



AICHE ASME AIME IEEE ASCE
Carbon Management



Gaps & Barriers to Carbon Management Technologies

Outcomes of the Founder Societies Technologies for Carbon Management Workshop



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Funded by the United Engineering Foundation

Carbon Management Project

- Project concept – 2007
 - Carbon management – a grand challenge
 - A role for engineering professional societies
- Assessment
 - Engineering societies are active (e.g. joint meetings, policy statements, congressional briefings)
 - Activities reflected engineering society interests
 - Limited focus on an integrated systems view
- Recognition of need to
 - Provide greater technical understanding to inform policy
 - Dialogue across our traditional engineering borders
 - Enable larger voice through collaboration

Project Objectives

Enable enhanced engagement of the engineering communities to improve the management and mitigation of greenhouse gas emissions by answering the following questions:

- What are the promising technologies and the gaps and barriers to their implementation?
- What are the metrics and system boundaries that should be used to monitor and manage emissions (including technical and societal dimensions)?

Project Activities

- Website established to share information
<http://www.aiche.org/FSCarbonMgmt/>
- Society leadership exchange meetings
- Electric Power and Transportation selected for initial technology focus (about 70% of CO₂ emissions in US)
 - Assessment of technologies
 - Scorecard
 - **Gaps and barriers workshop**
- GHG measurement workshop (December 6-8, 2009)
 - Early adopters experience
- Metrics project for evaluating energy systems

