ESS: M&R Workshop Overview

Engineers' Forum on Sustainability Workshop
ICOSSE '11

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The organizing Societies and co-sponsors represent 350,000 engineers worldwide

- American Institute of Mining, Metallurgical, and Petroleum Engineers, Inc. (AIME) and its Member Societies:
  - Society of Petroleum Engineers (SPE)
  - Society for Mining, Metallurgy, and Exploration (SME)
  - The Minerals, Metals, and Materials Society (TMS)
  - Association for Iron and Steel Technology (AIST)

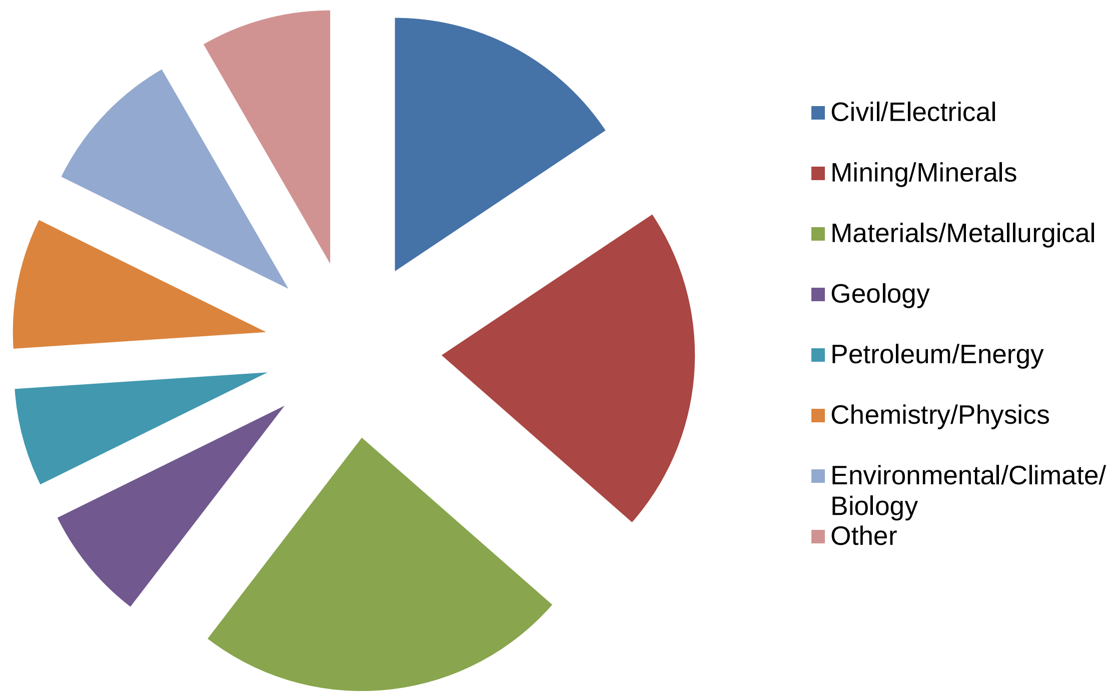
- Co-Sponsors were two other engineering Founder Societies of the United Engineering Foundation (UEF)
  - American Society of Civil Engineers (ASCE)
  - American Institute of Chemical Engineers (AIChE)

Engineering Solutions for Sustainability: Materials and Resources

22–24 July 2009 | Ecole Polytechnique fédérale de Lausanne, Lausanne, Switzerland

A generous grant from the United Engineering Foundation (UEF) ensured a diverse delegation

- 12 countries from North America, Europe, Africa and the Middle East
- Academia, industry, government, and non-governmental organizations
- Numerous disciplines participated…



Engineering Solutions for Sustainability: Materials and Resources

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The ESS:M&R workshop explored potential ways that the engineering profession can aid in addressing the needs for societal sustainability through technological, educational, and public policy solutions

- The challenges societies face today are broad, complex, and interconnected, including:
  - Widespread poverty
  - Lack of access to potable water and adequate food
  - Megacities
  - Increasing demand for renewable and nonrenewable resources
  - Climate change
- Solutions will require interdisciplinary, global approaches that are based on sound science and engineering advancements

A common reference point was the Brundtland Commission's definition of sustainability

"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

Two key concepts

- The concept of 'needs', in particular the essential needs of the world's poor, to which overriding priority should be given; and
- The idea of limitations imposed by the state of technology and social organization to the environment's ability to meet present and future needs."

