



**NAE**  
**Grand Challenges**  
for the 21st Century:  
Chicago Summit 2010



## Introduction

In the year 2000 the National Academy of Engineering (NAE) issued the result of its survey of the 20 most important engineering achievements of the 20th century from the viewpoint of the United States. The list includes the basics of life as we know it today (electrification of homes and businesses, clean water, refrigeration and air conditioning), as well as advances in communications, electronics, materials, medicine, transportation that have changed the way we live.

Looking forward, the NAE recently commissioned a committee of engineers, scientists and futurists to solicit ideas related to the “Grand Challenges” facing the global society in the 21st century.

Illinois Institute of Technology (IIT) and Chicago Council on Science and Technology (C2ST), along with our academic and corporate partners, co-sponsored a symposium during April 21-22, 2010 on four areas related to several of the 14 Grand Challenges: clean water; carbon, energy and climate; urban sustainability; and global health. The Chicago Summit is part of a nationwide debate on the Grand Challenges, with symposia on other topics related to the Grand Challenges held across the country.

The goals of the Chicago Summit 2010 were to:

1. Enhance interest in engineering and science and highlight its role in solving major problems facing society.
2. Increase the visibility and importance of engineering and science to society in general.
3. Enhance student interest in engineering, science and technology entrepreneurship.
4. Emphasize the importance of collaborations of engineers and scientists with professionals in business, government, law, and the humanities and social sciences to address the challenges facing society.

As a deliverable from the two days of presentations and rigorous discussion, the Chicago Summit Steering Committee presents the following report for contribution to the continuing dialogue of the NAE’s Grand Challenges initiative, and for presentation at the 2010 National Grand Challenges Summit in Los Angeles, California in October 2010.

This report captures a set of recommendations that were extrapolated from each of the four subject-area panels and presentations. By no means exhaustive, this list of recommendations represents the actionable items government, industry, academia, and the community can take together to meet the challenges of clean water; carbon, energy and climate; urban sustainability; and global health.

“We have to get better and better and better at innovation – both at doing old things in new ways, doing them better, and doing new things in new ways that are often going to be surprising.”

– Charles M. Vest, President,  
National Academy of Engineering

# Access to Clean Water



Keynote

**Charles O'Melia**, Abel Wolman Professor of Environmental Engineering Emeritus, Johns Hopkins University



Moderator

**Lynn E. Broadus, Ph.D., M.B.A.**, Director, Environment Programs, The Johnson Foundation at Wingspread



Panelist

**Paul Brandt-Rauf**, Dean, School of Public Health, University of Illinois at Chicago



Panelist

**Margaret Osbourne**, Green Coordinator, Environmental Protection Agency Region VI



Panelist

**Manian Ramesh, Ph.D.**, Chief Technology Officer, Nalco Company

## CONTEXT

All of life is based upon water. Insufficient clean water leads to more deaths per year than war. While there is plenty of water in the world, the problem is that either water is not where it is needed or it is not clean or fit for human use. Understanding water in the context of health, the current energy concerns, and life in urban environments is vital.

Thermo-electric production consumes 30% of water resources, and paper producers are the second greatest user. In the developing world, unsafe water contributes to 70-130 disability life years lost.

In developed countries, many people view water as an entitlement, or as a costless resource or amenity. Influencing the agency of the individual is paramount to achieving any long-term and widespread change in water use.

“When the U.S. sends food to other countries that don't have enough food, we call this Virtual Water.”

– Charles O'Melia

## RECOMMENDATIONS

1. Charge for water, charge more for water, and meter individual use.
2. Develop policies that encourage integrated solutions for water, energy and food, recognizing the success of such policies are essential for economic and societal well-being.
3. Pursue research and support models for the increased use of gray water.
4. Decentralize water systems to reduce water transportation energy costs, and reduce waste.

# Carbon, Energy and Climate



Keynote

**John P. Holdren**, Assistant to the President for Science and Technology and director, Office of Science and Technology Policy



Moderator

**Bill Kurtis**, A&E host, Producer and Narrator, "Cold Case Files" and "American Justice"



Panelist

**David Archer**, Professor of Geophysical Sciences, University of Chicago



Panelist

**Carlos A. Cabrera**, President and Chief Executive Officer, National Institute of Low Carbon and Clean Energy



Panelist

**Adele Simmons**, Vice Chair and Senior Executive, Chicago Metropolis 2020

## CONTEXT

Humans have long confronted the pollution created by the use of energy. The current challenge is not only the visible soot from wood and coal fires, or smog from poorly combusted gasoline and diesel, which affects human health in direct and obvious ways, but also invisible greenhouse gases, which do not directly affect human health but will impact our environment significantly.