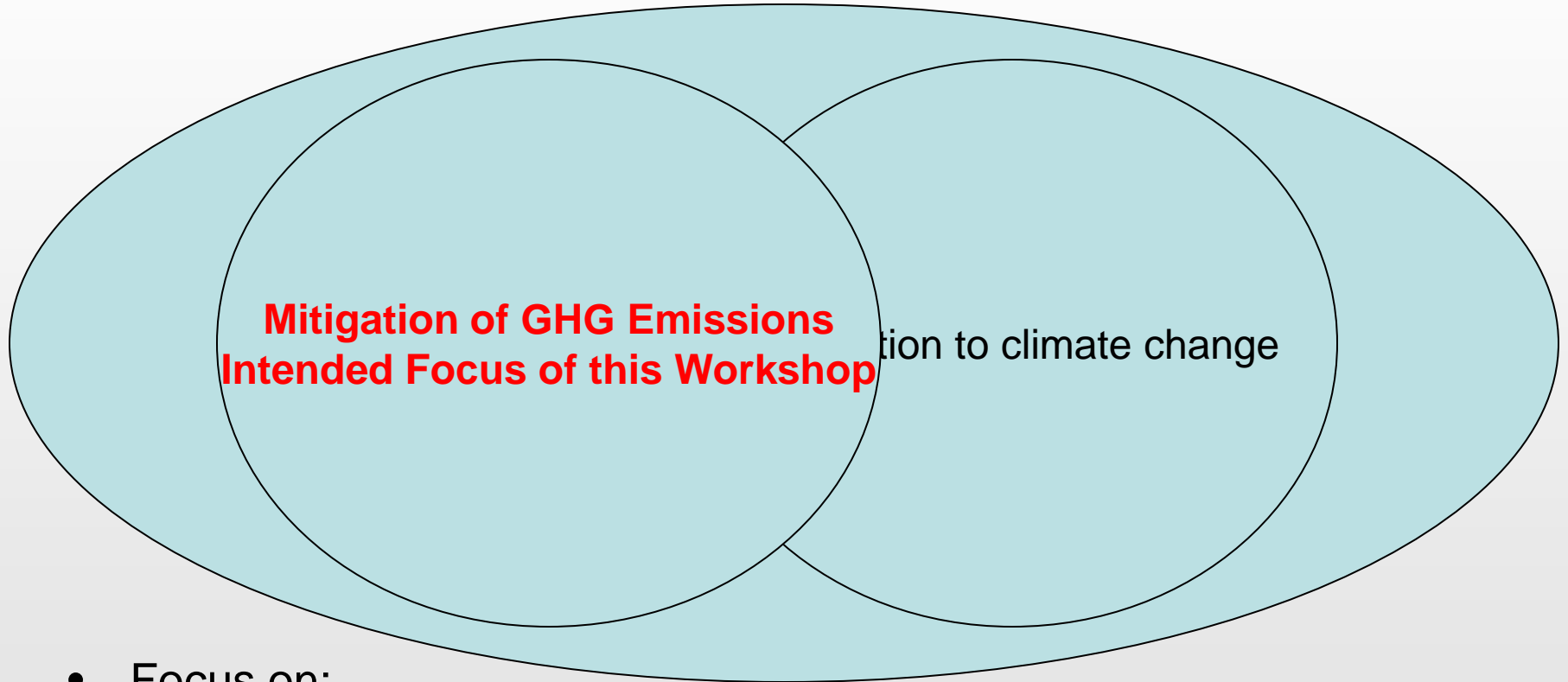
Workshop Objective

- For the most promising options in electric power and transportation*, the workshop objectives are to:
 - Identify the principal knowledge and technology gaps and implementation barriers
 - Define approaches to the resolution of these gaps and barriers
 - Define what roles Engineering Societies may take in resolving the principal gaps and barriers

*Recognizing that there are important demand management and efficiency options in all sectors

Electric Power & Transportation Options

- Options on the scale of demand for energy...with low GHG emissions



- Focus on:
 - Transportation sector
 - Electric Power

Gaps and Barriers

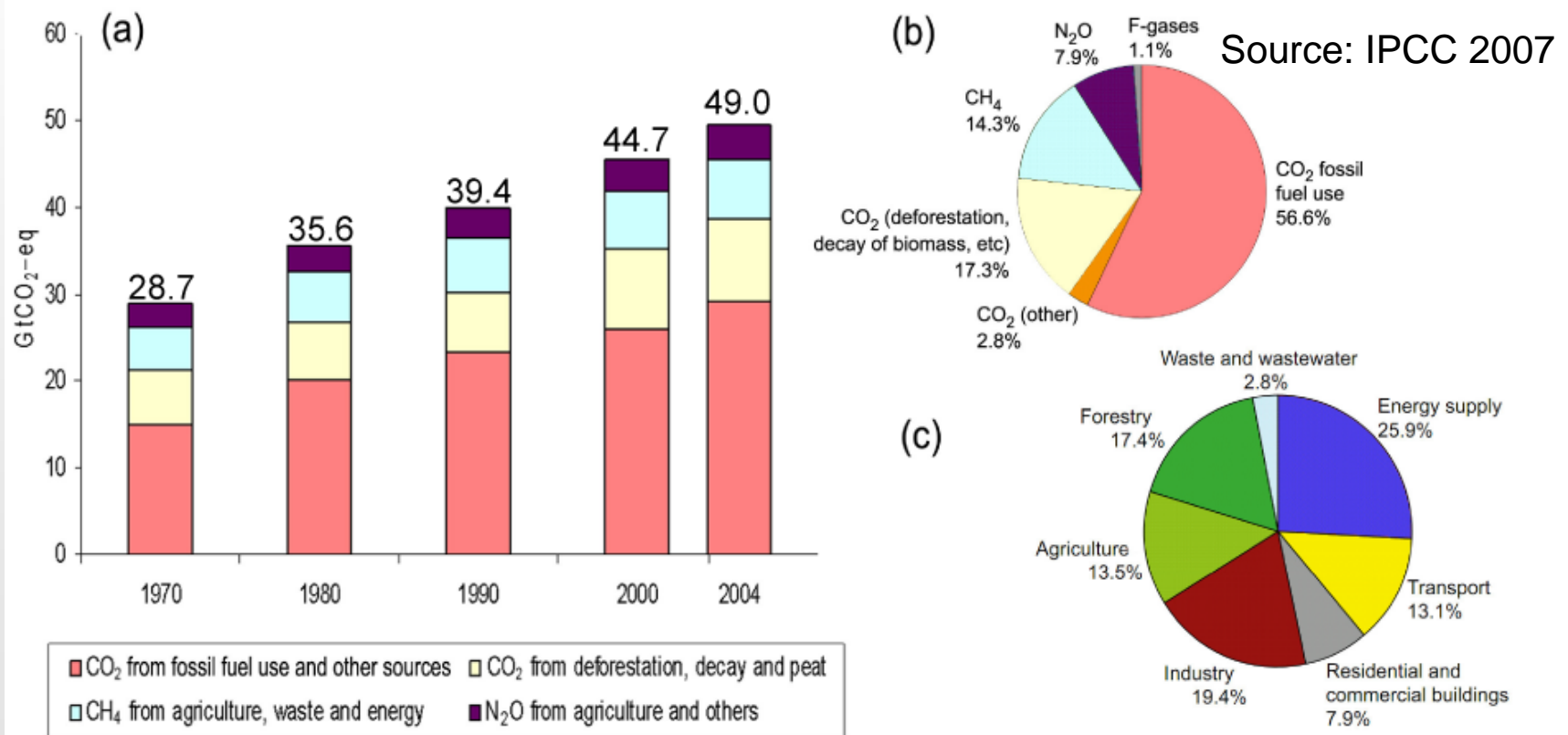
- Gaps in technologies and understanding of the systems that make up each *option*
- Barriers to each option's global deployment *at a pace and scale that may prove appropriate to manage the risks of climate change*