A key outcome was development of a consensus definition of sustainability

Agreed to key principles of sustainable engineering

- **Economic:** The engineered system is affordable.
- **Environmental:** The external environment is not degraded by the system.
- **Functional:** The system meets users' needs—including functionality, health and safety— over its life cycle.
- **Physical:** The system endures the forces associated with its use and accidental, willful, and natural hazards over its intended service life.
- **Political:** The creation and existence of the system is consistent with public policies.
- **Social:** The system is and continues to be acceptable to those affected by its existence.

18 expert Plenary and 3 Keynote speakers examined the role of engineering in achieving societal sustainability…

For 6 key sectors

- Transportation
- Energy
- Recycling
- Housing
- Food and Water
- Health

Presentations highlighted sector needs and fueled breakout session discussions of the following questions…

- What does sustainability mean for these sectors and why should we care?
- What technologies and engineering approaches exist and/or are being used now in these sectors?
- What technological and engineering advances are in the development and near-commercialization stages?
- What materials and resources will these technologies require?
- How do we sustainably produce these materials and resources?
- How might policies and markets support or limit implementation of these technologies?
- What about the human element?
- What are the next steps?

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Six critical overarching themes emerged that could provide a unifying framework in formulating strategy and implementing solutions

- Acknowledging the human element
- Resiliency, flexibility in designing technologies and systems
- Need for responsible resource use/resource-efficient design
- Life-cycle assessment and costing
- Escaping the “silo mentality” through systems thinking
- Engineering education can be a catalyst

The ESS:M&R workshop report summarizes the challenges and opportunities by topic areas that highlight linkages across the 6 sectors

- Human Needs: Food, Water, Health
- Infrastructure: Transportation, Housing, Urban Design
- The Resource Cycle: Energy, Mineral Resources, Materials and Recycling, Linking Technologies to Resources
- Human Resources: Strategies for unlocking the fullest potential of scientists and engineers to achieve progress in sustainable development

Human Needs

The “human needs” expanded to encompass the concept of human well-being.

- ***Water***
  - Rising world populations and consumption are inexorably increasing human demand for domestic, industrial, and agricultural water. A parallel concern is the human cost of obtaining water in many cultures.
- ***Food***
  - Local food production is critical in preventing hunger and promoting rural development
- ***Health***
  - A definition of health is strength, feeling well, and having good functional capacity

Infrastructure

- The concept of ***resilience*** (meaning possessing power of recovery) defines qualities needed for infrastructure to resist natural, accidental and willful hazards such as earthquakes, hurricanes, droughts, fires and terrorism. This means our infrastructure systems should be adaptable to unforeseen demands and technical capabilities.

- Infrastructure is long lived; its renewal (renovation or rehabilitation) during its service life is important for sustainability.

The Resource Cycle

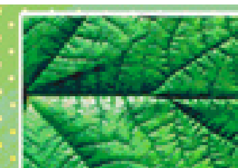
- There was agreement that recycling, reuse and remanufacturing can provide a stream of minerals and materials to society, but minerals from primary sources will continue to be needed for the foreseeable future. Further, ensuring an adequate supply of minerals and materials for emerging technologies will require significant effort and contributions from the research community.
- Technology and Resource Matrix

Human Resources

- **19th & Early 20th Century: The Professional Engineer**
  - Engineering became a distinct profession focusing on providing graduates with hands-on training
- **Second Half of the 20th Century: The Scientific Engineer**
  - Technological progress provided a need for engineers to be well-versed in science and mathematics
- **The 21st Century: The Entrepreneurial/Enterprising Engineer**
  - Know Everything
  - Do Anything
  - Work with Anybody, Anywhere
  - Imagine and Make the Imagination a Reality

Starting Points for Action

- Early stage development and dissemination of sound, sustainable, and resilient engineering concepts
- Wide-spread adoption of a systems (or scenario) approach to engineering
- Creation of reliable tools/models for measurement of water, energy/carbon, materials footprints, and their interactions
- Development technologies/approaches for systemic reduction of the human footprint



But, even the most groundbreaking solutions will not come to pass without the understanding and support of key decision-makers throughout society

- Engineers need to be involved to ensure sound science and engineering support policy development
- Technical solutions must be explored in conjunction with an analysis of the policy drivers and impediments to shift to more sustainable practices

Thank you

- To be informed of future related activities, contact AIME President-Elect, Brajendra Mishra at bmishra@mines.edu
- To access workshop proceedings, visit www.aimehq.org/news.cfm
- For questions or additional information, contact AIME Interim Executive Director, Michele Lawrie-Munro at LawrieMunro@aimehq.org or 1-303-948-4256