NATIONAL ACADEMIES *Sciences Engineering Medicine*

Macroeconomic Implications of Decarbonization Policies and Actions: A Workshop

September 12–13, 2024

Contents

Meeting Logistics

The National Academies are hosting the Roundtable on Macroeconomics and Climate-related Risks and Opportunities workshop in a hybrid format. In-person participants will convene at the National Academy of Sciences in Washington, DC. Remote participants will convene on a Zoom platform. Please review the meeting details provided below.

DATES & TIMES

- Thursday, September 12th, 2024: 10:00 am–4:15 pm ET
- Friday, September 13th, 2024: 9:30 am–3:00 pm ET

MEETING CONTACTS

- Katrina Hui (KHui@nas.edu, (509) 619-6092)
- Annie Manville (AMavnille@nas.edu, (703) 732-4236)

IN-PERSON LOCATION

- The NAS building is located at 2101 Constitution Ave. NW, Lecture Room, Washington DC 20418 (Parking and Driving Instructions are included below).

ZOOM CONNECTION

- Please see page 11 for Zoom links for each day.
- **In-person participants should bring a laptop to the meeting**, since we will be using personal cameras to push each person's video out (see hybrid meeting guidance on next page).

FOOD NOTES

- Light breakfast, lunch, and a tea/coffee service with snacks will be served in the building. Vegetarian/vegan and gluten free options will be available. If federal participants are responsible for covering the costs of their meals, please contact Annie Manville with questions.

NATIONAL ACADEMIES Sciences Engineering Medicine

BOARDS ON ATMOSPHERIC SCIENCES AND CLIMATE | ENERGY AND ENVIRONMENTAL SYSTEMS | ENVIRONMENTAL CHANGE AND SOCIETY | SCIENCE, TECHNOLOGY, AND ECONOMIC POLICY

Macroeconomic Implications for Decarbonization Policies and Strategies

A Workshop

CLICK HERE TO JOIN

Meeting ID
943 0455 0967
Passcode
396926

Phone Only
Find your local number here.

NAS Building
Lecture Room
2101 Constitution Ave. NW
Washington, DC 20418

Purpose

- Establish and understand the full scope of macroeconomic opportunities and risks to decarbonization.
- Identify barriers to decarbonization, and how macroeconomic modeling can be better incorporated into decarbonization policy.
- Consider the global interactions and implications for decarbonization.
- Highlight work from researchers, including early-career researchers, that addresses these emerging topics, and explore future research needs.

THURSDAY, SEPTEMBER 12, 2024

9:00–10:00 **Coffee and Light Breakfast Available**

10:00–10:15 **Welcome and Opening Remarks**

Sanya Carley (University of Pennsylvania) and **Jean-Francois Mercure** (University of Exeter), Workshop Co-Chairs

Provide motivation and aims for the workshop, including the workshop's cross-cutting themes:

1. **Economic Risks and Opportunities**
2. **Barriers to Decarbonization and Solutions**
3. **Incorporating Modeling Insights into Policy Design**
4. **Global Interactions**
5. **Other Cross-Cutting Themes:** Including but not limited to:
    - ***Role of Policy***
    - ***Equity and Distributional Effects***
    - ***Temporal Dimensions***

10:15–11:00 **Opening Keynote: Assessment of Current Progress**

10 min presentations + 25 min Q&A

Moderator: Jae Edmonds *(Joint Global Change Research Institute), Committee member*

Steven Davis, Thomas W. and Susan B. Ford Senior Fellow and Director of Research at the Hoover Institution, Stanford University

Nat Bullard, Climate Keynote Speaker and Co-founder of Halcyon

11:00–12:00 **Session 1: Economic Risks and Opportunities of Decarbonization**

5 min presentations + ~40 min Q&A

Risks are potential adverse outcomes that could emerge as we progress. The process of decarbonization carries inherent economic risks, while concurrently presenting opportunities for future economic growth. Potential economic risks and opportunities associated with decarbonization span areas such as finance, labor, supply chains, and the political economy. This session will explore these potential economic risks and how public policy can either exacerbate or mitigate these risks and help harness potential opportunities. Specific topics include:

Moderators: Jean-Francois Mercure *and* ***Marc Hafstead*** *(Resources for the Future), Committee co-chair and member*

Speakers:

- **Adele Morris,** Board of Governors of the Federal Reserve System
- **Cristina Peñasco,** Banque de France
- **Johannes Stroebel,** New York University
- **Heather Boushey,** Council of Economic Advisers

12:00–1:00 **LUNCH**

1:00–2:00 **Session 2: Barriers to Decarbonization and Solutions**

5 min presentations + ~40 min Q&A

Barriers are obstacles that hinder or obstruct progress. Potential barriers to achieving decarbonization goals include technical, institutional (interconnection queues, decentralized actors), social (trust, engagement, public perceptions), legal, and political (partisanship) obstacles. This session will explore their implications, potential interconnections and interactions, and possible solutions to eliminate or overcome these barriers.

Moderators: Sanya Carley *and* ***Diego Känzig*** *(Northwestern University), Committee co-chair and member*

Speakers:

- **Shelley Welton,** University of Pennsylvania Carey Law School
- **Jonas Meckling,** University of California, Berkeley
- **Costa Samaras,** Carnegie Mellon University
- **David Victor,** University of California, San Diego

2:00–2:15 **BREAK**

2:15–2:30 **Instructions for Poster Session**

2:30–3:45 **Poster Session**

Poster session on cross-cutting themes with parallel in-person poster hall and online poster presentations.

In-Person

- Participants may wander through poster hall in the Great Hall to interact with poster presenters and mingle with workshop participants.

Virtual

- Virtual participants will have the opportunity to interact with virtual poster presenters

3:45–4:15 **Report Back from Poster Session – Key Takeaways and Discussion**

END OF DAY 1

FRIDAY, SEPTEMBER 13, 2024

9:00–9:30 **Coffee and Light Breakfast Available**

9:30–9:45 **Opening Remarks**

Sanya Carley and Jean-Francois Mercure

Brief recap from Day 1 and outline of Day 2's agenda.

9:45–10:15 **Opening Keynote**

15 min presentation + 15 min Q&A

Moderator: Sanya Carley

Kate Calvin, National Aeronautics and Space Administration

10:15–11:15 **Session 3: Incorporating Modeling Insights into Policy Design**

5 min presentations + ~40 min Q&A

This session will consider current and emerging innovative methodologies for incorporating insights from various modeling disciplines (e.g., energy systems modeling, financial system modeling) into macroeconomic models used for decarbonization policy design, including:

- Emphasize focus on applications to actionable, granular policy design
- Identify opportunities to improve existing models, develop complementary approaches, and/or create new ones
- Provide insights on the effectiveness and efficiency of different policy approaches

Moderators: Marc Hafstead and Diego Känzig

Speakers:

- **Wei Peng,** Princeton University
- **John Bistline**, Electric Power Research Institute
- **David Hémous,** University of Zurich
- **Stephane Hallegate**, World Bank

11:15–12:15 **Session 4: Global Interactions**

5 min presentation + ~35 min Q&A

This session will consider the interplay among the U.S. economy and supply chains, other nation's energy transitions, and the global economy in the context of the global energy transition. It will explore how the transition is driving significant changes in exports, trade dynamics, and foreign investment patterns as countries reduce their dependence on fossil fuels, creating risks and opportunities. It will consider the economics and political economy of border adjustments.

Moderators: Jae Edmonds and Wei Peng

Speakers

- **Benjamin Sovacool,** Boston University
- **Valerie Karplus,** Carnegie Mellon University
- **Ryna Cui,** University of Maryland
- **Milan Elkerbout,** Resources for the Future
- **Jean-Francois Mercure,** University of Exeter

12:15–1:00 LUNCH

1:00–2:00 Breakout Discussion

Online and in-person participants self-select among four breakout session themes. Participants ID rapporteurs for each online group to report back in plenary.

1. Stakeholders
2. Research and Policy Synergy
3. Regional Differences and Barriers
4. Academic Engagement and Global Decarbonization

2:00–2:30 Report Back

3-minute report back key takeaways from each breakout group.

2:30–3:00 Wrap-Up: Synthesis Discussion

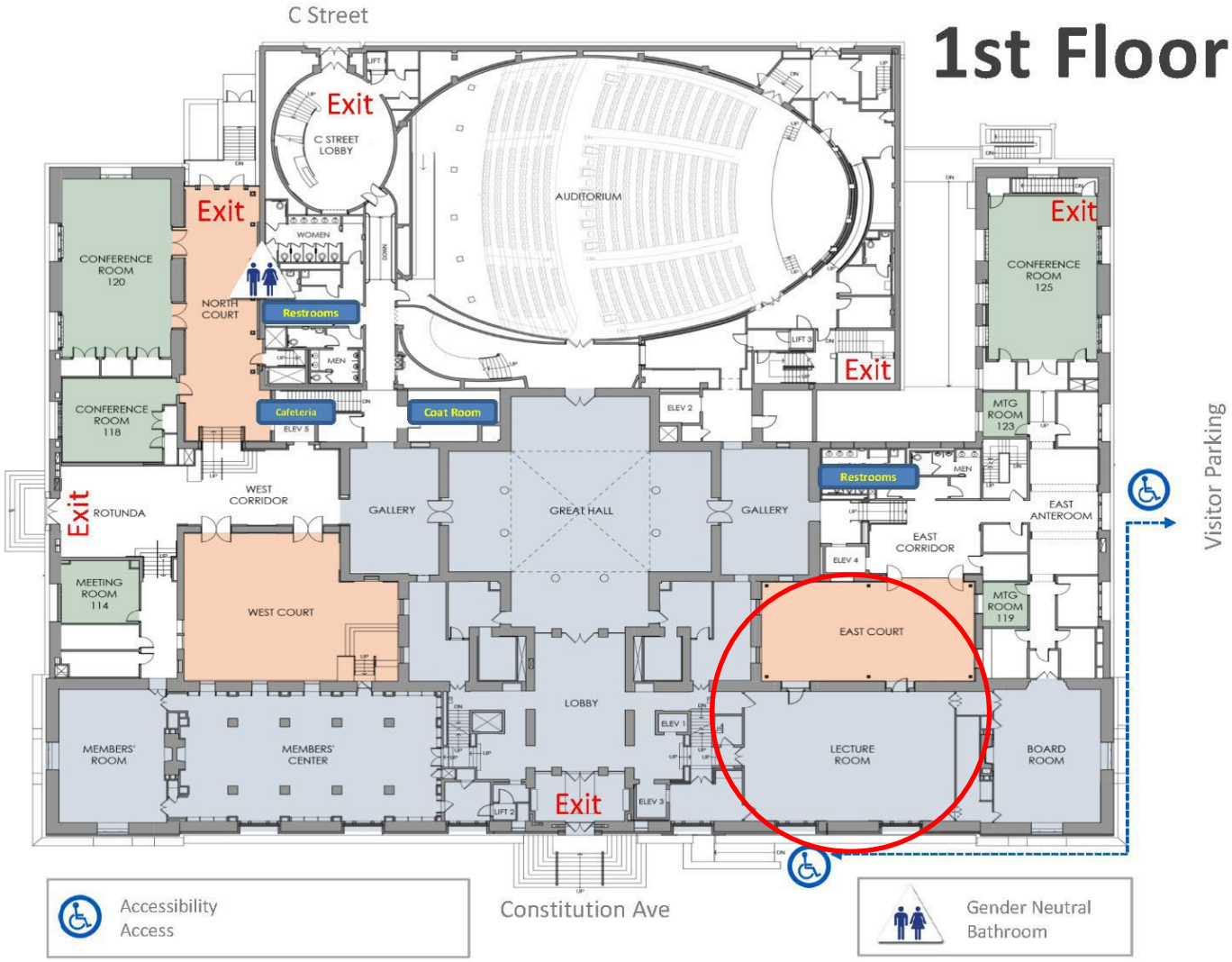
Planning committee members share recurring themes, key takeaways, and next directions that arose from workshop discussions.

Moderator: Sanya Carley and Jean-Francois Mercure

MEETING ADJOURNS

NAS Building Map, Location, Parking, and Metro

The workshop will take place in the Lecture Room, which is located on the east side of the building on the 1st floor.



LOCATION & PARKING

- The National Academy of Sciences building is located at 2101 Constitution Ave NW, Washington DC.
  - The main entrance is in the Front of the building (2101 Constitution Ave).
  - A secondary entrance is located at 2100 C Street.
  - There is a ramp at the C Street entrance and an elevator at the Constitution Avenue entrance to accommodate wheelchairs and the physically challenged.
- Limited parking is available for meeting participants in the visitors parking area of the NAS building. Parking is provided on a first-come basis, and overflow is directed to public parking garages. Parking entrance is at the intersection of 21st and C Streets NW.
- The public parking facilities closest to the NAS Building are Colonial Parking (20th Street, NW, between E and F Streets) and Columbia Plaza (23rd and Virginia Avenue, NW).

BY METRO

- Take the Orange or Blue Line to Foggy Bottom-GWU Metro stop.
- Turn right when you exit the station.
- Walk south down 23rd Street NW for approximately 7 blocks.
- Turn left onto C Street NW (after the State Department).
- Cross 22nd Street NW.
- The main entrance is the Front of the building (2101 Constitution Ave). A secondary entrance is located at 2100 C Street.