Addressing the risk of global climate change

Technology development to deployment, mainstay of engineering practice

Pace and Scale

- G8 stated a goal of 50% reduction in worldwide greenhouse gas emissions by 2050



Gaps & Barriers Workshop

October 21-22, 2009

- Focus on promising technology options
- Define principal gaps and barriers
 - knowledge & technology gaps and
 - implementation barriers
- Develop recommendations to address gaps and barriers
- Define role for Engineering Societies

Workshop Process

- 35 multi-disciplinary participants: engineers, economists, public policy, industry, university
- Four breakout groups with topics:
 - Gaps and barriers for the most promising electric power options
 - Gaps and barriers for the most promising transportation options
 - Barriers to implementation
 - Legal, regulatory and acceptance barriers to implementation

Gaps & Barriers Workshop

October 21/22, 2009



Workshop Participants

Organizing Task Team

Arnold Feldman, Dale Keairns, Haroon Kheshgi (chair), Veronika Rabl, Darlene Schuster, Richard Wright

Summary Posted on the Workshop Website:
<http://www.aiche.org/fscarbonmgmt>

Observations

- Achieving proposed goals would entail extraordinary changes in:
 - development and implementation of technology
 - streamlining of regulations to allow these changes, and
 - policies that would drive these changes worldwide

Observations

- Addressing the gaps and barriers requires solutions spanning technology, regulation, and policy
- Public and decision makers' expectations of the pace and scale of technology change are much higher than can realistically be achieved given the current state of technology, regulation and policy

