Carbon Capture: Beyond 2020

Charge to Panels

Michelle Buchanan
Oak Ridge National Laboratory

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Office of Science
U.S. DEPARTMENT OF ENERGY

Products Needed by End of Workshop

- Draft PRDs (Thursday; presented Friday AM) ➔ Final PRDs (Friday; presented at close-out)
- Five-column chart (Friday)
- Draft panel reports (writers only; due Saturday)
- Key graphics (Saturday)
- Sidebars (Saturday)

First Draft report: Due April 6

Final report: Due April 18

Workshop Guidelines

- **Factual document and today's plenary talks helped to define "Where are we today and where do we need to be?"**
- **Workshop discussions will define "How do we get there?"**

- **Describe fundamental research critical to breaking through today's technology bottlenecks**
- **Focus on fundamental science that will provide technology breakthroughs in 10+ year time frame**
- **Provide *inspiration* to research community to develop fundamental research concepts**

Priority Research Directions

- PRDs describe most important research directions that will provide underpinning, fundamental knowledge
  - Provide revolutionary breakthroughs, rather than incremental technology advances
- Panel discussions during first half of workshop should focus on developing PRDs
  - Define “stretch” goals
  - Provide guidance to the community for the next decade
  - Provide inspiration to community (not prescriptive)

PRD Development

- Draft PRDs will be presented at mid-session plenary on Friday morning
  - Provides opportunity to see where panels are headed
- Final PRDs will be presented at final plenary session on Friday
  - Format of PowerPoint templates is intended to help organize panel reports

Liquid Absorbents

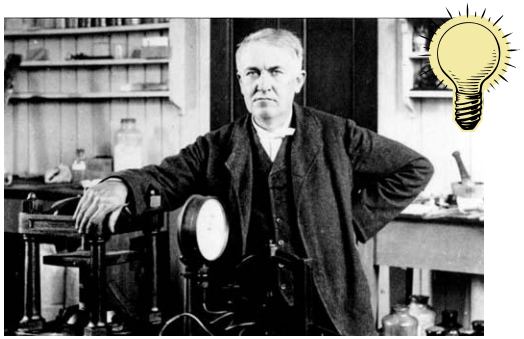
Enter name of priority research direction here

Scientific challenges

Brief overview of the underlying S&T challenge

Please use one slide for each priority research direction (PRD), and use this four-panel format.

Summary of research direction



What will you do to address the challenge?

Potential scientific impact

What new scientific discoveries will follow?

What new methods and techniques will be developed?

Potential impact on Carbon Capture

How might this impact carbon capture technologies?

What's the timescale in which that impact may be felt?

Workshop Report

- Panel reports
  - Based on panel discussions
  - Set stage for PRDs
  - Focus on:
    - “Why is it critical to do this research now?”
    - “ Why couldn’t we have done this research a decade ago?”
- PRDs
  - PRDs from all panels are rolled up together
- Cross-cut section assimilates common themes from all panels

How Nature Works ··· to ··· Materials and Processes by Design to ··· Technologies for the 21st Century

Grand Challenges *How nature works*	Discovery and Use-Inspired Basic Research *Materials properties and functionalities by design*		Applied Research	Technology Maturation & Deployment
▪ Controlling materials processes at the level of quantum behavior of electrons ▪ Atom- and energy-efficient syntheses of new forms of matter with tailored properties ▪ Emergent properties from complex correlations of atomic and electronic constituents ▪ Man-made nanoscale objects with capabilities rivaling those of living things ▪ Controlling matter very far away from equilibrium	▪ Basic research for fundamental new understanding on materials or systems that may revolutionize or transform today's energy technologies ▪ Development of new tools, techniques, and facilities, including those for the scattering sciences and for advanced modeling and computation	▪ Basic research, often with the goal of addressing showstoppers on real-world applications in the energy technologies	▪ Research with the goal of meeting ***technical milestones***, with emphasis on the development, performance, cost reduction, and durability of materials and components or on efficient processes ▪ Proof of technology concepts	▪ Scale-up research ▪ At-scale demonstration ▪ Cost reduction ▪ Prototyping ▪ Manufacturing R&D ▪ Deployment support

BESAC & BES Basic Research Needs Workshops

BESAC Grand Challenges Report

DOE Technology Office/Industry Roadmaps

Basic Energy Sciences
Goal: new knowledge / understanding
Mandate: open-ended
Focus: phenomena
Metric: knowledge generation

DOE Technology Offices:
EERE, NE, FE, EM, RW…
Goal: practical targets
Mandate: restricted to target
Focus: performance
Metric: milestone achievement

Electrical Energy Storage

Discovery Research

- Understand and predict interfacial charge transfer and multi-body effects
- Predict and control dynamics of phase transitions
- Control of chemistry and its dynamics at electrified interfaces
- Determine consequences of dimensionality
- Physicochemical consequences of nano-dimensions
- Fundamentals of solvation dynamics and ionic transport
- Revolutionary tools for *in situ* structural and dynamic studies over broad spatial/temporal regimes

Use-inspired Basic Research

- Retrosynthetic approaches to high performance new materials
- Design of new materials capable of multi-electron storage per redox center
- Understand design criteria for electrolytes that enable higher voltages
- Tailor nanoscale electrode architectures for optimal transport
- Novel chemistries for scavenging impurities and self-healing
- Generation of knowledge and computational and experimental tools to predict properties, performance evolution, and lifetime of materials

Applied Research

- Develop and apply material models and computational tools for component and system design and diagnostics
- Identify, develop, evaluate materials, electrodes, cells, and advanced electrochemical systems
- Develop and apply novel material processing technologies
- Design and develop device and system architectures
- Assemble/test devices with respect to energy storage system requirements—high power, high energy density, long lifetime, rapid recharge, deep discharge, reliability, safety, low cost

Technology Maturation & Deployment

- Demonstrate energy storage systems in advanced vehicle applications
- Support the establishment of domestic manufacturing capabilities for components and systems
- Assist development and deployment of high capacity storage systems for centralized and distributed power sources
- Develop long-life, low cost, reliable, environmentally friendly, recyclable energy storage for portable and stationary energy storage

Office of Science
BES

Technology Offices
EERE and OE

Final Thoughts

- **Report should be high level, compelling, and inspiring and focus on DOE mission needs**
- **Remember to follow prescribed format for panel reports and PRDs**
- **Additional needs**
  - **Graphics (high quality; please provide citation so appropriate permissions can be obtained)**
  - **Key illustrative examples should be provided as "sidebars"**
  - **Include high-level references**

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