

BP-Princeton University Carbon Mitigation Initiative (CMI) Annual Meeting Executive Summary

Major Research Results:

Steve Pacala, Princeton CMI co-director, presented results from the National Academy of Sciences Carbon Dioxide Removal Study. The study found that four negative emission technologies (NETs) are currently ready for deployment: afforestation/reforestation, forest management, uptake and storage by agricultural soils, and bio-energy with carbon capture and storage (BECCS). However, to reach ambitious warming targets (1.5° C and 2° C, 10-20 gigatons (Gt) of Carbon Dioxide (CO₂) is required to be removed annually), other negative emission technologies such as direct air capture and terrestrial carbon removal and sequestration will need to be developed.

Steve Pacala, Eric Larson, and Chris Greig outlined a new research project that plans to quantitatively and qualitatively forecast the engineering and industrial activities required to deeply decarbonize the U.S economy by mid-century. The value in this project lies in the granular details deconstructing emission scenarios and describing the necessary infrastructure to reach emission targets. Kelly Sims Gallagher, Zheng Li, and Dan Schrag discussed their research results on the China Belt and Road Initiative (BRI). BRI refers to China providing financing for massive energy projects in southeastern Asian countries. Recipient countries' energy demand is skyrocketing, and they are accepting of coal because it is the cheapest up front ('good enough' phenomenon), often benefits government officials (corruption), and provides firmly dispatchable energy. Encouraging China to provide more natural gas, wind, and solar energy financing is a huge opportunity for the climate and oil and gas community because the BRI Investment goal by 2030 is 4 trillion dollars.

Amilcare Porporato, Howard Stone, Ian Bourg, and Judy Yang shared their research results on soil carbon. Their research appeared to be in its infancy but emphasized the importance of soil as an untapped sink in the carbon cycle. They intend to use microscale modelling to better understand how roots, the elemental composition of soil, moisture, and plant life can all promote increased carbon uptake. Xinning Zhang, Elena Shevliakova, and Vaishali Naik presented their latest findings on methane. Most notable was Zhang's lab work which has reconciled why methane production (anaerobic process that occurs in the absence of oxygen) appears to be so high in peatlands that are oxygen-rich. Her research suggests that controlling water variability in swamps and marshes would lower natural methane production from these areas.

Claire White presented her research investigating alternatives to traditional Portland cement for the creation of concrete. Currently, concrete is responsible for 8% of global CO₂ emissions and 95% of all concrete used is composed of Portland cement. However, several alternatives are available that are natural, robust, and have lower emissions. Magnesium based compounds like Forsterite (Mg₂SO₄), and alkali activated materials are viable alternatives to Portland cement. Laure Resplandy and Gabriel Vecchi presented climate change impacts on severe weather and oceans. Resplandy introduced atmospheric potential oxygen as a quantity that can be used as a proxy for temperature. Using potential oxygen to understand climate change's impacts on the ocean suggests ocean uptake of energy is largely underestimated and future warming could be amplified as a result. Vecchi presented climate attribution studies showing that Hurricane Harvey flooding was likely worsened by human induced climate change. Urbanization was shown to enhance rainfall (lifting of air

due to skyscrapers) and increased asphalt hurt draining capability. He also presented research showing a projected increase in US east coast tropical cyclone impacts and post-tropical systems affecting western Europe. Finally, tropical cyclones are projected to increase their wind speeds faster which means harder forecasts, less notice, and stronger storms.

Conference Themes and Recommended Future Commercial Opportunities:

Several themes on the dual energy challenge repeatedly surfaced during the conference. Renewable energy is gaining market share but at a rate that is wildly below what is necessary to reach ambitious global warming targets. Conference presenters highlighted that the popularity of renewables will continue to accelerate but the variability of renewables requires it to be paired with a dispatchable partner and oil and gas industries should seize the opportunity. Wind energy was also discussed as a renewable energy source that BP might venture into. Scientists hypothesized that BP expertise in the engineering required to construct deep water floating structures could be applied to offshore wind turbines.

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