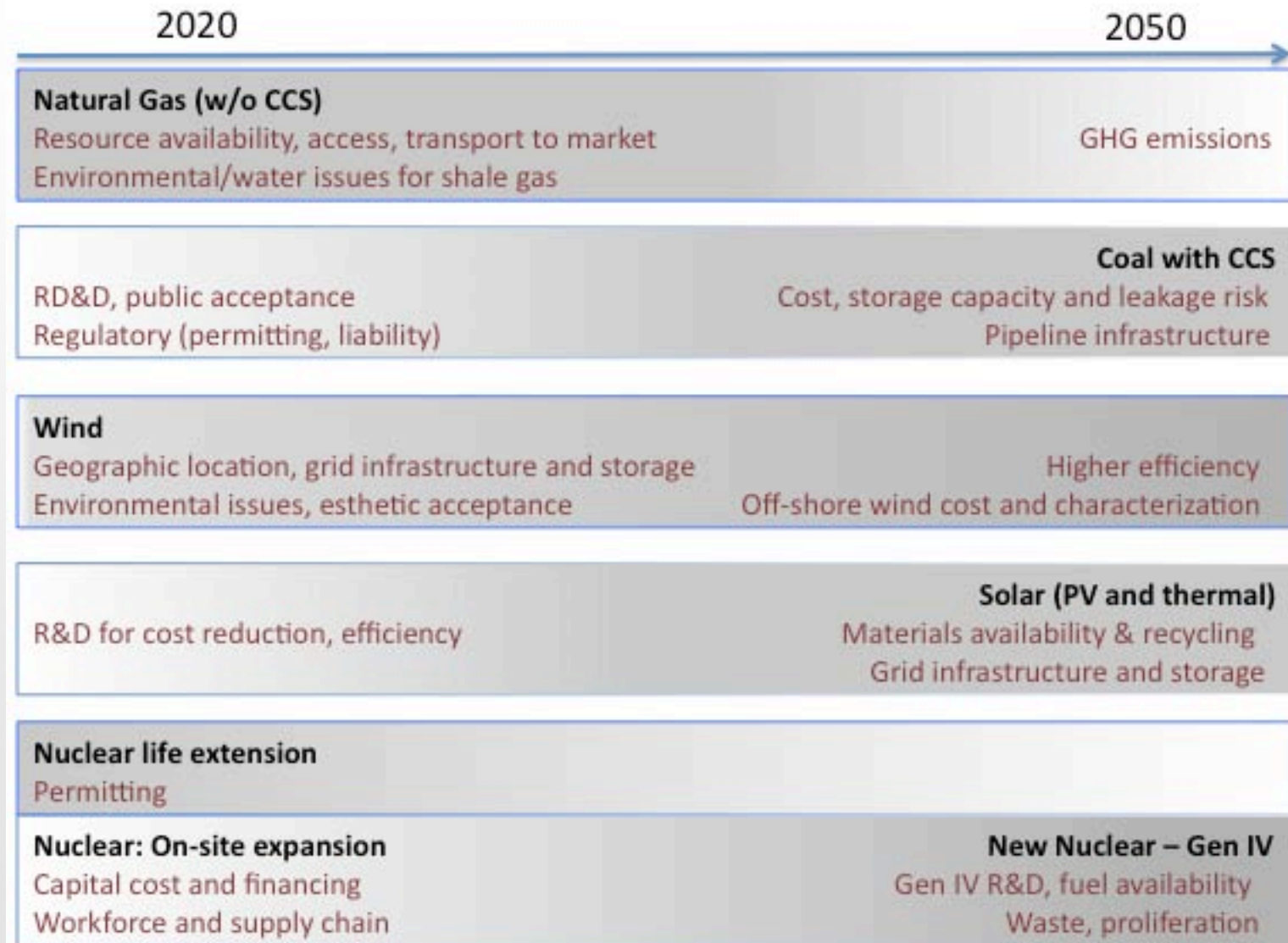
Observations

- Energy and material resource availability is critical to most potential mitigation options
- Availability of human resources is important to achieving the goals.

