

# Breakout Session 5

L. L. Horton  
E104

# Question 1 Technology Barriers: Cost effectiveness, Efficiency, Sustainable, Safe, Benign... - 1 of 2

- 1. Predictability of processes, risks, side effects, pollutants at the ppm range**
  1. Optimization of a process
- 2. Energy Storage – generic to many energy technologies**
  1. Duplicate performance of tank of gasoline
  2. Ubiquitous to all renewables
- 3. Capturing CO<sub>2</sub> from existing processes....and Sequestration**
- 4. Closing nuclear fuel cycle in an sustainable manner**
  1. Includes research for breeder reactors
- 5. Transportation issues:**
  1. Different by region; sustainable aviation (post 9/11 temp changes were observed...)
  2. Development of Alternate liquid fuels
    1. Solar “Fuel”: Artificial photosynthesis, other innovations in biology....
    2. Do this at scale and volume to replace liquid fuels...while dealing with the CO<sub>2</sub> problem.
- 6. Hydrogen economy – making it economic... in the broadest terms**
  1. Production, storage, etc.

# Question 1 Technology Barriers: Cost effectiveness, Efficiency, Sustainable, Safe, Benign... - 2 of 2

## **7. Intelligent management of networks**

1. Grid issues – international?
2. Address intermittency of renewables..
3. Alternate storage media, eg hydrogen
4. Wireless transmission?
5. Perfect High Tc Superconductor wires...
6. Distributed energy? Downscale to distributed systems without losing efficiencies or economics.. Intelligent integration of different technologies into a single network

## **8. Energy Efficiency technologies**

1. Smart buildings, industries, transportation
9. Energy Technologies for developing countries
10. Deep geothermal resources
  1. Drilling technology, etc.

# Criteria for Prioritization: Technology Barriers

- Transformational impact
  - Potentially disruptive technology
- What is the potential for application?
  - Impact on moving away from carbon emissions?
  - Reduction in oil dependence?
- How big of a barrier – is it just optimization
  - How big is the opportunity?
  - What about the cost?

# Question 2 Science Opportunities: Technologies,

## Compelling opportunities – 1 of 2

### 1. Multiscale and multiscale science

1. Validated models with time, space, etc. – modelling from first-principles to systems
  1. Uncertainty and sensitivity analysis
2. Physical-chemical-biological (?) modelling
3. Predictive to allow assessment of risks, economics, etc.
4. Imaging and diagnostics.
5. Classic examples: global environmental models, combustion, etc.

### 2. Materials research

1. Nanoscale to mesoscale
2. Interfaces
3. High temperature applications; harsh environments (incl. radiation)

### 3. Separations Science

1. Membranes
2. CO<sub>2</sub>

### 4. Multiphase systems at the nanoscale

1. Water
2. Particles, aerosols
3. Composite systems...

### 5. Proton coupled electron transfer

1. Photosynthesis and beyond

### 6. Inexpensive Catalysts: Organics, more selective catalysts

# Question 2: Science Opportunities – 2 of 2

7. Advanced in-situ tools and instrumentation
  1. Chemical spectroscopy, neutrons, x-rays, etc.
  2. Improved sensors (large and small scale)
8. Computer Simulation
  1. Large systems, linked with experiment
  2. Uncertainty and sensitivity analysis
9. Environmental Science
  1. Systems modelling of energy technologies;
  2. Includes renewables: Marine tidal, waves, hydro, etc.
  3. Interface with social science
10. Harnessing living systems, genomics, to tailor biofuels, biochem, green manufacturing, etc.
  1. Understanding risks of bio-modified materials, etc. – Systems level validated modelling
11. Geosciences
  1. Sequestration, energy production (geo thermal, fossil, ...., )
12. Conversion Science
  1. Includes combustion
  2. Turbulence
13. Fusion Science

# Question 3 Science-Technology Conceptual Framework

1. Critical barrier is moving science to technologies
  1. How does it move to commercialization... Who does the research/development?
  2. Benefits at basic end are in the public domain... rewards at the other end are not.
  3. Where is the challenge great enough to overcome the concerns from both communities
2. Band-wagon issue – focus on single technology for which the funding is available;  
Consistency of long-term support
  1. Easier to fund issues than long term research
  2. Balance between top down and bottom up
3. It is difficult to achieve significant multi-country collaborations in building large scale demonstrations (every country wants to do their own).
  1. Funding of significant scale for translational (fundamental to market) research
4. Scientific collaborations, especially international:
  1. Collaboration costs real money – it is not virtual.
5. Intellectual property issues
  1. Public to private
6. How to fund/find new ideas?
7. Stove Pipes (silos)... need to be eliminated
  1. Between basic and applied research...
  2. Between disciplines...
  3. Focus on a common problem; has to be funded – put funds into budget for cross-disciplinary work
    1. Built into system, change of culture
  4. Government agencies need to talk as well.
8. Education

# Other feedback

## 1. Future workshops

1. Need to be more specific for future workshops
2. If there are future general workshops would like to identify bottom-up opportunities and develop specific proposals for policy makers
3. How are policy makers being influenced? Reports? Are there other opportunities: Workshop for policy makers? Media?

## 2. Pro's and Con's

1. General workshops may not lead to enough specific outcomes that will impact

## 3. Strategies

1. Involve more working level scientists/engineers in the next level of workshops
2. Balance between industry, academia, national/federal research institutions
3. What is next for AHGSET? (after the acronym is changed?)



# Question 1 Technology Barriers

- What are seen as the major technology barriers that, *if overcome by science*, could result in significant innovation?
- What is the highest priority subset of these barriers (no more than 6 ) seeming to hold the greatest potential and appropriate to be distinguished as “*GRAND CHALLENGES*”?
- What criteria were used by the group in distinguishing the “*GRAND CHALLENGES*”?

## Question 2 Science Opportunities

- What areas of science (<12) do you see as most promising responding to recognised energy technology barriers or offering the opportunity for ***significant science push*** across a range of important applications or as an enabler of radically new ideas.?
- What attributes of these areas are most compelling and where do you see the potential applications?
- What criteria were used by the group in distinguishing these selected areas as promising?

## Question 3 Science-Technology Conceptual Framework

- What organising framework best illustrates the linkages between science and the technologies and/or energy options they support ? Crosscutting nature of basic research.

## Other feedback

1. Strategies for future workshops
2. Pros and cons for paths forward
3. Strategies for future consultations