Zoom Links

Thursday, September 12, 2024 (10:00 am–4:15 pm EDT)
Friday, September 13, 2024 (9:30 am–3:00 pm EDT)

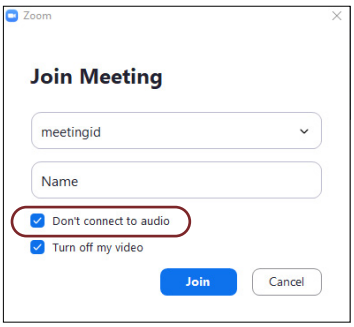
Enter Zoom Meeting
Meeting ID: 943 0455 0967
Password: 396926

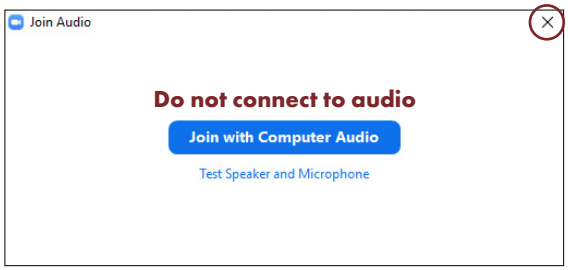
Local Numbers to Join by Phone

Thank you for participating in our event! For the best meeting experience, please follow this guide when setting up your laptop or tablet for in-room participation.

CONNECTING TO ZOOM

All participants in the room will be connected to Zoom. This will help us keep our virtual participants engaged by allowing them to see who is raising their hand and who is speaking in the room.





Before connecting to the Zoom meeting, please **mute your speakers**. When you connect to Zoom, please **do not connect to the audio**. This will cause loud feedback in the room. You will be connected to the Zoom audio automatically in the room via the table microphones.

USE OF WEBCAMS

The use of your webcam is very important for our remote participants. This allows them to better see who is speaking in the room and make it easier to engage with everyone. During today's event your webcam may be spotlighted when you speak. Remember, do not connect to the audio—even if you are prompted to.

If you do not have a device or webcam available, please let the staff know so they can make alternative arrangements.

PARTICIPATING IN THE MEETING

We will be using Zoom's raise hand feature for both remote participants and for those in the room. Please **use your raise hand feature** when giving a comment or asking a question. This will help the moderator know the order in which hands were raised.

Summary

- Connect to Zoom using the information provided by the Academies staff.
- Do NOT connect to Zoom Audio. Muting your speakers is also preferred.
- Use the raise hand feature in Zoom for comments/questions.

NATIONAL ACADEMIES Sciences Engineering Medicine

Contributing Meaningfully in a Virtual Setting

INTRODUCTION

Occasionally, some National Academies meetings will be held virtually. Virtual meeting technology allows us to continue our important work of providing independent, objective advice to inform policy, spark progress and innovation, and confront challenging issues for the benefit of society, even when in-person meetings are not possible. The skills and practices that help you successfully contribute to an in-person meeting are just as important in a virtual setting, but some additional adaptations can help improve the virtual meeting experience.

BEFORE THE MEETING

Make time before your meeting for the following essential types of preparation:

- **Intellectual Preparation:**
  - Review the agenda, the Statement of Task, and any other provided materials.
  - Develop a list of questions you have or points you want to discuss.
  - If possible, familiarize yourself with the list of meeting participants and their expertise.
- **Technology Preparation:**
  - Ensure you have a reliable high-speed internet connection.
  - Install the latest version of the virtual meeting platform installed (Zoom, Microsoft Teams, etc.).
  - Gain familiarity with the basic features of the platform. Check out our *Training on Systems and Tools* PDF for more information on the specific platform you'll be using.
  - If possible, close all other computer programs and turn off notifications to minimize distractions and interruptions.
- **Location and Logistics Preparation:**
  - Choose a private location to ensure the confidentiality of the meeting.
  - Minimize potential disruptions and background noise.
  - Clean up the space behind you or use a virtual background.
  - Dress appropriately for the formality of the meeting.
  - To make a great impression, ensure your face is clearly lit.
  - Login a few minutes early to check your audio, headphones, camera, and microphone. Arriving early helps the meeting organizers begin on time and minimizes distractions for other participants.

DURING THE MEETING

The success of the virtual meeting is up to you and the other participants. Each volunteer at the meeting was chosen because they have valuable expertise and insight to contribute. To make the most of this unique opportunity to share your expertise and learn from other volunteers, try to:

- Be deliberate and assertive in sharing your own insights and questions – no one else can do this for you.
- Take a lead in encouraging discussion. If you notice someone hasn't spoken up yet, ask their opinion.
- Avoid interrupting others – in a virtual setting, this is especially disruptive to the flow of a meeting. If you want to build on or respond to a comment, write down your ideas and share them when the other speaker has finished, or share your insights via chat.
- Remember that the chat transcript can become an important record of the meeting, and use it to share information, ideas, and responses to comments. As much as possible, post in complete sentences and clearly note which comments you are replying to, to make the transcript clearer.
- When possible, leave your camera on to create an inclusive, consistent experience for all.
- Ensure your name is displayed to others.
- Consider adding your pronouns to your name display.
- Be aware of your mute button. Muting your audio improves the audio experience for others, but make sure to unmute yourself as you speak up.
- When screen sharing, ensure you do not have distracting, unnecessary, or unprofessional tabs and programs open.
- Don't multitask. Treat this meeting as you would an in-person meeting and devote your attention fully to the discussion.
- Avoid personal grooming while on camera.
- Acknowledge and deal with any personal interruptions, such as from children or pets.

Following this guidance will enable you to make meaningful contributions to the meeting, which will lead to a more impactful final product.

Guidance for Asking Questions via Slido

How to join the conversation

Access the link directly: http://bit.ly/macro-decarb

OR

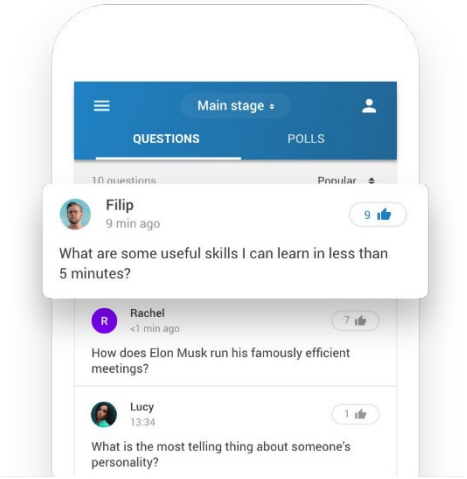
Go to slido.com and enter the event code: **#MacroDecarb**

Open browser

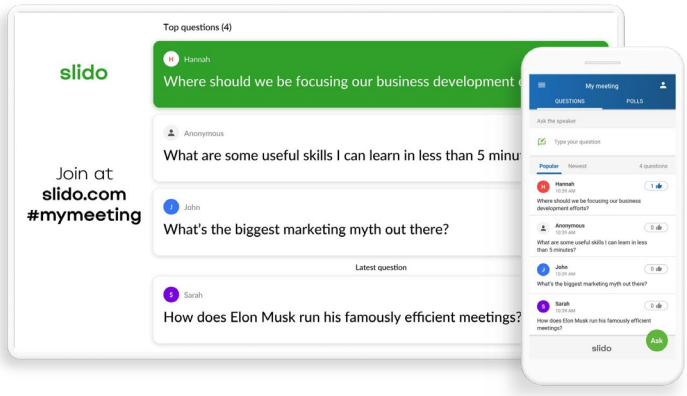
Go to slido.com

Enter event code: **MacroDecarb**

Upvote comments you like



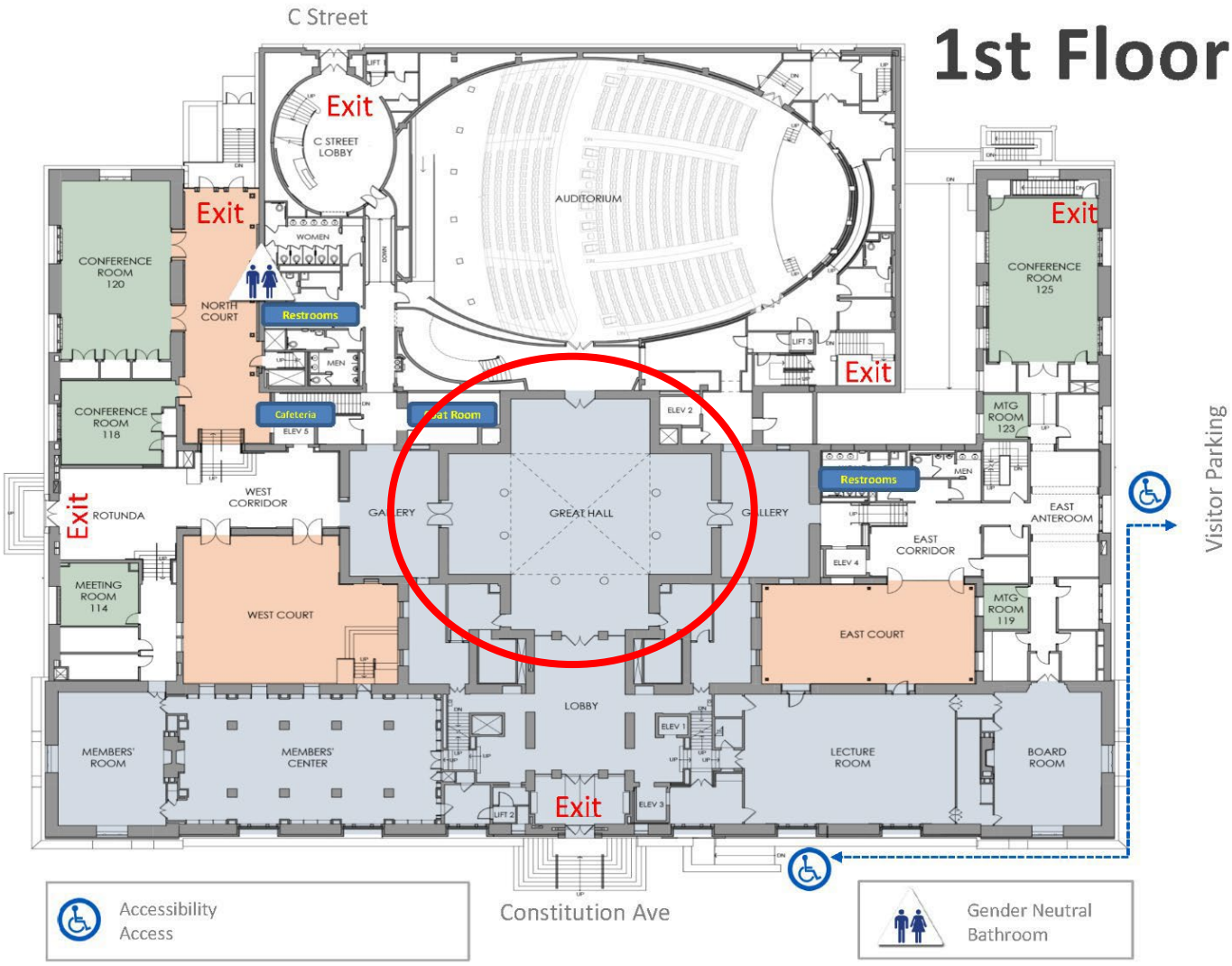
Comments, replies, and votes will appear in real-time on an interactive wall



For more information: https://community.sli.do/

September 12: In-person Poster Session Guidance

The in-person poster session will take place on **September 12, from 2:30-3:45 PM ET**, in the **Great Hall**, which is located in the middle of the 1st floor of the National Academy of Sciences building (circled below).



Agenda

2:30-3:45 PM ET	In-person participants may head to the poster hall set up in the Great Hall to visit the posters and interact with the presenters; we highly encourage participants to visit all the posters, which highlight research, especially early-career research
3:45 PM ET	All in-person participants will reconvene in the Lecture Room in plenary for a summary of key takeaways from the first day of the workshop and poster session

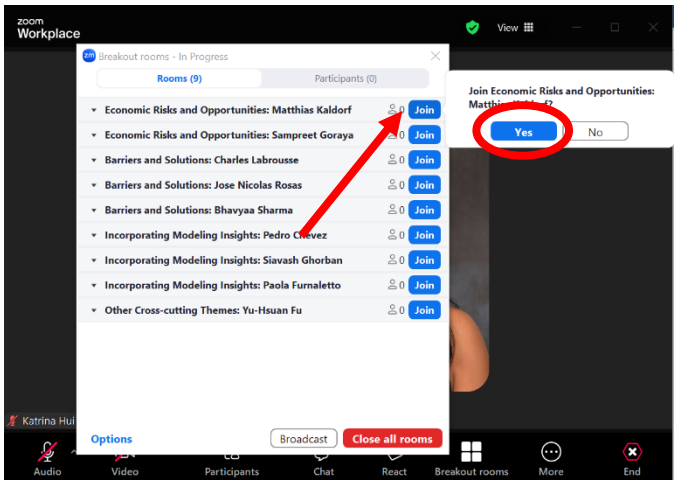
September 12: Virtual Poster Session Guidance

Agenda

2:30-3:45 PM ET When the virtual poster session begins, NASEM staff will open up Zoom breakout rooms

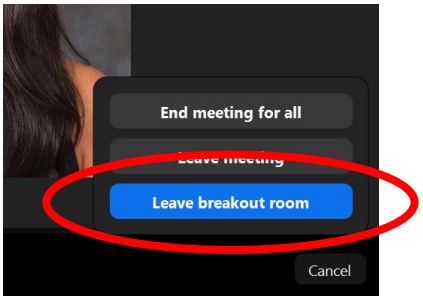
Each virtual poster presenter will have their own Zoom breakout room

1. Virtual participants may click on the poster/presenter they would like to visit to join that room



2. Once the room is selected, the participant will be sent to the room, where they can listen to the poster presentation and interact with the presenter

3. When the participant is ready to visit the next poster, they may click on “Leave Breakout Room” in the bottom right corner of the screen and they will be sent back to the main Zoom meeting room



4. In the main Zoom room, clicking the “Breakout Rooms” icon in the bottom bar will pull up the Breakout Room menu to select the next poster to visit (Step 1)

3:45 PM ET At the end of the virtual poster session, all virtual participants will be automatically send back to the main Zoom meeting to reconvene in plenary for a summary of key takeaways from the first day of the workshop and poster session

September 13: Breakout Groups and Questions

Breakout Group #1: Stakeholders

Discussion Questions:

a. Who are the primary and secondary communities affected by decarbonization policies (e.g., policymakers, industries, environmental justice communities, and local communities, etc.), and what kinds of considerations would help make different policies/mixes more desirable to the various perspectives?
b. How can we tailor research to address the specific needs and challenges of these diverse communities?
c. What strategies can be employed to effectively communicate uncertainties in decarbonization research to different stakeholders without undermining trust or policy action?