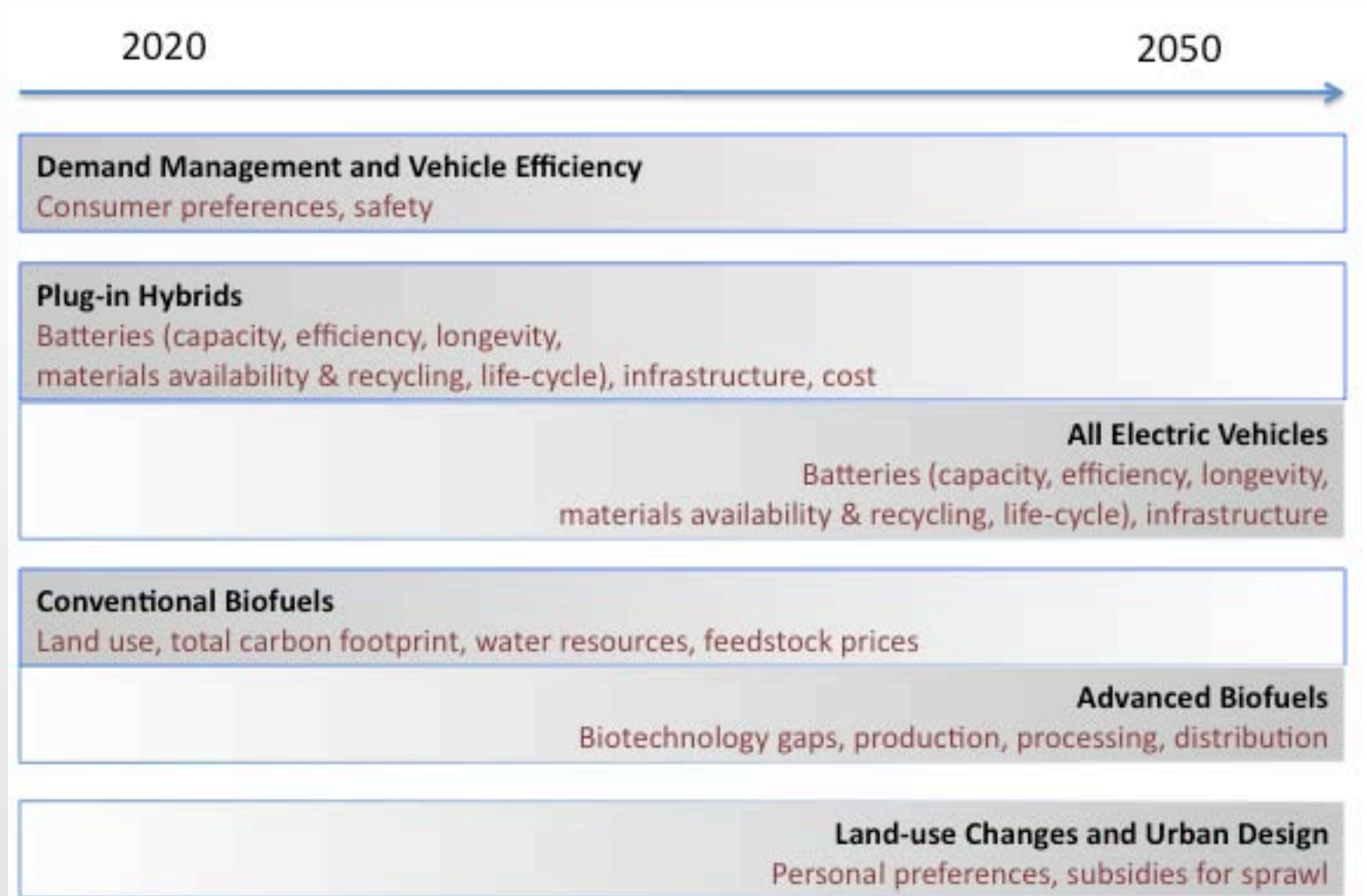
Observations

- Engineers and engineering societies offer unique and significant expertise and experience in addressing knowledge gaps and implementation barriers
 - Bring relevant engineering disciplines to bear in the development and evaluation of energy technology systems.
 - Improve Communication: both within their memberships, and externally with public interest organizations, governmental agencies, educational institutions, business, and the general public; engineering societies also have international reach

Electric Power – Promising Options



Transportation – Promising Options



Recommendations

R&D funding must be consistent, sustained, and focused

- Energy storage development in all forms (thermal, chemical, electrical, and mechanical) is a priority.
 - Improvements in battery performance and costs are essential if transportation is to be electrified on a major scale.
 - Grid-level storage is needed to effectively increase the contribution of renewable generation sources to our electric power supply.

Recommendations

R&D funding must be consistent, sustained, and focused

- Revolution in biotechnology creates new possibilities to be explored.
- A robust, smart power grid will be required to facilitate resource substitution and accommodate the large variety of new sources and uses.

Recommendations

R&D funding must be consistent, sustained, and focused

- Successful demonstration of economic capture and secure storage of carbon dioxide would open key pathways to deep reductions in carbon dioxide emission, recognizing that about 50% of U.S. electric power is from coal-based power plants.

Recommendation

Close gaps on resources: availability and bringing to market

- Clarity on resource abundance and accessibility is important for natural gas, uranium, and materials for photovoltaic devices, batteries, and other advanced energy systems.
- Assure the infrastructure for delivery and production of fuels and raw materials.

Recommendation

Close gaps on resources: availability and bringing to market

- Understand and develop environmental and economic extraction/production processes.
- Apply life-cycle analysis to manage resources sustainability.

Recommendation

Streamlined regulatory and permitting system

- With over 40,000 regulatory jurisdictions in the U.S., GHG mitigation technologies will be impacted by legislation and regulation intended to address a multiplicity of other purposes.

Recommendation

Streamlined regulatory and permitting system

- A concerted effort is needed to identify regulation and legislation that would apply to promising new technologies and simplify the process to avoid unnecessary delays.

Recommendation

- Recognize the need for an integrated systems perspective – addressing the connections between technical, economic, societal and environmental issues when evaluating energy systems, including conventional energy systems.

Next Steps...

- **Project expanding to form expert groups to assess and address specific types of identified gaps and barriers:**
 - **e.g.: groups on regulatory streamlining, batteries, power infrastructure, CCS**
 - **Development of metrics for the measure of key gaps and barriers to the principal options for carbon management**

More information? See:

<http://www.aiche.org/fscarbonmgmt>

Interested in participating? Contact:

carbonmanagement@foundersocieties.org