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**Committee on Developing a Research Agenda for Carbon
Dioxide Removal and Reliable Sequestration**

Workshop on Bio-Energy with Carbon Capture and Storage

Beckman Center of the National Academies of Sciences, Engineering, and Medicine
100 Academy Way, Irvine, CA 92617

Workshop objective: *to determine the status and research needs to quantify the potential of bio-energy with carbon capture and storage as a carbon dioxide removal approach, including biomass production capacities that minimize GHG emissions, broader implications of various feedstock utilizations, advanced conversion technologies, capture and storage strategies, and cross-cutting issues that include life cycle impacts of large-scale deployment, policies and incentives for implementation of BECCS approaches, and social acceptability barriers.*

AGENDA

October 23, 2017

08:00 AM Breakfast

08:30 AM **Opening Remarks and Workshop Goals**
Stephen Pacala, Committee Chair
Erica Belmont, Committee Member

Session I: State of the knowledge on the capacity of BECCS as a CDR approach and technical research needs for biomass supply and conversion technologies, including capture and storage strategies.

08:45 AM **Supply**

- How to achieve biomass production capacity in a way that minimizes GHG emissions (harvesting, transportation, pretreatment)
- Assessment of the potential supply of bio-energy feedstocks
- Considerations of the co-location of supply and demand
- What are desirable feedstock properties (i.e. crops, agricultural waste)
- Broader implications of utilizing different feedstocks (forest, crop, algae, waste) in terms of land use competition, fertilizer use, water requirements, etc.
- Market considerations of bio-energy supply

Panelists:

Carolyn Smith, Canadian Forest Service

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Overview of bio-energy feedstock supply (woody biomass) and research needs, including radius of biomass supply, high-level overview of biomass from logging residues, and associated climate change mitigation potential

Wellington Muchero, Oak Ridge National Laboratory

Genetic basis of tree growth and development and potential for research to improve bioenergy feedstocks

Robert Abt, North Carolina State University

General market considerations of bio-energy demand and supply response

09:30 AM Discussion

10:15 AM Coffee break

10:30 AM **Conversion**

- Status and research needs on biomass conversion technologies, including combustion, gasification, and pyrolysis
- Prospects and benefits of advanced combustion strategies (i.e. pressurized oxy-combustion, chemical looping)
- Potential to improve carbon negativity of a combined biofuel/biochar approach
- Current status of carbon capture technologies for bio-energy applications

Panelists:

Vann Bush, Gas Technology Institute

Current status of conversion technologies (gasification, pyrolysis) and research needs for clean biomass conversion for electricity

Robert Brown, Iowa State University

Thermochemical conversion strategies and challenges, including gasification, fast pyrolysis, and solvent liquefaction of biomass

Raghubir Gupta, RTI International

Overview of carbon capture technology for bio-energy applications

11:15 AM Discussion

12:00 PM Lunch

Session II: State of the technology and challenges for commercial-scale BECCS activities, identification of research needs for policies and incentives for implementation of BECCS, life cycle impacts of large-scale deployment, and socio-economic barriers to BECCS activities.

01:00 PM **Commercial-Scale Activities**

- Capacity and challenges of bio-energy implementation and BECCS
- Prepping of biomass, pretreatment, efficiency considerations (benefits, associated emissions, costs)

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- Economics of bio-energy and potential carbon negativity, including major drivers

Panelists:

Wayne Lei, Oregon Torrefaction

Status and challenges of bio-energy implantation activities (feedstock cost, ash behavior, social/policy)

Tom Jordan, San Joaquin Valley Air District Board

Challenges of biomass for electricity generation

Steven Rose, EPRI

Biomass transition between the deployment of first bio-electricity plants and scaled-up BECCS for climate mitigation

01:45 PM Discussion

02:30 PM Coffee Break

02:45 PM **Cross-cutting Issues**

- Financial gaps between costs and profitability
- Policies to incentivize broader implementation of BECCS and biofuel/biochar approaches
- Incentives for current implementations of bioenergy and biofuels/biochar
- Potential indirect land use change impacts (especially for crops biomass)
- Large-scale deployment of BECCS impacts on biodiversity, water resources, and nutrients? Land availability effects on large-scale deployment of BECCS
- Landowner interest in participating in biomass supply
- Barriers associated with social acceptability of BECCS technologies and how can they be addressed (both for bio-energy production and geological carbon storage)

Panelists:

Chris Galik, North Carolina State University, via Webex

Public policy and governance related to BECCS, emphasis on land-use issues. Incentives for current implementations of bio-energy and needs for broader implementation

Michael Wang, Argonne National Laboratory

Energy-related life cycle analyses, life cycle impacts of bio-energy, and additional LCA research needs

Margaret Torn, Lawrence Berkeley National Laboratory, via Webex

Ecological aspects of bio-energy production: anthropogenic influence on the carbon-cycle through land use, ecosystem-climate feedbacks, soil carbon cycling

03:45 PM Discussion

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04:30 PM Adjourn Workshop

NOTE FOR PUBLIC MEETINGS: This meeting is being held to gather information to help the committee conduct its study. This committee will examine the information and material obtained during this, and other public meetings, in an effort to inform its work. Although opinions may be stated and lively discussion may ensue, no conclusions are being drawn at this time; no recommendations will be made. In fact, the committee will deliberate thoroughly before writing its draft report. Moreover, once the draft report is written, it must go through a rigorous review by experts who are anonymous to the committee, and the committee then must respond to this review with appropriate revisions that adequately satisfy the Academies' Report Review Committee and the NAS president before it is considered an official Academies report. Therefore, observers who draw conclusions about the committee's work based on today's discussions will be doing so prematurely.

Furthermore, individual committee members often engage in discussion and questioning for the specific purpose of probing an issue and sharpening an argument. The comments of any given committee member may not necessarily reflect the position he or she may actually hold on the subject under discussion, to say nothing of that person's future position as it may evolve in the course of the project. Any inference about an individual's position regarding findings or recommendations in the final report is therefore also premature.