Breakout Group #2: Research and Policy Synergy:

Discussion Questions:

a. What are the most critical research gaps that need to be addressed to support decarbonization policies in the next decade?
b. How can research be more effectively translated into actionable policy recommendations for achieving climate objectives?
c. What role does interdisciplinary research play in shaping comprehensive climate policies, and how can we foster stronger collaborations between scientists and policymakers?

Breakout Group #3: Regional Differences and Barriers:

Discussion Questions:

a. What are the key differences in the decarbonization challenges faced by the Global North and Global South?
b. How can we address the unique risks and barriers faced by the Global South while ensuring equitable access to opportunities in the green economy?
c. What are the barriers for international cooperation to bridge the gap between the Global North and South in terms of technology transfer, financing, and capacity-building for decarbonization?

Breakout Group #4: Academic Engagement and Global Decarbonization:

Discussion Questions:

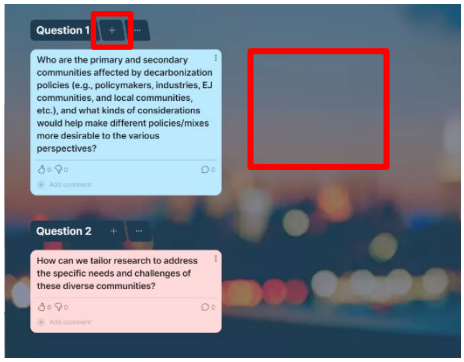
a. What are the current decarbonization research efforts in the Global South and how is US academia currently engaging with these efforts?
b. How can US academia foster more impactful partnerships with practitioners, policymakers, and industries both domestically and international?
c. What are some innovative models for academia-practitioner collaboration that can drive decarbonization research and policy implementation at scale?

Padlet Instructions

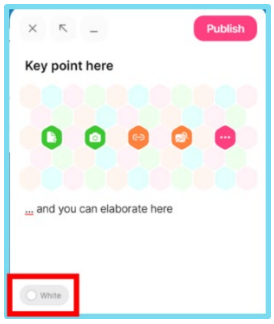
Virtual breakout group discussions will be using the Padlet platform. Below, please see the instructions for how to use this platform.

1. Navigate to the appropriate Padlet: each breakout discussion will have its own Padlet page. The Padlet is pre-populated with the discussion questions and a section for key takeaways.

2. Use the "+" button beside the question or double-click anywhere in the open space to add your ideas.



3. Type your input. Padlet also allows you to add attachments (e.g., links, images, etc.). Click "Publish" to add your post.



4. You can "thumbs up" or add comments to posts from others.

Padlet Links for the Virtual Breakout Discussions

Virtual Breakout Group 1 – Stakeholders:
- https://padlet.com/khui12/virtual-breakout-on-stakeholders-h6uetf4z1rs6m3m6

Virtual Breakout Group 2 – Research and Policy Synergy:
- https://padlet.com/khui12/virtual-breakout-on-research-and-policy-synergy-qdrv061h3vzt4sno

Virtual Breakout Group 3 – Regional Differences and Barriers:
- https://padlet.com/khui12/virtual-breakout-on-regional-differences-and-barriers-gcfu3aflatmtkyux

Virtual Breakout Group 4 – Academic Engagement and Global Decarbonization:
- https://padlet.com/khui12/virtual-breakout-on-academic-engagement-and-global-decarboni-ih77pd3cvlfusuqq

Statement of Task

The National Academies of Sciences, Engineering, and Medicine will convene an ad hoc planning committee to organize a hybrid workshop to examine the relationship between decarbonization strategies and the macroeconomy. This workshop is the third in a series of workshops organized by the Roundtable on Macroeconomics and Climate-related Risks and Opportunities. The goal of this workshop is to distill key insights from scientific and economic research efforts that may inform equitable and effective public policy within the broader macroeconomic landscape. Specifically, this workshop will explore climate change mitigation pathways and transitions to decarbonization, their macroeconomic and socioeconomic implications, and, in turn, the role of the macroeconomy in achieving decarbonization policy goals. The workshop may include discussions on:

- Potential economic barriers that may affect decarbonization—including those stemming from finance, labor, and supply chains—and the role of policy in exacerbating or ameliorating those barriers.
- Methodologies for incorporating insights from the energy transition and energy systems modeling into macroeconomic models used for policy design.
- Local and regional distributional effects in the United States of decarbonization strategies on certain geographic, underserved, and vulnerable populations.
- The interplay among the U.S. economy, other nation's energy transitions, and the global economy in the context of the global energy transition.

A proceedings of the workshop that describes the presentations and discussions will be produced by a designated rapporteur in accordance with institutional guidelines.

Speaker Bios

John Bistline is a Program Manager in EPRI's Energy Systems and Climate Analysis group. His research analyzes the economic and environmental effects of policy and technological change to inform energy systems planning and company strategy. Dr. Bistline was an author for the Intergovernmental Panel on Climate Change Sixth Assessment Report and for the Fifth U.S. National Climate Assessment. He earned a Bachelor of Science degree in Mechanical Engineering and Engineering and Public Policy from Carnegie Mellon University, a Master of Science degree in Mechanical Engineering from Stanford University, and a doctorate in Management Science and Engineering from Stanford University.

Heather Boushey is a member of President Biden's Council of Economic Advisers. Dr. Boushey is co-founder of the Washington Center for Equitable Growth, where she was President and CEO from 2013–2020. She previously served as chief economist for Secretary Clinton's 2016 transition team and as an economist for the Center for American Progress, the Joint Economic Committee of the U.S. Congress, the Center for Economic and Policy Research, and the Economic Policy Institute. Dr. Boushey received her Ph.D. in Economics from The New School for Social Research.

Nat Bullard has spent nearly two decades focused exclusively on global business and climate change, with a deep dedication to understanding how the world can reach net zero greenhouse gas emissions by mid-century. He is the founder and managing director of Business Climate Pte Ltd, a Singapore-based specialized consultancy helping global corporates and financial institutions, early-stage founders, and experienced entrepreneurs address business-critical decarbonization challenges. He is also a co-founder of Halcyon, an AI-assisted research and information platform focused on energy transition and decarbonization. Nat is a member of the advisory boards of climate and energy think tank Ember and utility enterprise data and community solar platform Arcadia. From 2022 to 2023, he was a venture partner at early-stage climate tech venture capital fund Voyager Ventures . Previously he spent 15 years with BloombergNEF, concluding as group chief content officer. He is based in Singapore.

Kate Calvin is currently serving as the Chief Scientist and Senior Climate Advisor at NASA. Since 2008, Kate has been an Earth scientist at the Pacific Northwest National Laboratory's Joint Global Change Research Institute (JGCRI) in College Park, Maryland. At JGCRI, she worked on the Global Change Analysis Model and on the Department of Energy's Energy Exascale Earth System Model. Her research simulates the interaction between global resources, focusing on the interactions between land, water, energy use, and climate through an environmental and socioeconomic lens. In the IPCC's Sixth Assessment Report Cycle, she served as a coordinating lead author on the Special Report on Climate Change and Land, a lead author on the WGIII report, and is a section facilitator for the Synthesis Report. She received her doctorate in Management, Science, and Engineering from Stanford University and a bachelor of science in Computer Science and Mathematics from the University of Maryland.

Ryna Cui is an associate research professor at the University of Maryland School of Public Policy and acting director for the Center for Global Sustainability (CGS). Cui is an expert in global coal transition, integrated assessment modeling and international and national climate and energy policies. She leads the Global Fossil Transition Project at CGS that focuses on rapid, just coal phaseout pathways both globally and in key countries of interest, including China, India, Indonesia, South Africa and others. As the China program co-director, Cui manages the development and implementation of CGS's China program portfolio. Cui also holds a joint appointment at the Joint Global Change Research Institute, a collaboration between the Pacific Northwest National Laboratory and the University of Maryland. She holds a PhD in Environmental Policy from the University of Maryland, a master's degree in public policy from the College of William and Mary and a bachelor's degree in management science and engineering from Renmin University in Beijing.

Steven Davis is a highly-cited researcher and expert in earth system science, emissions and energy scenarios, climate impacts and solutions, and corporate climate strategy. He is currently Professor of Earth System Science in the Stanford Doerr School of Sustainability and the Chair of the Science Advisory Board at Watershed. At Stanford, Steve leads the Sustainable Solutions Lab, a research group dedicated to quantifying how different human activities are affecting climate and air quality, how those environmental changes in turn jeopardize human wellbeing, and the relative priority of solutions. He and his group have published seminal papers assessing carbon emissions and air pollution impacts embodied in international trade, committed emissions related to existing energy infrastructure, the economic and biophysical limits of

various carbon removal approaches, interactions among food-energy-water systems, drivers of agriculture and land-use change emissions, and the key challenges and opportunities for net-zero emissions energy systems.

Milan Elkerbout is a fellow at RFF working on international climate policy and on European climate policies to decarbonize energy-intensive industries in particular. He has worked extensively on the European Union's emissions trading system (EU ETS), its various reforms, and its role in decarbonizing industry. He has led policy research on green steel, carbon capture and carbon removals, carbon leakage, climate clubs, as well as the EU's response to the COVID-19 pandemic, energy crisis, and US Inflation Reduction Act. He has also written on industrial and innovation policy, the trade-climate policy nexus, and supranational governance, and has worked with policymakers, industry, civil society, and academia. He has a background in European political economy. Between 2014 and 2023, he was working for CEPS, a policy think tank in Brussels, as a research fellow and head of its climate program. From spring 2019, he spent a year as a visiting fellow at IVL Stockholm as part of the Mistra Carbon Exit research program.

Stephane Hallegate is the Senior Climate Change Advisor of the World Bank Climate Change Group. Dr. Hallegatte is the author of dozens of articles published in international journals in multiple disciplines and of several books and World Bank reports including *Shock Waves: Managing the Impacts of Climate Change on Poverty*. He also led the development of the Resilience Rating System, a tool of monitor and report on how resilience is included in public or private investments. More recently, he has supervised the new World Bank diagnostic, the Country Climate and Development Reports, and has co-led the CCDRs for Turkey and Brazil. Mr. Hallegatte holds an engineering degree from the Ecole Polytechnique (Paris) and a Ph.D in economics from the Ecole des Hautes Etudes en Sciences Sociales (Paris).

David Hémous is the UBS Foundation Associate Professor of Economics of Innovation and Entrepreneurship at the University of Zurich. He is a macroeconomist working on economic growth, environmental economics and international trade. His research explores the effect of technology on income inequality and the role played by innovation in the design of climate policy. His work has been published in the *American Economic Review*, the *Journal of Political Economy*, the *Review of Economic Studies*, or the *American Economic Journal: Macroeconomics* among others. He is the recipient of an ERC starting grant on Automation and was awarded the European Award for Researchers in Environmental Economics under the Age of Forty in 2022.

Valerie J. Karplus is a Professor in the Department of Engineering and Public Policy at Carnegie Mellon University and the Associate Director of the Wilton E. Scott Institute for Energy Innovation. Karplus studies resource and environmental management in organizations operating in diverse national and industry contexts, with a focus on the role of institutions and management practices in explaining performance. Areas of expertise include decarbonization of global corporate and industrial supply chains, regional approaches to low carbon transition, and the integrated design and evaluation of energy, air quality, and climate policies. At CMU, she directs the Laboratory for Energy and Organizations and serves as principal investigator for the NSF-funded Industrial Decarbonization Analysis, Benchmarking, and Action (INDABA) Partnership, involving five universities in four countries and multi-sector, multi-stakeholder partners. From 2011 to 2016, she co-founded and directed the MIT-Tsinghua China Energy and Climate Project, a five-year research effort focused on analyzing the design of energy and climate change policy in China, and its domestic and global impacts. Karplus holds a BS in biochemistry and political science from Yale University and a Ph.D. in engineering systems from MIT.

Jonas Meckling is an Associate Professor of Energy and Environmental Policy at the University of California, Berkeley, and Climate Fellow at Harvard Business School. At Berkeley, he leads the Energy and Environment Policy Lab and the Climate Program of the Berkeley Economy and Society Initiative. Dr. Meckling studies the politics of climate policy and the energy transition, with a focus on green industrial strategy. He received multiple awards for his research, including the American Political Science Association's Emerging Young Scholar Award in the field of science, technology, and environmental politics. Previously, he was a visiting professor at Yale University, served as Senior Advisor to the German Minister for the Environment and Renewable Energy, was a Research Fellow at the Harvard Kennedy School, and worked at the European Commission. He holds a Ph.D. from the London School of Economics.

Jean-Francois Mercure is an Associate Professor in Climate Policy at the Global Systems Institute, University of Exeter, United Kingdom, following a secondment as Senior Climate Economist at the World Bank. His research focuses on macroeconomics and innovation economics, developing models and methods for public policy appraisal for assessing the effectiveness and macro- and socio-economic impacts of diverse types of low-carbon, energy and climate policies. At the

World Bank, he headed $8M of projects aiming to build capacity in ministries of finance and the World Bank around economic analytics to inform low-carbon transition policy. Prior to that, he headed a £5M international research consortium commissioned by the UK government, called 'Economics of Energy Innovation and System Transition', working with stakeholders in India, China, Brazil, the United Kingdom, and European Union. He helped raise awareness of and provide analytics for assessing transition risks, including an early assessment of the macroeconomic impacts of stranded fossil fuel assets. He authored the book 'Complexity Economics for Environmental Governance' at Cambridge University Press. Mercure received an M.S. in physics at the Université de Montréal, Canada and Ph.D. in physics and complexity science from the University of St. Andrews, Scotland before transitioning to a career in economics.

