most recently as the Acting Director and Deputy Director for Research of the Resource Economics Division. He has been a scientist with Battelle's Pacific Northwest National Laboratory and with the Institute for Energy Analysis, Oak Ridge Associated Universities. He received his Ph.D. in economics from the University of Pennsylvania in 1983 and holds a B.S. in economics and political science from the University of Wisconsin.

**Anthony J. Sinskey** is Professor of Microbiology at MIT, where he received his Sc.D. in Food Science. He joined the MIT faculty after doing a Post Doctoral Fellowship at the Harvard School of Public Health. His major research interests encompass Microbiology, Biotechnology, Metabolic and Biopolymer Engineering, and Mammalian Cell Culture. His laboratory has specific goals of establishing an interdisciplinary approach to metabolic engineering, focusing on the fundamental physiology, biochemistry and molecular genetics of important organisms. In particular, they are studying key factors that regulate the synthesis of different biomolecules and apply metabolic engineering in several different project areas. Among prokaryotic systems, they study amino acid metabolism in *Corynebacterium glutamicum*, bioremediation and bioconversion processes in *Rhodococcus*, and biopolymer synthesis among Gram-negative bacteria. Among eukaryotic systems, they are studying apoptosis in mammalian cells, lipid biosynthesis in oil palm, and the accumulation of secondary metabolites in tropical plants.

**Kenneth A. Smith** is a Professor of Chemical Engineering at MIT who has, for over 30 years, devoted his research efforts to problems in fluid mechanics and in heat and mass transfer. He holds an Sc.D in Chemical Engineering from MIT; he has done postdoctoral and sabbatical research at Cambridge University; and he is a member of the National Academy of Engineering.
Previous research foci include turbulence, drag reduction, hydrodynamic stability, facilitated transport, transport in living systems, and crystal growth.

**Gregory Stephanopoulos** Professor of Chemical Engineering at MIT, received his Ph.D. from the University of Minnesota. His research includes applications of genetic engineering to strain improvement through metabolic engineering, to development of methods for the measurement and control of metabolic fluxes, and to study of cellular responses to genetic and environmental perturbations. He presently is conducting research on CO$_2$ fixation by cyanobacteria in collaboration with Prof. Sinskey’s work on directed evolution of PHA synthases.

**Jeffrey Steinfeld** is Professor of Chemistry, Massachusetts Institute of Technology, Cambridge, MA. B.S. Chemistry at M.I.T. (1962), Ph.D. in physical chemistry at Harvard (1965). N.S.F. Postdoctoral Fellow with Sir George Porter at the University of Sheffield (U.K.). Joined M.I.T. Chemistry Department in 1966. Research interests include molecular spectroscopy, molecular energy transfer, and laser applications to chemistry, including optical methods for remote sensing and atmospheric monitoring. Co-Director, Program on Environmental Education Research at M.I.T.; Chair, American Chemical Society's Committee on Environmental Improvement. Received 1999 ACS Director's Award for Advancing ACS Public Policy in Environment, for work to encourage the use of sound science in global climate change policy.

**Peter Stone** is Professor of Climate Dynamics, Department of Earth, Atmospheric, and Planetary Sciences, MIT. Professor Stone is an expert in atmospheric dynamics who has made important contributions to the development of climate models of all kinds, ranging from the simplest one-dimensional process models to full-scale three-dimensional general circulation models. He is a member of the team that developed the NASA/Goddard Institute for Space Studies general circulation climate model and has been applying it to climate change problems. Professor Stone is also a participant in the interdisciplinary part of NASA’s Earth Observing System (EOS) program, which is making key observations of climate processes. Currently he is the Director of MIT’s Climate Modelling Initiative, a new effort to construct improved coupled atmosphere-ocean general circulation models, and use them in studies of the predictability of climate.

**Jefferson W. Tester** is the H.P. Meissner Professor of Chemical Engineering and Director of MIT’s Energy Laboratory. For three decades, he has been involved in various aspects of chemical engineering process research as it relates to energy extraction and conversion and environmental control technologies. He has co-authored more than 100 papers and 8 books on various topics related to energy and environmental issues. Topics have ranged from geothermal energy and drilling technology to power conversion system design and economics, to assessing regional and global environmental effects of energy supply and use, including the possibilities of carbon sequestration.

**M. Nafi Toksöz** is Professor of Geophysics and Founder of the Earth Resources Laboratory at MIT. His research specialties include seismic tomography, rock physics, and reservoir characterization, with an extensive list of publications in these areas.
Bernhardt Trout is the Joseph R. Mares Assistant Professor of Chemical Engineering at MIT. He received an S.B. and an M.S. in Chemical Engineering Practice from the MIT, Department of Chemical Engineering, and a Ph.D. from the UC Berkeley, Department of Chemical Engineering. He spent a year in post-doctoral studies at the Max-Planck Institute, Stuttgart, Germany. His research interests involve developing and applying molecular computational methods to gain insights leading to the design of chemical materials and processes. Applications include heterogeneous catalysis on zeolites for the synthesis of cleaner-burning fuels and olefins, high conversion, next generation automotive catalysts, heterogeneous stratospheric chemistry to understand the consequences of releasing chemicals into the atmosphere, natural gas hydrates as an abundant, clean, future fuel source, CO$_2$ hydrates involved in the sequestration and storage of CO$_2$, and therapeutic protein stabilization. There is an overall emphasis on environmental research and the development of more environmentally benign technologies.

Roger Turpening is a Research Associate in the Earth Resources Laboratory (ERL) a unit of the Department of Earth, Atmospheric, and Planetary Sciences. He is a seismologist specializing in the hydrocarbon exploration segment of that science. In particular he enjoys the data acquisition problems associated with hydrocarbon exploration and in that capacity has been at the leading, innovative, edge of the vertical seismic profiling (VSP) methods, shear wave generation and recording techniques, cross well reflection and tomographic methods. Currently he leads a major data acquisition program at ERL sponsored by twelve oil companies and contractors that will, for the first time, deploy the receivers and the sources in a completely random manner. At the same time, this program will deploy a seismic vibrator in a deep borehole and record the seismic wave field with the same random spread of geophones. This technique is called reverse vertical seismic profiling (RVSP) and holds out the promise of much higher resolution 3-D images of the subsurface especially when the receivers are buried beneath the weathered zone.