Panel: Ongoing Projects and Next Steps

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World Café: Energy-Water-Food Nexus Professional Society Collaboration

- AIChE / IChemE Collaboration
  - Solving the nexus challenge requires integrated systems approach – a chemical engineering competency
  - Requires collaboration between multiple disciplines and cultures
  - An engineering ‘voice’ is important to inform public policy
  - Past presidents of AIChE and IChemE initiated collaboration to address this challenge
  - Initial work focused on building awareness within chemical engineering community through technical meetings – invitations to academic, industry, government; multiple disciplines

Drivers
- Population Growth
- Urbanization
- Technology
- Climate Change
- Industry Development
- Agriculture Transformation
- Cultural Behavior

Energy
- Fossil fuel use; Biofuels; Water use; Capacity growth; Resilient Power; Smart buildings; Energy Efficiency; Cost

Water
- Domestic – agricultural - industry use competition; Quality; Scarcity

Food
- Higher yields/acre; Rainfed vs Irrigated Ag; Food waste; Resource rich food demand; Land use

Energy Intensity
- e.g. Fertilizer, Chemicals, Transport, Processing

Environmental Impact


AIChE / IChemE Collaboration: Hank Kohlbrand, Dale Keairns, Richard Darton, Desmond King; Darlene Shuster (AIChE staff), Andy Furlong (IChemE staff)
World Café Energy-Water-Food Nexus
Professional Society Meetings – Example Presentations

- A Process Methodology for Assessing Sustainability Applied to the Nexus, Richard C. Darton, University of Oxford

- Energy-Water-Food: Maui and the World, Carey W. King, University of Texas

- The Water-Energy-Food Nexus, Olivier Dubois, UN FAO

- Impact of Future Energy on Water-Food-Energy Nexus, Joe Powell, Shell Chief Scientist

- The P-graph Methodology as Tool for Studying Sustainability in the Energy-Water-Food Nexus, Heriberto Cabezas, U.S. EPA, University of Pannonia

- Sustainability considerations in the energy-water-food nexus, Adisa Azapagic, University of Manchester

- Agriculture: Feeding the World within Planetary Boundaries, Kate Scow, UC Davis

- Addressing challenges at the water-energy-food nexus, Desmond King, Chevron

- Science / Technology / Risk Communication: It’s Harder Than You Think, Paul Fischbeck, CMU
Prior Work That Informs the Collaboration*

- **Purpose of Nexus Studies**
  - Discussion papers
  - Quality of life studies
  - Product studies
  - Develop system modeling tools

- **Aggregated Nexus Modeling**
  - Data intensive computational models
  - Life cycle and supply chain analysis
  - Accounting for the future (business as usual; scenarios)

- **Case Studies**
  - Regional development
  - Specific sectors (e.g. sustainable agriculture, food production, consumer goods)
  - Urban areas

* Based on Nexus Review by Dale Keairns, Richard Darton, Angel Irabien
World Café: Energy-Water-Food Nexus
Case Studies and Engaging the International Community

- Invitation for specific projects to serve as case studies: develop system modeling methodologies, identify needs and candidate solutions

- Extended collaboration to include the World Chemical Engineering Council to include broader international chemical engineering communities

Next steps
- Implement case studies
- Lessons from case studies
- Continue ‘awareness’ activities within chemical engineering community (U.S. and international)
- Initiate dialogue with others (science & engineering, social science, NGOs, business, public policy)
Collaboration Case Study Project Invitation
Techno-Economic-Societal-Environmental System

**Problem Definition**

**Identify Question**  
e.g. policy, drought constraint, product sustainability, Quality of Life

**Study Objective**  
e.g. solutions, technology opportunity, metrics, analysis methodology, understanding

**System Boundaries**  
Time and Geographical  
e.g. State, Watershed, Food Supply Chain

**Approach**

**System Analysis Methodology**  
e.g. integrated system model, LCA, scenarios

**Data Sources**  
e.g. Population (urban/rural), Water availability and Use, Energy supply/demand, Ag production, Import/Export flows

**Assumptions**  
e.g. demographics, energy-water-food system technology, ag yields, societal change, climate change, industry growth, policy
Case Study Illustration*
Objective: Electric Power Technology – Water Trade-offs

Parameters Affecting Electricity-Water Demand in the Watershed
- Population
- Urban / Rural
- Environmental
- Agriculture
- Industry
- Electric Power
- ‘Policies’

Water
Water Supply
- Unappropriated surface water
- Unappropriated groundwater
- Appropriated but unused
- Brackish groundwater
- Wastewater

Assumptions about ‘drought’
Assumptions about electricity import / export
Assumptions about fate of existing power plants
Assumptions about water resource distribution
Assumptions about Ag, M&I, Electricity, Environment
Assumptions about new technology, water requirements, CO₂ emissions, COE

Time Horizon: Present to 2040

* DOE NETL Case Study