Adele Morris is a Senior Adviser in the Division of Financial Stability at the Board of Governors of the United States Federal Reserve System. She works with the Federal Reserve's Financial Stability Climate Committee, which is charged with incorporating climate considerations into the Federal Reserve's financial stability framework. Before joining the Federal Reserve in October 2021, Dr. Morris was the Joseph A. Pechman senior fellow in Economic Studies and policy director for the Climate and Energy Economics Project at the Brookings Institution. Her academic research relates to climate change, energy, and tax policy, and she is a leading global expert on the design and analysis of carbon pricing policies. She joined Brookings in July 2008 from the Joint Economic Committee of the U.S. Congress, where she advised members and staff on economic, energy, and environmental policy. Prior to that, Dr. Morris was the lead natural resource economist for the U.S. Treasury Department for nine years. On assignment to the U.S. Department of State in 2000, she led negotiations on land use and forestry issues in the international climate change treaty process. Prior to Treasury, she served as the senior economist for environmental affairs at the President's Council of Economic Advisers during the development of the Kyoto Protocol. Morris began her career at the Office of Management and Budget, where she oversaw rulemaking by agriculture and natural resource agencies. Dr. Morris holds a Ph.D. in Economics from Princeton University, an M.S. in Mathematics from the University of Utah, and a B.A. from Rice University.

Cristina Peñasco is a Senior Research Economist at the Centre for Climate Change of the Banque de France and an Associate Professor in Public Policy at the Department of Politics and International Studies at the University of Cambridge (currently on leave). Her research lines bring together multidisciplinary research in environmental economics, innovation policy and energy economics in green and energy efficiency technologies, with a focus on the evaluation of policy instruments enabling the transition to decarbonised economies. Lately she has become interested in the modelling of transition risks with a focus on technological risks. With a PhD in Economics, she has more than 10 years of experience working at the intersection between research and policy making.

Wei Peng is an Assistant Professor of Public and International Affairs and the Andlinger Center for Energy and the Environment at Princeton University. Her research uses computational models to quantify difficult tradeoffs of climate policy across social, political, and environmental aspects. Peng currently leads two main projects: a) Political Economy in Integrated Assessment Modeling (PE-IAM), and ii) Health Effects of Deep Decarbonization (HEALED). Prior to joining Princeton, she was an Assistant Professor of International Affairs and Civil and Environmental Engineering at the Pennsylvania State University. Her research has been published in Nature, Nature Climate Change, Nature Sustainability, PNAS among others, and has been featured in national and local media such as PBS and NPR. She also served as a co-author of the Fifth National Climate Assessment. Peng received a B.S. in environmental sciences from Peking University, China, a Ph.D. in science, technology, and environmental policy from Princeton University, and was a Giorgio Ruffolo Post-Doctoral Fellow and Research Associate at the Harvard Kennedy School.

Costa Samaras is the Director of Carnegie Mellon University's Scott Institute for Energy Innovation. He previously served in the White House Office of Science and Technology Policy (OSTP) as the Principal Assistant Director for Energy and OSTP Chief Advisor for the Clean Energy Transition, working with the OSTP Director, Deputy Director for Industrial Innovation, and senior governmental leaders in coordinating Federal activities on U.S. energy policy, assessing energy technologies for meeting U.S. climate, resilience, equity, and security objectives, and aligning U.S. energy innovation systems to achieve the climate commitments of the U.S. He is a Professor in Carnegie Mellon's Department of Civil and Environmental Engineering, Affiliated Faculty in the Department of Engineering and Public Policy, and by courtesy, a faculty member CMU's Heinz College of Information Systems and Public Policy. His research focuses on assessing the policy and technical pathways to clean, climate resilient, equitable, and secure energy and infrastructure systems. He founded & directs both the Center for Engineering and Resilience for Climate Adaptation and the CMU Power Sector Carbon Index.

Benjamin K. Sovacool is Professor of Earth and Environment at Boston University in the United States, where he is the Founding Director of the Institute for Global Sustainability. Professor Sovacool works as a researcher and consultant on issues pertaining to energy policy, energy justice, energy security, climate change mitigation, and climate change adaptation. More specifically, his research focuses on renewable energy and energy efficiency, the politics of large-scale energy infrastructure, the ethics, and morality of energy decisions, designing public policy to improve energy security and access to electricity, and building adaptive capacity to the consequences of climate change. He has played a leadership role in winning collaborative research grants and endowments worth more than $48 million in directly managed funds on proposals and projects worth more than $259 million. With much coverage of his work in the international news media, he is one of the most highly cited global researchers on issues bearing on controversies in energy policy and climate change. His research has been ranked in the world's top 1% of social scientists according to citations of his publications in 2019, 2020, 2019, 2022, and 2023.

Johannes Stroebel is the David S. Loeb Professor of Finance at the New York University Stern School of Business. He conducts research in climate finance, household finance, social network analysis, macroeconomics, and real estate economics. He is the director of NYU Stern's Climate Finance Initiative. Among other roles, he was a member of the Climate-Related Market Risk Subcommittee at the Commodities and Futures Trading Commission (CFTC), as well as a member of a Working Group on Extreme Weather and Financial Risks at the President's Council of Advisors on Science and Technology (PCAST). He is the Chair of the Academic Advisory Council of the Center on Regulation and Markets at the Brookings Institution. He was awarded the 2023 Fischer Black Prize by the American Finance Association, given every two years to the top financial economist under the age of 40. In 2012, he earned a Ph.D. in Economics at Stanford University, where he held the Bradley and Kohlhagen Fellowships at the Stanford Institute for Economic Policy Research. Before joining NYU in 2013, Professor Stroebel was the Neubauer Family Assistant Professor of Economics at the University of Chicago Booth School of Business.

David Victor is a professor of innovation and public policy at the School of Global Policy and Strategy at UC San Diego. He co-directs the campus-wide Deep Decarbonization Initiative, an effort to understand how quickly the world can eliminate emissions of warming gases. He is adjunct professor in Climate, Atmospheric Science & Physical Oceanography at the Scripps Institution of Oceanography and a professor (by courtesy) in Mechanical and Aerospace Engineering. Prior to joining the faculty at UC San Diego, Victor was a professor at Stanford Law School where he taught energy and environmental law. He has been heavily involved in many different climate- and energy-policy initiatives, including as convening lead author for the Intergovernmental Panel on Climate Change (IPCC), a United Nations-sanctioned international body with 195 country members that won the Nobel Peace Prize in 2007. His Ph.D. is from the Massachusetts Institute of Technology and A.B. from Harvard University.

Shelley Welton is the Presidential Distinguished Professor of Law and Energy Policy at the University of Pennsylvania Carey Law School where she holds an affiliation with the Kleinman Center for Energy Policy. Welton previously was an Associate Professor at the University of South Carolina School of Law. Welton's scholarship focuses on how climate change is transforming energy and environmental governance within the United States and transnationally. Current research projects include exploring a just energy transition for the U.S. south; understanding what lessons the failed nuclear renaissance offers for climate infrastructure development; and investigating grid reliability governance under climate change. Prior to academia, Welton worked as the deputy director of Columbia Law School's Sabin Center for Climate Change Law. She received her Ph.D. in law from Yale Law, her J.D. from NYU School of Law, a M.P.A. in environmental science and policy from Columbia University's School of International and Public Affairs, and her B.A. from the University of North Carolina at Chapel Hill.

Moderator Bios

Rachel Cleetus is the policy director with the Climate and Energy program at the Union of Concerned Scientists. She leads the program's efforts in designing and advocating for effective and equitable policies to address climate change. Dr. Cleetus has over twenty years of experience working on policies to promote clean energy, drive deep cuts in heat-trapping emissions, and promote climate resilience. She also researches the risks and costs of climate impacts on people and the economy. She has co-authored numerous reports and articles including *Compound climate risks in the COVID-19 pandemic*; *Killer Heat in the United States: Climate choices and the future of Dangerously Hot Days*; *Underwater: Rising Seas, Chronic Floods, and the Implications for US Coastal Real Estate*; *Surviving and Thriving in the Face of Rising Seas*; and *A Transformative Climate Action Framework: Putting People at the Center of Our Nation's Clean Energy Transition*. She is also an expert on the United Nations Framework Convention on Climate Change (UNFCCC) process and has been attending international climate negotiations since 2009. Dr. Cleetus has testified several times before Congress, including before the House Select Committee on the Climate Crisis, the Senate Committee on Banking, Housing and Urban Affairs and the House Committee on Financial Services. She has also been quoted widely in the media. Dr. Cleetus holds a Ph.D. and an M.A. in economics from Duke University and a B.S. in economics from West Virginia University.

Sathya Gopalakrishnan is an Associate Professor in the Department of Agricultural, Environmental and Development Economics (AEDE) in the College of Food, Agricultural, and Environmental Sciences (CFAES) at The Ohio State University (OSU). She is also on the faculty of the Environmental Science Graduate Program (ESGP) and a founding member and former Director of the STEAM Factory—a diverse and inclusive grassroots faculty network at OSU committed to interdisciplinary research, community engagement, and education. Dr. Gopalakrishnan's research is motivated by an interest in applying economic theory to understand ubiquitous interdependencies between human decisions and geophysical processes in complex resource systems. She specifically focuses on developing coupled models of complex human and natural systems, applied to coastal and water resources; non-market valuation of environmental amenities and risks; and resource management problems in which environmental and economic systems are linked by spatial-dynamic processes. She serves as an associate editor for the American Journal of Agricultural Economics, Chair of the Committee for Women in Agricultural Economics, and is a member of the board of directors of the Association of Environmental and Resource Economists (AERE). Dr. Gopalakrishnan received her Ph.D. in Environmental Economics and Policy from Duke University in 2010.

Sarah Kapnick is chief scientist for the National Oceanic and Atmospheric Administration (NOAA). In this role, Dr. Kapnick is responsible for advancing policy and program direction for NOAA's science and technology priorities. She has extensive experience at the intersection of climate science and economics. Prior to NOAA, she served as a managing director at J.P. Morgan in the role of Senior Climate Scientist and Sustainability Strategist for Asset and Wealth Management. While at J.P. Morgan, she supported sustainability and climate action efforts and served as an advisor on new business and investment opportunities and risks. Previously, Dr. Kapnick was a physical scientist and deputy division leader on seasonal to decadal variability and predictability at NOAA's Geophysical Fluid Dynamics Laboratory (GFDL). At GFDL, her work spanned seasonal climate prediction, mountain snowpack, extreme storms, water security and climate impacts. Dr. Kapnick is a member of the American Geophysical Union, American Meteorological Society and American Association for the Advancement of Science. She received a Ph.D. in Atmospheric and Oceanic Sciences with a Certificate in Leaders in Sustainability from UCLA, and an A.B in Mathematics with a Certificate in Finance from Princeton University.

Lori Hunter is the Director of the Institute of Behavioral Science at the University of Colorado Boulder where she also Professor of Sociology. Dr. Hunter's research and teaching focus on links between environmental context and human population dynamics. Specific settings include rural South Africa and Mexico, where her scholarship connects rural livelihoods strategies, including migration, to local shifts in rainfall, temperature, and natural resource availability. She has been an invited speaker on the topic of migration and climate change at a variety of settings including the United Nations, National Academies of Sciences, Engineering, and Medicine (NASEM), the Rio+20 Earth Summit, Future Earth, and the French Demographic Research Institute. Dr. Hunter received her Ph.D. from Brown University in 1997. She is a member of NASEM's Board on Environmental Change and Society and the Board's liaison to the NAS Committee on Managed Retreat on the Gulf Coast.

Eric Kemp-Benedict is a Senior Economist and Director of the Equitable Transitions program at the Stockholm Environment Institute's (SEI's) US Center. He was SEI's Asia Center Director from 2013 to 2016 and has served in various SEI global leadership roles. Dr. Kemp-Benedict's research focuses on the macroeconomics of a sustainability transition, addressing questions around long-run growth, decoupling, structural change, and economic development. He contributes to interdisciplinary studies on diverse topics of relevance to sustainability at national, regional, and global levels. Among his other contributions, he is a key contributor to the Shared Socioeconomic Pathways (SSPs), part of the global climate scenario framework that underpins a wide range of climate studies. Dr. Kemp-Benedict received his Ph.D. in physics from Boston University.

Adele Morris is a Senior Adviser in the Division of Financial Stability at the Board of Governors of the United States Federal Reserve System. She works with the Federal Reserve's Financial Stability Climate Committee, which is charged with incorporating climate considerations into the Federal Reserve's financial stability framework. Before joining the Federal Reserve in October 2021, Dr. Morris was the Joseph A. Pechman senior fellow in Economic Studies and policy director for the Climate and Energy Economics Project at the Brookings Institution. Her academic research relates to climate change, energy, and tax policy, and she is a leading global expert on the design and analysis of carbon pricing policies. She joined Brookings in July 2008 from the Joint Economic Committee of the U.S. Congress, where she advised members and staff on economic, energy, and environmental policy. Prior to that, Dr. Morris was the lead natural resource economist for the U.S. Treasury Department for nine years. On assignment to the U.S. Department of State in 2000, she led negotiations on land use and forestry issues in the international climate change treaty process. Prior to Treasury, she served as the senior economist for environmental affairs at the President's Council of Economic Advisers during the development of the Kyoto Protocol. Morris began her career at the Office of Management and Budget, where she oversaw rulemaking by agriculture and natural resource agencies. Dr. Morris holds a Ph.D. in Economics from Princeton University, an M.S. in Mathematics from the University of Utah, and a B.A. from Rice University.