"The challenges are too big and the resources too limited for us to afford not to cooperate."

– John P. Holdren

Carbon emission contributes to global warming and climate changes affecting our water supply and quality. The impact of increasing atmospheric carbon is widely recognized, but diminution of human emissions of carbon will either require a difficult decrease in our use of fossil fuels or significant scientific and technological breakthroughs. The increase in atmospheric carbon represents a generational challenge of global importance.

## RECOMMENDATIONS

1. Create public-private partnerships and international collaborations to create a market for the carbon economy: Governments should set public policy, and industry should work within those policies and leverage the efficiencies of the market to achieve carbon reduction goals.
2. Encourage personal behavior modification and local action by stimulating entrepreneurship and innovation.
3. Pursue additional science on carbon sequestration and develop a method to monetize it.
4. Target research at efforts to make renewable energy more affordable.

# Urban Sustainability



Keynote

**Roger E. Frechette III**, PE, President, PositivEnergy Practice



Moderator

**Blair Kamin**, Architecture Critic, Chicago Tribune



Panelist

**Carol Ross Barney**, Founder and Design Principal, Ross Barney Architects, and Adjunct Professor, Illinois Institute of Technology



Panelist

**Jeanne Gang**, President and Principal, Studio Gang Architects, and Adjunct Associate Professor, Illinois Institute of Technology  
Community Panelist



Panelist

**Antony Wood**, Executive Director, Council on Tall Buildings and Urban Habitat, and Associate Professor, Illinois Institute of Technology

## CONTEXT

Chicago, as with other cities around the world, reached a milestone this past year when more than one-half of the world's population now resides in an urban environment.

There are 200,000 people moving from rural to urban areas in the world every single day. In China there are 171 cities with more than 1,000,000 people, compared to 10 in the U.S. This urban growth results in unbelievable pressure on existing cities, yet it does create a more sustainable living environment, as increasing the density of living decreases the carbon use per household.

As our cities grow, they must have an appreciation that health and urban infrastructure are inextricably coupled. Sustainable architecture is simply about exploiting opportunities, and is dependent on will.

“The suburban living pattern would create approximately 7 times the amount of carbon compared to a city.”

– Jeanne Gang

## RECOMMENDATIONS

1. Pursue new research for the development of net energy positive buildings (pressure design, wind turbines, solar).
2. Pursue additional research to determine the height at which a building becomes unduly inefficient/unsustainable.
3. Promote city planning policies that allow residents to do all everyday activities within a 10 minute walk of their house
4. Provide building owners incentives to make investments in energy efficiency upgrades where tenants pay utility bills.
5. Create easy connections between transportation modes.
6. Focus on innovation in passive systems, understanding that not everything can be actively controlled most effectively.

# Global Health



Keynote

**Tachi Yamada**, M.D., President, Global Health Program, Bill & Melinda Gates Foundation



Moderator

**Nesita Kwan**, Health Reporter and Anchor, NBC 5 Chicago New



Panelist

**Marie Denise Milord**, Postdoctoral Fellow, University of Notre Dame



Panelist

**Norbert G. Riedel**, Corporate Vice President and Chief Scientific Officer, Baxter International Inc



Panelist

**Father Thomas Streit**, Assistant Professor, Department of Biological Sciences, University of Notre Dame



Panelist

**Eric E. Whitaker**, Executive Vice President, Strategic Affiliations, and Associate Dean, Community-Based Research, University of Chicago Medical Center

## CONTEXT

Good health is essential for a quality life. Attacks on good health come from both outside our bodies (e.g., infectious agents, pollutants, and our physical and social environment) as well as within (e.g., genetic predisposition to cancer, heart disease, and neurological disease, etc).

Understanding the nature of these ailments and their propensity to occur, along with the development of effective technologies to manage health (preventive, diagnostic, and therapeutic), is critical to our civilization and its future.

Unfortunately, more than half the world has no access to Western health advancements, and 9 million children are dying every year of diseases we know how to control. Life expectancy is under the age of 50 in sub-Saharan Africa, while here in the U.S., we can expect to live to 80 or more. There is a significant need for innovation in delivery of medicines and solutions, in addition to innovation in science.

*“We are each others’ neighbors globally, and the health problems of our neighbors could be ours very quickly.”*

*– Father Thomas Streit*

## RECOMMENDATIONS

1. Seek policies that truncate the time it takes for new ideas to get into development, and into developing countries.
2. Develop new human capital in health-related fields to ensure generations of innovation.
3. Connect health researchers with people in developing countries to develop solutions that meet their needs.
4. Focus on translational research and execution science by developing public-private partnerships with universities (centers of excellence).
5. Focus long-term planning on the need for eradication, rather than settling for vaccination, which is a temporary solution.

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