Jun Ukita Shepard is a Physical Scientist in the Office of Technology Policy at the U.S. Department of Energy (DOE). In her role, she coordinates energy systems modeling for the Office of Policy, which advises the Secretary of Energy on domestic energy and climate policy. Jun received her PhD in Earth and Ocean Sciences from Duke University, MPhil in Environmental Policy from the University of Cambridge, and A.B. in Environmental Science and Public Policy from Harvard University.

Committee Bios

Sanya Carley *(Co-Chair)* is the Presidential Distinguished Professor of Energy Policy and City Planning at the Stuart Weitzman School of Design, and faculty co-director of the Kleinman Center for Energy Policy at the University of Pennsylvania. She holds a secondary appointment at the Wharton School and is a University Fellow at Resources for the Future and co-directs the Energy Justice Lab. Carley's research focuses on energy justice and just transitions, energy insecurity, electricity and transportation markets, and public perceptions of energy infrastructure and technologies. She is an author of the Fifth National Climate Assessment report. Carley received a B.A. in economics and sustainable development from Swarthmore College, an M.S. in urban and regional planning from the University of Wisconsin-Madison, and a Ph.D. in public policy from the University of North Carolina at Chapel Hill. She She currently serves on the National Academies Innovation Policy Forum and the Roundtable on Macroeconomics and Climate-related Risks and Opportunities.

Jean-Francois Mercure *(Co-Chair)* is an Associate Professor in Climate Policy at the Global Systems Institute, University of Exeter, United Kingdom, following a secondment as Senior Climate Economist at the World Bank. His research focuses on macroeconomics and innovation economics, developing models and methods for public policy appraisal for assessing the effectiveness and macro- and socio-economic impacts of diverse types of low-carbon, energy and climate policies. At the World Bank, he headed $8M of projects aiming to build capacity in ministries of finance and the World Bank around economic analytics to inform low-carbon transition policy. Prior to that, he headed a £5M international research consortium commissioned by the UK government, called 'Economics of Energy Innovation and System Transition', working with stakeholders in India, China, Brazil, the United Kingdom, and European Union. He helped raise awareness of and provide analytics for assessing transition risks, including an early assessment of the macroeconomic impacts of stranded fossil fuel assets. He authored the book 'Complexity Economics for Environmental Governance' at Cambridge University Press. Mercure received an M.S. in physics at the Université de Montréal, Canada and Ph.D. in physics and complexity science from the University of St. Andrews, Scotland before transitioning to a career in economics.

James (Jae) Edmonds is a researcher at the Joint Global Change Research Institute, a collaboration between the Pacific Northwest National Laboratory, where he is Chief Scientist and Battelle Fellow, and the University of Maryland, College Park, where he is College Park Professor of Public Policy. He is one of the pioneers in the field of the integrated analysis of human and physical Earth systems. He began development of the Global Change Analysis Model, GCAM, in 1978. GCAM enables simultaneous analysis of global and regional energy, technology, economy, land, water, atmosphere, and climate systems on time scales ranging from decades to century. He has served as lead author on every major Intergovernmental Panel on Climate Change assessment. Edmonds received a Ph.D. in economics from Duke University.

Marc Hafstead is a Fellow at Resources for the Future (RFF) and the Director of RFF's Carbon Pricing Initiative. His research has primarily focused on the evaluation and design of federal and state-level climate and energy policies using sophisticated multi-sector models of the U.S. economy. He co-authored "Confronting the Climate Challenge: U.S. Policy Options" to evaluate the environmental and economic impacts of various federal climate policy proposals. Hafstead's research has also analyzed the distributional and employment impacts of carbon pricing. He co-authored the paper "Impacts of a Carbon Tax across US Household Income Groups: What are the Equity-Efficiency Trade-Offs?" which won the Journal of Public Economics 2021 Atkinson Award for best paper published in the journal between 2018 and 2020. Hafstead received a B.A. in mathematical methods in the social sciences from Northwestern University, a Ph.D. in economics from Stanford University, and completed a postdoctoral fellowship at the Stanford Institute of Economic and Policy Research.

Paulina Jaramillo is a Professor of Engineering and Public Policy at Carnegie Mellon University and the co-Director of the Open Energy Outlook Initiative. Her past research focused on life cycle assessment of energy systems with an emphasis on climate change impacts and mitigation research. She is currently involved in multi-disciplinary research projects to better understand the social, economic, and environmental implications of a low-carbon transition in the U.S. energy system. Jaramillo's research and education efforts also include issues related to energy access and development

in the Global South. Jaramillo was a coordinating lead author for the Transportation chapter of the Working Group III report that was part of the IPCC's 6th Climate Assessment Report. She was a 2020 Andrew Carnegie Fellow of the Carnegie Corporation of New York. Jaramillo received a B.S. in civil and environmental engineering from Florida International University and an M.S. and Ph.D. in civil and environmental engineering from Carnegie Mellon University. Jaramillo serves on the National Academies Roundtable on Macroeconomics and Climate-related Risks and Opportunities and previously served on the planning committee for the Workshop on the Dynamics of Climate and the Macroeconomy.

Diego Känzig is an Assistant Professor in the Department of Economics at Northwestern University, a Faculty Research Fellow at the National Bureau of Economic Research and a Research Affiliate at the Centre for Economic Policy Research. His research interests are in macroeconomics and macro-finance with a focus on climate change and inequality. In his work, he studies the role of energy and climate change for financial and macroeconomic fluctuations and how economic inequality and household finance matter for the macroeconomy and macroeconomic policy. His research has been published in leading peer-reviewed journals including the American Economic Review and the Journal of Monetary Economics. Känzig received an M.Sc. in economics from the Universities of Bern and Basel anda Ph.D. in economics from London Business School.

Wei Peng is an Assistant Professor of Public and International Affairs and the Andlinger Center for Energy and the Environment at Princeton University. Her research uses computational models to quantify difficult tradeoffs of climate policy across social, political, and environmental aspects. Peng currently leads two main projects: a) Political Economy in Integrated Assessment Modeling (PE-IAM), and ii) Health Effects of Deep Decarbonization (HEALED). Prior to joining Princeton, she was an Assistant Professor of International Affairs and Civil and Environmental Engineering at the Pennsylvania State University. Her research has been published in Nature, Nature Climate Change, Nature Sustainability, PNAS among others, and has been featured in national and local media such as PBS and NPR. She also served as a co-author of the Fifth National Climate Assessment. Peng received a B.S. in environmental sciences from Peking University, China, a Ph.D. in science, technology, and environmental policy from Princeton University, and was a Giorgio Ruffolo Post-Doctoral Fellow and Research Associate at the Harvard Kennedy School.

Poster Presenter Bios

Octavio M. Aguilar is a Senior Research Assistant at the Federal Reserve Board of Governors in the Macroeconomics and Quantitative Studies Section of the Division of Research and Statistics. At the Board, Octavio has contributed to research on U.S. energy consumption patterns, the labor market effects of online learning, the macroeconomic effects of remote work, and relationship between U.S. federal debt and long-term interest rates. His current early-stage research examines the relationship between automation and jobless recoveries. Building on this work, Octavio plans to pursue a PhD in Economics. Before joining the Board, he studied at the University of Georgia, where he worked on projects addressing food insecurity and housing hardship during the COVID-19 pandemic.

Hiba Baroud is an associate professor and the associate chair in the Department of Civil and Environmental Engineering at Vanderbilt University. She is the interim director of the Vanderbilt Center for Sustainability, Energy, and Climate. She holds secondary appointments in Computer Science and Earth and Environmental Science. Her research is interdisciplinary at the intersection of data analytics and risk analysis. Her group develops and applies methods founded in statistical learning, network models, and decision analysis to evaluate infrastructure performance and interdependent economic impacts during disasters. Her recent work investigates climate finance methods to inform climate adaptation and decarbonization strategies for infrastructure systems. Hiba is the recipient of the 2019 Global Voices Fellowship, the 2020 National Science Foundation Early CAREER award, and the 2022 National Academy of Sciences Arab-American Frontiers Fellowship. She is a member of the Global Young Academy and a fellow of the International Science Council.

Tabitha Benney is an Associate Professor in the Department of Political Science, Affiliated Faculty in Environmental Studies, and Associate Director for Equity and Inclusion at the Utah Energy and Power Innovation Center (U-EPIC) at the University of Utah. Dr. Benney is also a Research Fellow for the Earth Research Governance Network and Tribal Liaison for the U.S.-Canada Center on Climate-Resilient Western Interconnected Grid (WIRED). She received her BSFS (2001) and MA in International Affairs (2007) from Georgetown University and her PhD in Political Science from the University of California, Santa Barbara (2013). Dr. Benney's current research is focused on the social, economic, and health disparities caused by energy, climate, and air quality, which she undertakes with three sovereign Native American Tribes of the American West. She also studies low carbon energy transitions, disparities produced by environmental justice, and the impact of capitalism on environmental governance.

Pedro Chévez holds a PhD in Science in the Area of Renewable Energies and a Specialization in Renewable Energies, both from the National University of Salta (UNSa). He is also an architect, having graduated from the National University of La Plata (UNLP). He currently works as a Researcher at the National Council for Scientific and Technical Research (CONICET) of Argentina, based at the Institute for Research and Policy of the Built Environment (IIPAC CONICET-UNLP). He has also developed research stays at the University of Bologna in Italy and at the National Energy Secretariat in Argentina. His research focuses on the development of methodologies for the elaboration of multi-scale energy diagnoses, the construction of energy supply and demand scenarios and energy models in general. Additionally, he is an assistant professor in the Faculties of Architecture and Urbanism and Engineering at the UNLP, where he teaches courses related to installations and buildings.

Vladimir Dvorkin is an Assistant Professor in the Electrical Engineering and Computer Science Department at the University of Michigan — Ann Arbor. Before moving to Michigan, he was a postdoctoral fellow at the Massachusetts Institute of Technology (Energy Initiative and LIDS) from 2021–2023. He earned his Ph.D. in electrical engineering from the Technical University of Denmark (DTU Elektro) in 2021 and visited Georgia Tech's School of Industrial and Systems Engineering during his Ph.D. studies. Vladimir's research focuses on the energy transition towards a renewable-dominant and low-carbon energy supply, viewed through the lenses of optimization and machine learning, energy economics, and algorithmic data privacy. His work has received numerous recognitions, including the Marie Skłodowska-Curie Actions & Iberdrola Group postdoctoral fellowship and the IEEE Transactions on Power Systems Best Paper Award.

Luis Fernandez Intriago is an economist at the Environmental Defense Fund (EDF) and the editor of EDF's Economics Discussion Paper series. Previously, he was a Post-doctoral Fellow, Labor Economist at EDF and a Postdoctoral Fellow at Resources for the Future (RFF). Luis holds a Ph.D. in Economics from Arizona State University (ASU) and has worked as a Policy Advisor at the Mexican Ministry of Finance. Combining macroeconomics, environmental economics, and quantitative economy-wide modeling, Luis's research focuses on understanding the effects of implementing carbon pricing and other environmental policies on the labor market and the economy; he strives to ensure a just labor transition. He is also interested in investigating ways to generate equitable international climate cooperation. Further, Luis's recent work explores the impacts of the EU's Carbon Border Adjustment Mechanism (CBAM) in India.

Yu-Hsuan Fu is currently a research assistant at Academia Sinica in Taiwan. Her research interests are green and sustainable economy. She specializes in climate change economics with focus on carbon pricing, climate club, transition to 2050 net-zero and post-2050 net negative economy. She earned her master's degree in economics in 2019 and is now interested in pursuing a PhD position. Over the past eight years, she has been deeply involved in numerous research projects focused on evaluating climate policies and has excelled in applying a global energy-environment-economy macroeconometric model (E3ME model) developed by Cambridge Econometrics. She has demonstrated significant promise in her field, having published two articles on climate club that propose a club fund system (Shaw & Fu, 2020; Shaw, Fu, & Chen, 2023), and she is also a contributing author to an essential book "Roads to Net-zero: A Win-win Strategy for Taiwan".

Paola Furlanetto is a PhD candidate in Industrial Engineering and Operations Research at UMass Amherst and recipient of the 2024 Commitment to Diversity Award. She is passionate about power systems and how their evolution can transition society into a more efficient and environmentally responsible era. Her research interests are market structures and public policy dedicated to improving the Power Grid through Renewables, Energy Storage, Carbon Capture, and other disruptive technologies. Originally from Brazil, her experience involves working as an energy storage research engineer in her home country, an internship at a Massachusetts-based high altitude wind energy start-up (Altaeros Energies), and undergraduate enrolment on projects and organizations related to renewable generation, both in Brazil and the USA. Her academic background includes M.S. in Energy Systems (Northeastern University, Boston) and a bachelor's degree in Electrical Engineering with a minor in Power Systems (Federal University of Campina Grande, Brazil).

Siavash Ghorbany is a 2nd Year Ph.D. student in Civil and Environmental Engineering at the University of Notre Dame. He is a graduate research assistant in Dr. Ming Hu's lab, Built Environment Decarbonization Lab (BEDL). His research uses data-driven methods, machine learning, and AI to optimize the construction industry, creating smart, sustainable, and equitable built environments and reduce health burdens. Siavash began his education at the National Organization for Development of Exceptional Talents (NODET) in Iran, then earned a bachelor's degree in Architectural Engineering from Zanjan University, and a master's in Project and Construction Management from the University of Tehran. He is an expert in data science and has in-depth knowledge of software development and programming. With over seven years of construction industry work experience, he seeks to make the connection between academia and industry by creating research-supported tools for non-researchers. His work bridges complex technologies and practical applications for public health, poverty reduction, and climate improvement.

Matthias Kaldorf is an Economist at the Bundesbank Research Centre. He obtained an Economics PhD from the University of Cologne in 2022. His research interests lie at the intersection of financial economics and macroeconomics, while also touching the fields of environmental economics and international finance.

Audrey Kindlon is a Program Manager for the Microbusiness Innovation Science and Technology Survey at the National Science Foundation. She also leads a project focused on innovation with a goal to improve current innovation metrics and develop internationally comparable statistics on innovation. Previously, she was a managing consults at IBM Global Business Services, a principal consultant at PricewaterhouseCoopers, and a social science analyst at the Smithsonian Institute. She hold a MA in Political Science from the University of Connecticut, and a BA in Political Science from Siena College.

Idowu Kunlere is a doctoral student in Energy and Environmental Policy at the University of Delaware. He is dedicated to advancing a just energy transition through low-carbon solutions. He is interested in innovative circular economy, sustainable finance, and carbon market strategies to help companies decarbonize smoothly, justly, and profitably. Kunlere holds an MS (Energy and Environmental Policy) from the University of Delaware and an MPA from the National University

of Singapore. He also holds an MSc (Environmental Microbiology) and a BSc (Microbiology) from the University of Ibadan and Obafemi Awolowo University in Nigeria, respectively, and a postgraduate diploma (Environmental Management) from the Technical University Dresden, Germany. Before his PhD studies, Kunlere served at Nigeria's apex environmental regulatory agency, where he helped companies reduce emissions, protect biodiversity, and comply with regulations. Kunlere's doctoral research explores innovative carbon market solutions, policies, and strategies to optimize seamless, sustainable, and equitable large-scale industrial decarbonization.

Charles Labrousse is an Insee administrator and PhD candidate at the Paris School of Economics. He works under the supervision of Professor Katheline Schubert. His research focuses on macroeconomics and heterogeneity, with a focus on climate change, fiscal policy and monetary policy. Labrousse's research, co-authored with Yann Perdereau, focuses on the political acceptability of carbon taxes, examining their impacts across different socio-economic and geographic groups. Their paper, *"Geography versus Income: The Heterogeneous Effects of Carbon Taxation,"* is a significant contribution to environmental economics, analyzing the distributional effects of carbon taxes and exploring revenue recycling strategies through targeted transfers. This work is directly relevant to policymaking and has actively engaged with policymakers, including participation in policy meetings with the French General Secretary for Ecological Planning and the writing of policy briefs for institutions like Insee and PSE. Charles' recent appointment as an economist in the French administration underscores his commitment to translating research into actionable policies.

Huilin Luo is a third-year Ph.D. candidate in Environmental Engineering at Penn State University and a visiting student at the Princeton School of Public and International Affairs, advised by Dr. Wei Peng. Her research centers on integrating political realism into decarbonization strategies through advanced integrated assessment modeling. Specifically, she examines how different policy instruments and their implementation sequences—whether domestically focused on industrial policy or internationally oriented through trade policies—can influence the energy system or future decarbonization policy stringency in the United States. By bridging the gap between modeling and political realism, Huilin aims to contribute to more effective decarbonization efforts. She holds a background in Environmental Engineering and psychology, and before joining Penn State, she collaborated with policymakers at various levels, including subnational, national, and international arenas.

Yagmur Menzilcioglu a Ph.D. candidate in economics, and her research interests lie at the intersection of macroeconomics, climate change, environmental and energy economics, public finance, and industrial organization. As a researcher with an extensive background in econometric analysis and macroeconomic modeling, she uses her varied skill set to understand the distributional effects of climate change policy. In her dissertation, she studies the distributional consequences of carbon tax and low-carbon technology subsidies across heterogeneous firms and consumers. She has utilized various macroeconomic and environmental data from the United States to provide motivational evidence for her research.

Jose Nicolas Rosas José Nicolás Rosas is an Economics Job Market candidate at Universitat Pompeu Fabra (UPF), where he is pursuing a PhD under the supervision of Professors Jordi Galí and Davide Debortoli. His research is primarily focused on empirical macroeconomics, with particular emphasis on time series econometrics, monetary policy, and the economic impacts of climate change. In his Job Market paper, he studies the dynamic causal effects of monetary policy on U.S. carbon emissions, revealing additional channels of monetary policy transmission and uncovering relevant sectoral variations that influence aggregate outcomes. In additional work, he investigates the propagation of natural disasters through input-output linkages in India's manufacturing sector, addressing key issues in disaster management and adaptation strategies. Before his PhD, José Nicolás worked at the International Monetary Fund (IMF) and the Inter-American Development Bank (IDB) in Washington, D.C., and as a graduate research assistant at Universidad de los Andes in Bogotá, Colombia.

Moses Ogutu is an Associate Program Officer with both the U.S. National Academies of Sciences, Engineering, and Medicine (NASEM), and the InterAcademy Partnership (IAP), the global network of 150 academies of sciences, engineering, and medicine. He was co-director of the study on *Decarbonisation of Transport in Africa: Opportunities, Challenges, and Policy Options.*[1] He joined NASEM as a Christine Mirzayan Science and Technology Policy Fellow in 2023. He was previously an international business and trade faculty at the African Leadership University, Rwanda. He has over ten years experience working on international trade and development policy, social innovation and entrepreneurship,

[1] https://www.interacademies.org/sites/default/files/2024-06/Decarb-Report_May-22_compressed.pdf

and leadership development in Africa. Moses has an MA in International Relations with a specialization in EU – Africa trade relations, and a Master of Philosophy in Inclusive Innovation Research and Practice, both from the University of Cape Town. He is a Mandela Rhodes Scholar (2017), a Dalai Lama Fellow (2019), and a Bertha Scholar (2020). He is currently studying for a PhD in Political Science at the Maxwell School of Citizenship and Public Affairs, Syracuse University, where his research explores African *agency* in international relations in areas, including climate change and sustainability, trade, science and technology, and migration.

Gregor Semieniuk is a senior climate change economist at the World Bank, on leave from the University of Massachusetts Amherst. Dr. Semieniuk's research focuses on the political economy of rapid, policy-induced structural change that is required for the transition to a low-carbon economy, considering questions of both financing low-carbon investments and divesting from high-carbon ones, and analyzing the characteristics of stable, equitable growth with climate policy. At the World Bank, he contributes to integrating climate mitigation and adaptation aspects into the Bank's macroeconomic analysis.

Amir Sharafi began his new role as a researcher at UNLV under Dr. Fortier's guidance. This position will transition to a postdoctoral role upon the submission of his PhD certificate. Amir holds a bachelor's degree in mechanical engineering from Iran and a master's degree in mechanical engineering from Sweden. He collaborated on developing a high-density piezoelectric energy harvesting system from highway traffic, published papers, and holds a patent for it. He then pursued his studies at UC Merced, where he received his PhD in environmental systems, with his defense in May 2024. Amir has expertise in life cycle assessment (LCA) of electricity generation systems and managing uncertainties in emerging technologies. He developed machine learning methods to incorporate site-specific data on energy infrastructure and geospatial LCA to minimize life cycle greenhouse gas emissions. His recent research focuses on integrating techno-economic analysis with LCA to improve the assessment of energy systems.

Bhavyaa Sharma is a Ph.D. candidate in Economics at the University of California, Santa Cruz. Her primary fields are Macroeconomics and Financial Economics, with a focus on climate risks. She is particularly interested in investigating how firms, households, and financial institutions make decisions regarding climate risk mitigation and adaptation in the context of (i) lack of information about climate change and (ii) behavioral biases such as under-reaction in response to available information. She is also interested in leveraging increasingly available microdata across developed and emerging economies to inform macroeconomic models of labor market outcomes and firm expectations. Her research has benefited from visits to the Board of Governors of the Federal Reserve, the New York Federal Reserve, and the San Francisco Federal Reserve. Before starting her Ph.D., she worked as a Research Fellow at the National Institute of Public Finance and Policy, an autonomous research institute under the Ministry of Finance in India.

Sampreet Singh Goraya is an Assistant Professor of Economics at the Stockholm School of Economics and EUDN associate. His research focuses on macroeconomics, with a particular emphasis on economic development. Sampreet's work seeks to understand the constraints to firm growth and resource allocation in both developing countries and advanced economies, including Europe and the United States.

Poster Abstracts

Theme 1: Economic Risks and Opportunities of Decarbonization

IMAGINED: Intermodal Analytics for Green Infrastructure Network Energy Decarbonization (In-person)
Hiba Baroud[1]*, Hani Mahmassani*[2]*, Craig Philip*[1]*, Paul Johnson*[1]*, Pablo Durango-Cohen*[2]
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The multimodal freight transportation and logistics system in the U.S. serves as a critical supply chain that links the nation's economy. Among the different modes, trucking dominates freight transportation and contributes the largest share of emissions. To achieve a greener freight transportation system, efforts must focus on improving multimodal freight transportation by streamlining the interaction between freight modes at transloading terminals to enable a larger share of more environmentally friendly modes such as rail and waterways. This work presents an overview of a framework aimed at developing a platform to inform the transition from existing fossil fuels to alternative/renewable energy sources. The platform consists of interrelated modules to support evaluation, selection, and roll out of infrastructure investments across the nation's multimodal freight network encompassing roadways, railways, and waterways, including the facilities and vehicles that connect them and ensure their safe and efficient operations. The research combines network analysis, optimization methods, economic modeling, and risk analysis to evaluate the benefit of making such investments by quantifying the anticipated reduction in emissions and increase in resilience. The anticipated outcome of the research will allow stakeholders to analyze the return on investing in the decarbonization of the freight system and its impact on enhancing the network connectivity and resilience to future climate disasters. Preliminary work focused on developing financial models to evaluate the return on investing in climate resilient infrastructure as well as an optimization model to streamline and decarbonize intermodal facilities that act as transfer points between different freight modes.

Climate Minsky Moments and Endogenous Financial Crises (Virtual)
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Disclaimer: The views expressed in this paper are those of the authors and do not necessarily represent those of the Deutsche Bundesbank or the Eurosystem.
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Does the transition to net zero decrease financial stability and, if so, by how much? Since carbon taxes reduce the return on capital and the valuation of assets, ambitious climate policy might render the leverage of the financial system unsustainable. Should the financial system be unable to de-leverage fast enough, depositors might question the solvency of the financial system, which can trigger a system run on the financial system. In this paper, we develop a quantitative macroeconomic model with carbon taxes and endogenous financial crises to study such "Climate Minsky Moments". The model is calibrated to match salient features of financial crises and climate policy. We solve the model using global methods to study the non-linear transition dynamics along a shift towards ambitious climate policy. We show that a shift towards ambitious climate policy substantially elevates the financial crisis probability in the short run. The effect is particularly strong if the carbon tax path is steep or front-loaded. However, the economy experiences financial stability gains in the medium run since permanently lower asset returns prevent the buildup of excessive financial sector leverage. We define the "Excess Crisis Probability" as the average crisis probability induced by a given carbon tax path minus the crisis probability on a business-as-usual path without ambitious climate policy action. Using this measure of financial stability along different transition paths, we find that there is no pronounced trade-off between maintaining financial stability and achieving climate policy objectives – if future financial stability gains are not discounted too much.

Beyond Offsetting: Leveraging the Voluntary Carbon Market as a Catalyst for Sustainable Development in Africa (In-person)

Idowu Kunlere[1] *and Kalim Shah*[1]
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The voluntary carbon offset market (VCM) has traditionally been utilized for emissions reduction. While this and mitigating climate change remain paramount, this paper argues that the VCM has a dual nature and can be harnessed to drive sustainable development. Specifically, this paper explores how the VCM can be leveraged to catalyze improved clean energy access, environmental protection, and economic diversification in Africa. First, using a combination of theoretical analysis and case reviews, this paper describes how the VCM's challenges are linked to its defective market design and inherent limitations when used as a standalone decarbonization tool. These challenges include market transparency, the quality and integrity of offsets, and the uneven distribution of benefits. However, despite these challenges, the VCM presents significant opportunities for enhancing development initiatives. For instance, integrating the VCM with clean energy solutions can improve energy access in remote areas, foster economic growth, and improve quality of life. Second, the paper explores how the VCM can be designed to support sustainable development goals alongside emissions reductions. For example, it proposes a multi-pronged approach that combines market-based mechanisms with direct investments in clean energy infrastructure and technological development in Africa. Lastly, this paper aims to shift the discourse on the VCM by presenting a holistic approach that addresses decarbonization and sustainable development. It highlights the importance of rethinking market mechanisms to ensure they contribute effectively to climate goals while promoting socioeconomic benefits. This approach aligns with the broader macroeconomic landscape and supports a just transition towards a low-carbon future.

Incorporating an Investment Multiplier into DICE Supports Rapid Decarbonization (In-person)

Anders Fremstad[1]*, (submitted by) Mark Paul*[2]*, and* ***Gregor Semieniuk***[3]
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Integrated Assessment Models (IAMs) assume that economies operate on the efficiency frontier, resulting in hard tradeoffs between decarbonization, consumption, and non-climate investments. Since climate action is costly, protecting future generations requires austerity today. This paper suggests that this perspective is misguided. We review the (neo)classical economic assumptions underpinning IAMs and incorporate modest Keynesian investment multipliers in DICE that reflect economists' uncertainty about how the economy operates. Our results suggest that decarbonization should be undertaken more rapidly than DICE recommends with optimal policy pathways within the range of 1.5-2°C, as outlined in the Paris Agreement. The addition of an investment multiplier also suggests that rapid decarbonization can lead to economic expansion.

Climate Change, Firms, and Aggregate Productivity (Virtual)

Andrea Caggese[1]*, Andrea Chiavari*[2]*,* ***Sampreet Singh Goraya***[3]*, Carolina Villegas Sanchez*[4]
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This paper employs a general equilibrium framework to analyze how temperature affects firm-level demand, productivity, and input allocative efficiency, informing aggregate productivity damages due to climate change. Using data from Italian firms and detailed climate data, it uncovers a sizeable negative effect of extreme temperature on firm-level productivity and revenue-based marginal product of capital. Based on these estimates, the model generates aggregate productivity losses higher than previously thought, ranging from 0.60 to 6.82 percent depending on the scenario and the extent of adaptation. Additionally, climate change exacerbates Italian regional disparities.

Theme 2: Barriers to Decarbonization and Opportunities

Energy Transitions in Sovereign Native Nations of the American West (In-person)
Tabitha M. Benney[1], *Jordan Giese*[1], *Jenna Murray*[1], *Scott Collingwood*[1], *and Brett Clark*[1]
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Energy transition in the United States often de-prioritizes the importance of rural and tribal communities, but these communities are critical to securing the energy infrastructure there. Tribal communities, for example, often have conflicting histories and identities that leave a notable legacy of distrust and produce varying capacity and incentive structures that run counter to the surrounding state. This makes both groups prone to energy vulnerability. From a political ecology perspective, the imbalances in power, uneven development, and the rural landscape and the livelihoods it supports, all play a further role in defining identities in the region. Together, these shortcomings present an obstacle for just transition. Understanding these sociological and political perspectives are critical to research on just transition and can enhance modeling and improve model specification. To better understand these complexities, we explore the theoretical underpinnings that explain why energy transitions unfolder uniquely in Tribal Nations. Next, we explore examples of energy transition in rural and tribal communities and then conduct an in-depth case study on energy transition in Wind River (WY). Based on this exploration, we offer some suggestions on the complexity of this policy arena and suggest how national and international energy transition policy will need to adapt to include the needs of these unique communities. Without doing so, current energy governance may leave key players behind, creating serious health and wellness impacts locally, and exposing the surrounding state to long term grid resilience and vulnerability issues.

Unique Data on Decarbonization Strategies in the 2023 Annual Business Survey (In-person)
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Studying the socio-technical transition from a fossil fuel economy to a renewable energy economy needed to avert an increase in global temperatures of more the 2 C will require detailed data on the plans, strategies, and investments of businesses to decarbonize. These data have been lacking to date. This poster will provide an overview of the 2023 Annual Business Survey Climate and Sustainability Module that collected this type of information from a sample of 850,000 nonfarm employer businesses in the U.S. Questions that can be investigated include why businesses are pursuing decarbonization strategies absent a price on carbon; the ambition, time frame, and approaches used to decarbonize; and the regional characteristics associated with facilitating or hindering the socio-technical transition. The ability to link these data to the Manufacturing Energy Consumption Survey collected for the same reference year will allow establishing a baseline of carbon performance for industrial emissions along with preliminary analysis of the business and local characteristics associated with better carbon performance. These data should be available for analysis in the Federal Statistical Research Data Center system by early 2025. Information on the Standard Application Process required to gain access to these confidential data is also provided.

Geography versus Income: The Heterogeneous Effects of Carbon Taxation (Virtual)
Charles Labrousse[1,2] *and Yann Perdereau*[2]
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Distributive effects of carbon taxation are key for its political acceptability. We introduce geographical heterogeneity into a calibrated dynamic general equilibrium heterogeneous-agent model, where energy is both a consumption good and an intermediate input. We evaluate the aggregate and distributive effects of carbon taxation and obtain three key results. First, the distributive effects of carbon taxation are driven by geography more than income, with rural households suffering larger welfare losses. Second, taxing households' direct emissions is regressive, while taxing firms' direct emissions is progressive. Third, we simulate various revenue-recycling policies using targeted transfers. We find that it is possible to reduce emissions and mitigate welfare losses associated with the green transition.

Carbon Emissions and the Transmission of Monetary Policy (Virtual)
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This paper studies the dynamic causal effects of monetary policy on carbon emissions in the U.S. Using high-frequency changes in interest rates around FOMC announcements (i.e. monetary policy surprises), I identify a structural monetary policy shock. A subsequence assessment of the effects of these shocks reveals that, in contrast to the consensus view, a contractionary monetary policy shock is associated with a *rise* in carbon emissions: while emissions of the industrial sector fall (as expected), non-industrial sectors' emissions rise significantly by 1.51pp in the short run. A detailed exploration reveals that the channels of monetary policy transmission vary in strength and relevance across sectors and help explain these heterogeneous responses: while the conventional *aggregate demand* channel appears to play a central role in the response of emissions from the industrial sector, the evidence points at a more relevant role of the *commodity price* channel of monetary policy for the transmission of shocks to the non-industrial sectors.

Information about Climate Transition Risk and Bank Lending (Virtual)
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Is there any evidence for climate transition risks being priced in syndicated corporate loans? Empirical evidence shows a role for bank specialization in pricing climate transition risk. However, this role varies across geographies and regulatory and technological aspects of climate transition risk (measured using firm-level GHG emissions and forward-looking exposure to climate regulations and green technologies). Moreover, bank specialization does not necessarily translate into higher lending rates for negatively exposed firms after an oil supply news shock. I explain the role of bank specialization as a source of heterogeneity in costs of private information acquisition through a theoretical model of costly screening in a competitive bank lending structure. I allow for non-Bayesian belief updates by the banks about the borrowers' exposure to transition risk. Optimal private information acquisition steeply increases when banks under-react more in response to public information. Conditional on the signals from screening, the expected interest rates in the equilibrium are higher for borrowers for whom the public signal points towards greater exposure to transition risk. However, the interest rate differential between more and less exposed borrowers is smaller when banks under-react more to public information. This effect becomes stronger as the average borrower quality decreases, and even lower levels of under-reaction can result in the interest rate differential declining sharply in favor of more exposed borrowers. These results imply that even with high-quality public information and communication about decarbonization, lowering the cost of acquiring information about firms' climate change exposures through standardized firm-level disclosures and comprehensive climate-stress testing guidelines for banks is important for reducing financing costs for greener firms.

Theme 3: Incorporating Modeling Insights into Policy Design

MATE-AR: Model for the Analysis of Energy Transformations in the Argentinean Residential Sector. A Key Tool for Energy Policy Design (Virtual)
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Due to the conditions of inequality among Argentine households, in recent years energy policies have been implemented that incorporate segmented tariff structures and targeted subsidy systems, considering the diverse realities of the population. Within this framework, the development of diagnostic methodologies becomes crucial to identify the specific energy characteristics of the different sectors of the population, providing data and arguments that can support decision making. In this line, this poster presents the main results of the MATE-AR (Model for the Analysis of Energy

Transformations in the Argentinean Residential Sector). These results are unprecedented for the country, since this is the first time that the residential energy consumption in Argentina is organized by province, income level (quintiles), sources and end-uses. Also, a set of key performance indicators that allow periodic comparisons for the future evaluation of their trajectories are presented. This set of results are useful to design energy policies for the residential sector. The developed methodology is based on the micro-dataset of the National Household Expenditure Survey 2017/2018, which has 21 547 households surveyed throughout the 24 jurisdictions of the country. For this purpose, the called "energy block" questionnaire is mainly used, which includes a survey of more than one million household appliances with their respective usage habits. In this instance, the necessary equations were established to obtain the energy used by each of the declared equipment within each dwelling and, thus, reconstruct the energy consumption of each of the energy vectors used by the Argentinean residential sector.

US Electric Grid Decarbonization Pathways under Market and Policy Uncertainties (In-person)
Vladimir Dvorkin[1]*, Audun Botterud*[2]*, and Dharik Mallapragada*[3]
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This work addresses the impact of market and policy uncertainties on investment decision-making within the US electricity grid's decarbonization efforts. The current reliance on deterministic models for guiding investments into the electricity sector does not adequately account for variable renewable investment costs, electricity demands, and policy uncertainties. As a result, the planned deterministic investment trajectories may fall short in satisfying the 2035 net-zero target set for the electric power grid in the US in a feasible and economically efficient way. To overcome the limitations of deterministic planning, this work develops optimization-based tools that produce decarbonization pathways (e.g., investments in renewable power and energy storage systems) that are informed by many representative scenarios of market and policy uncertainty and provide formal guarantees to satisfy the decarbonization target with prescribed probability requirements. For example, it is possible to internalize the tolerance for CO_2 emission constraint violation in 2035 to produce decarbonization trajectories with different trade-offs between the investment cost and the degree of carbon policy constraint satisfaction. Moreover, a policymaker can specify the degree of stochasticity of decarbonization pathways and sample investment trajectories with varying degrees of randomness, with more certain trajectories typically featuring a higher investment cost. Our case study based on the U.S. Southeast power system quantifies the trade-offs between the cost and stochasticity of decarbonization pathways, the cost of 100% satisfaction of decarbonization targets, and how they can be reduced by marginal relaxation of carbon constraint satisfaction requirements.

Strategic Interventions for Urban Carbon Reduction: A Bottom-Up Archetype Approach for Sustainable Cities (Virtual)
Siavash Ghorbany[1] *and Ming Hu*[1]
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The construction industry accounts for approximately 40% of global greenhouse gas emissions, making it a critical sector for addressing carbon emissions. Urban areas are particularly significant contributors. However, tackling this issue has been challenging due to a lack of comprehensive data and methodologies for assessing the building sector's impact on such a large scale. This study aims to develop a methodology for collecting data and simulating embodied carbon emissions across the entire lifecycle of buildings at an urban scale. It demonstrates the effects of various scenarios on embodied carbon emissions, including changes in building lifespans, renovation and replacement strategies, area per building, and new construction volumes. Using a bottom-up archetype approach, the study models cities and evaluates the impact of six mitigation strategies on urban-scale carbon emissions. Additionally, it develops standalone software to simulate, assess, and predict the embodied carbon emission in these scenarios and their economic impacts at the national level in the United States. As a pilot, this approach was applied to Chicago, demonstrating potential reductions in embodied carbon emissions by 65 to 80 percent through strategic interventions. The findings underscore the profound influence of urban planning decisions on city decarbonization and offer valuable software for policymakers and researchers aiming to evaluate and implement effective carbon reduction strategies across American cities.

Modeling the Impacts of Policy Sequencing on Energy Decarbonization (In-person)
Huilin Luo[1,2], *Wei Peng*[2]*, *Allen Fawcett*[3], *Jessica Green*[4], *Gokul Iyer*[3], *Jonas Meckling*[5], *David Victor*[6]
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Many countries have embraced a climate policy strategy that starts with large subsidies to clean energy ("carrots") and later introduces more punitive policies ("sticks"). This policy sequence has proven to be more politically feasible than the reverse, but little is known about its ability to drive energy decarbonization and deliver long-term mitigation goals. Using a state-level energy system model for the United States (GCAM-USA), we represent this policy sequence and evaluate its impacts on the energy system and the future level of efforts needed for sticks. We identify three mechanisms for the carrot first approach to lower future stick level: reducing emissions early on, driving down technology cost, and accelerating the shift to sticks. The implementation of carrots also results in uneven distributional effects across technologies (e.g., supply vs. demand side) and sectors (e.g., fossil-based vs. low-carbon). Our results thus suggest an important role for integrating political economy research with energy system modeling to better understand the drivers, impacts, and timing of policy choices.

Health and Environmental Outcomes of US Policies Related to Carbon Capture in the Power System (Virtual)
Paola Furlanetto[1], *Michael Ash*[1], *Erin Baker*[1], *Bridget Diana*[1], *Tim Donaghy*[2], *and Golbon Zakeri*[1]
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Recently proposed rules, including the 45Q Tax Credit and EPA Rule 111, are designed to encourage the adoption of carbon capture in the power system. We evaluate how these rules will impact the emissions of co-pollutants in a networked electricity system. We evaluate combinations of these two rules and the EPA Good Neighbor, under a range of plausible technical and economic scenarios, the pace of renewable deployment, and the structure of the power grid. We employ a Power Flow model of a three-node, mixed-source network in which fossil fuel power plants may invest in CC via retrofit. Co-pollutants (non-GHG emissions from fossil fuel generators, like NOx, SOx, PM25 and NH3) are harmful for those directly exposed; and may have particular consequences for low-income and marginalized populations who are often disproportionately represented near polluting power plants. We report on the extent of CC adoption, the energy source mix, the airborne emissions (CO2 and co-pollutants), and the distribution of monetized damages across population types. We find that the CC tax credit can generate perverse incentives to increase fossil fuel generation while stalling the expansion of renewables, and the results are worse when combined with EPA Rule 111. We also observed scenarios with an increase in co-emissions and damages to public health; these, however, can be ameliorated by imposing strict limits on co-pollutants. Our work shows that CC policy design must carefully consider environmental and societal impacts and look beyond GHG reductions.

Deep Decarbonization Targets are Shallower than they Appear (In-person)
Amir Sharafi[1,2], *Alyssa Pfadt-Trilling*[1], *Sam Markolf*[1], *Marie-Odile Fortier*[2]
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Regional decarbonization or climate action plans in the US generally do not employ life cycle assessment (LCA) in their development. At most, they rely instead on average carbon footprints of electricity generated by renewable energy systems instead of detailed geospatial carbon footprint data. Still, many simply assume that most renewable energy systems equate to "zero emissions." California uses the latter approach in its decarbonization plan, the 2022 Scoping Plan for Achieving Carbon Neutrality. However, our analysis of California's prospective electricity sector changes through 2045

highlights the risks of omitting life cycle greenhouse gas (GHG) emissions and their geographic variability in decarbonization planning. The total GHG emissions of the proposed power sector in California through 2045 were calculated to be 54.1% higher than reported by the state's Scoping Plan, even when designed to minimize the overall carbon footprint while meeting the same capacities by energy source. The lack of life cycle accounting in decarbonization planning risks setting and aiming for a target that does not genuinely lead to its emissions reduction goal. The massive associated infrastructure shift and its macroeconomic consequences may then be insufficient to prevent catastrophic climate change. To avoid such shallow decarbonization outcomes, we use our California analysis to present methodology to overcome complications in conducting geospatial LCA for decarbonization planning. System siting decisions, future climate conditions, and technological choices can be modeled and assessed using open-source approaches and datasets to minimize the life cycle GHG emissions of future energy systems. Effective decarbonization policies require life cycle accounting.

Theme 4: Global Interactions

A Global and Inclusive Just Labor Transition: Challenges and Opportunities in Developing and Developed Countries (In-person)

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This research identifies challenges and opportunities for achieving an inclusive just transition (JT) to a low-carbon economy, focusing on promoting an equitable workforce while advancing a sustainable economy in developed and developing countries. We conduct a two-stage comparative analysis of JT labor-oriented policies between developed and developing countries. We draw lessons from some developed countries that have implemented national and local initiatives to revitalize resource-rich communities that have experienced a downturn in the energy sector. We argue that these countries face common challenges in achieving a JT by ensuring "quality" jobs, compensating for displaced workers, and determining the appropriate extent of governmental interventions. In assessing developing countries, we recognize the heterogeneity among these countries, so we focus on a sample from the global south that allows us to characterize the labor market within the transitioning sectors, thereby identifying both challenges and potential avenues for creating new employment opportunities, facilitating skill retraining, and ensuring the integration of communities. Many of these countries are in the initial phases of a just energy transition, and notably, within the developing countries, we also explore the nascent just energy transition partnership efforts. Also, we advance opportunities and lessons drawn from advanced economies' experiences and the recent efforts of developing countries that could help achieve a global and inclusive JT. These findings demonstrate some key steps many countries can take towards beginning and achieving their JT journey. Finally, we present a tool to measure progress towards JT, our JT Progress Scale, and apply the scale to the previously analyzed countries.

Decarbonizing Transport: Ensuring a Sustainable and Ethical EV Supply Chain between the US and Africa (In-person)

***National Academies of Sciences, Engineering, and Medicine** (submitted and presented by **Moses Ogutu**, Associate Program Officer)[1]*
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The global shift towards electric vehicles (EV) is crucial for decarbonizing transport, as the sector contributes about one-quarter of global greenhouse gas emissions. However, this transition also carries substantial risks. For example, unethical practices in the supply chain, such as child labor, poor working conditions, and environmental degradation, particularly in the mining of key EV components like lithium, cobalt, and nickel, can undermine the equity and sustainability of the decarbonization process. This poster will present the findings of a recent study on the Decarbonisation of Transport in Africa, which assessed the current status and reviewed crosscutting issues such as policy, institutional and technical

capacity, technologies, financing, and social, legal, and regulatory frameworks essential for facilitating the transition to net-zero transport in Africa. Within the theme of global interactions and other cross-cutting issues, the presentation will underscore that decarbonizing the US economy should be centered on an equitable and sustainable supply chain for products essential to the transition, such as sourcing critical minerals. Discussions will explore how collaborative policies between the US and African nations can accelerate EV adoption while ensuring ethical and sustainable practices in the mining of key EV components. Macroeconomically, addressing these social equity issues is crucial, as failure to do so might result in future expenses, such as providing refuge to climate migrants or increasing development aid to support affected communities. Additionally, the presentation will explore how these relationships can drive economic growth and development in African countries while supporting the US's transition to a low-carbon economy.

Other Cross-cutting Themes

Energy Consumption and Inequality in the U.S.: Who are the Energy Vulnerable? (In-person)
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This paper documents the empirical regularities of within-home and overall—including energy for transport—energy consumption in the U.S. using the PSID survey over the 1999-2021 period. For the U.S., we propose redefining standard indicators measuring energy vulnerability by using overall energy expenditures instead of just within-home energy consumption. We show that, depending on the definition of energy consumption and on the indicator, between 10% and 28% of U.S. households are energy vulnerable. Using our preferred measure, 18% of households are energy vulnerable, and 94% of these households have incomes below the median, with their median income being 59% lower than that of non-energy-vulnerable households. In addition, we estimate the marginal propensity to consume (MPC) for households in our sample and conclude that energy-vulnerable households have substantially larger overall MPCs and energy MPCs compared to non-energy-vulnerable ones. This suggests that fiscal interventions affecting energy prices would have significant distributional effects.

The Distributional Effects of Carbon Pricing and the Implications for Vulnerable Households in Taiwan (Virtual)
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Carbon pricing is indispensable to meeting the 2050 net-zero target. A key challenge is achieving an equitable transition across the economy and society while reducing emissions. Many studies have analyzed the distributional effects of carbon pricing and how revenue recycling can help reduce inequality. However, most studies focus only on the short-term distributional effects on income groups, revealing that carbon pricing without revenue recycling would be regressive. However, other characteristics of households, such as family types, having elders, genders, occupations, educational attainments, and areas, may also be essential factors of distributional effects. This study examines the distributional effects of carbon pricing in Taiwan when considering household characteristics. We apply the E3ME-FTT model (a global, macro-econometric model) and develop a methodology to use the rich data of the Taiwan Family Income and Expenditure Survey to assess the distributional effects of different carbon pricing scenarios in the short and long term. Based on the results, we further illustrate how to achieve equitable distributions with revenue recycling. The results show that lower-income households have a higher ratio of carbon pricing burden on income. Second, regarding the characteristics of households, we find that households with elders, low educational attainments, unemployment, or farm households could be more vulnerable to carbon pricing. Last, with revenue recycling, the results suggest that Taiwan can achieve win-win solutions in terms of economic growth and equitable society while reducing emissions effectively.

Equity in Transition: Analyzing the Distributional Effects of Low-Carbon Technology Subsidies (In-person)

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One concern about low-carbon technology subsidies is that they tend to benefit high-income households more. For example, the top income quintile in the United States is receiving almost 70% of investment tax credits for residential energy efficiency improvements. These subsidies can be regressive and may exacerbate income inequality. At the same time, if we consider the environmental and learning-by-doing external economy effects, they may not be as regressive. This paper quantifies the overall distributional effects of low-carbon technology subsidies by developing a heterogeneous agent dynamic stochastic general equilibrium (DSGE) model with climate change and costly clean energy technology adoption. Since wealthy households account for the lion's share of aggregate residential emissions, speeding up their transition to low-carbon technologies will yield the most environmental damage prevention benefits. Moreover, when positive spillovers through learning-by-doing are considered, subsidizing early adopters could reduce the high adoption costs faster to make adoption feasible for more income groups. We compute the transition path from the high-carbon energy-fueled steady-state to a terminal steady-state fully fueled by the low-carbon technology and evaluate the heterogeneous welfare effects of introducing the subsidy across the joint income and wealth distribution. By calibrating the model to reflect the U.S. economy, we quantify the equity and efficiency of the recent energy transition policies, such as tax credits implemented under the Inflation Reduction Act. Finally, we conduct counterfactual policy experiments to evaluate the relative regressivity of alternative climate policies.

Meeting Conduct*

We are committed to fostering a professional, respectful, inclusive environment where all participants can participate fully in an atmosphere that is free of harassment and discrimination based on any identify-based factors.

DO

- **Show respect and consideration** for all people, and do not dominate discussions.
- **Listen to others.** Make room for a diversity of voices in group discussions, on panels, and the like without pressuring those who choose not to speak.
- **Be collegial and collaborative.** Be mindful of your tone and the potential impact your position, experience, and/or privilege may have on others.
- **Show that you value differing perspectives.** Communicate openly and civilly—critique ideas, not people.
- **Be inclusive** and intentional about welcoming a diversity of individuals and their perspectives and identities when leading sessions or inviting others to share ideas.
- **Act professionally and responsibly.**
- **Report concerns immediately** so that we can act quickly to address and resolve issue (see below for details on how to report concerns).
- **Respect confidentiality** of the identities of any individuals involved in a conduct concern while it is being reviewed and addressed.
- **Comply with requests to stop behavior.** If any NASEM staff, Roundtable member, or other person in a facilitation or leadership role asks you to stop a behavior deemed unacceptable, please immediately and respectfully comply.

DO NOT

- **Intentionally talk over or interrupt others.**
- **Engage in conduct or make comments that are biased, demeaning, intimidating, coercive, or harassing/hostile,** whether seriously or in jest (examples include derogatory, exclusionary behaviors or comments toward others based on gender, sexual orientation, disability, physical appearance, body size, race, religion, national origin, or any identity-based factors).
- **Engage in personal attacks or bullying.**
- **Comment on personal appearance,** seriously or in jest, unless you know such comments are welcome.
- **Display nudity and/or sexual images** in public spaces or presentations.
- **Disrupt or engage in violence or abuse, threats of violence, harm, or threats of harm of any kinds.** Do not create/contribute to a safety threat or unsafe or exclusionary situation.
- **Drink or use other legal intoxicants** to the extent that your ability to act professionally is compromised.
- **Take or distribute pictures or recordings without approval.**
- **Retaliate against or disadvantage anyone for reporting a concern** or cooperating in an investigation. Do not make bad faith accusations.

How to Report Misconduct

If you experience or witness behavior that appears to violate this Code of Conduct, please notify us immediately so we can take appropriate steps to address your concerns. Feel free to use any of the following options:

- Contact NASEM event staff: Katrina Hui, KHui@nas.edu.
- Contact NASEM Office of Human Resources, HRServiceCenter@nas.edu.

**This code of conduct was adapted from the Geological Society of America's Events Code of Conduct, found here: https://www.geosociety.org/GSA/Events/EventConductCode/GSA/Events/Conduct.aspx*

PREVENTING DISCRIMINATION, HARASSMENT, AND BULLYING:
POLICY FOR PARTICIPANTS IN NASEM ACTIVITIES

The National Academies of Sciences, Engineering, and Medicine (NASEM) are committed to the principles of diversity, inclusion, integrity, civility, and respect in all of our activities. We look to you to be a partner in this commitment by helping us to maintain a professional and cordial environment. **All forms of discrimination, harassment, and bullying are prohibited in any NASEM activity.** This policy applies to all participants in all settings and locations in which NASEM work and activities are conducted, including committee meetings, workshops, conferences, and other work and social functions where employees, volunteers, sponsors, vendors, or guests are present.

Discrimination is prejudicial treatment of individuals or groups of people based on their race, ethnicity, color, national origin, sex, sexual orientation, gender identity, age, religion, disability, veteran status, or any other characteristic protected by applicable laws.

Sexual harassment is unwelcome sexual advances, requests for sexual favors, and other verbal or physical conduct of a sexual nature that creates an intimidating, hostile, or offensive environment.

Other types of harassment include any verbal or physical conduct directed at individuals or groups of people because of their race, ethnicity, color, national origin, sex, sexual orientation, gender identity, age, religion, disability, veteran status, or any other characteristic protected by applicable laws, that creates an intimidating, hostile, or offensive environment.

Bullying is unwelcome, aggressive behavior involving the use of influence, threat, intimidation, or coercion to dominate others in the professional environment.

REPORTING AND RESOLUTION

Any violation of this policy should be reported. If you experience or witness discrimination, harassment, or bullying, you are encouraged to make your unease or disapproval known to the individual at the time the incident occurs, if you are comfortable doing so. You are also urged to report any incident by:

- Filing a complaint with the Office of Human Resources at 202-334-3400 or hrservicecenter@nas.edu, or
- Reporting the incident to an employee involved in the activity in which the member or volunteer is participating, who will then file a complaint with the Office of Human Resources.

Complaints should be filed as soon as possible after an incident. To ensure the prompt and thorough investigation of the complaint, the complainant should provide as much information as is possible, such as names, dates, locations, and steps taken. The Office of Human Resources will investigate the alleged violation in consultation with the Office of the General Counsel.

If an investigation results in a finding that an individual has committed a violation, NASEM will take the actions necessary to protect those involved in its activities from any future discrimination, harassment, or bullying, including in appropriate circumstances **the removal of an individual from current NASEM activities and a ban on participation in future activities**.

CONFIDENTIALITY

Information contained in a complaint is kept confidential, and information is revealed only on a need-to-know basis. NASEM will not retaliate or tolerate retaliation against anyone who makes a good faith report of discrimination, harassment, or bullying.

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NATIONAL ACADEMIES Sciences Engineering Medicine

A GUIDE TO THE

Harassment Complaint Process for Participants

AT THE NATIONAL ACADEMIES

Review the Policy here.

Complaints regarding violations of the National Academies anti-harassment policies should be reported by:

- Filing a complaint with the Office of Human Resources at 202-334-3400 or hrservicecenter@nas.edu or
- Reporting the incident to an employee involved in the activity in which you are participating.

Complaints of harassment, discrimination, or bullying should be filed as soon as possible after an incident. The Office of Human Resources will investigate the alleged violation in consultation with the Office of the General Counsel.

When reporting an incident, please provide as much of the following information as is possible and applicable:

- Name and role of the person or persons allegedly causing the harassment;
- Description of the incident(s), including the dates, locations and the presence of any witnesses;
- Steps taken to try to stop the harassment; and
- Any other information that may be relevant.

If the National Academies determines that a participant in a National Academies activity has violated this policy, the National Academies will take action as it deems appropriate to address the situation and to prevent the participant from engaging in future discrimination, harassment, or bullying in National Academies activities, up to and including banning that individual from current or future participation in National Academies activities.

All inquiries, complaints, and investigations are confidential, and information is revealed only on a need-to-know basis. Information contained in a complaint is kept confidential. The National Academies will not retaliate or tolerate retaliation against anyone who makes a good faith report of discrimination, harassment, or bullying. or participates in a complaint investigation.

For more information, please watch the following videos from our Expert Volunteer Orientation:

- Making a Commitment to Diversity, Equity, and Inclusion
- Preventing Discrimination, Harassment, and Bullying