REPORT OF THE

# Forum and Workshop on Campus and Community-Scale Climate Change Solutions

MARCH 8 & 9, 2023, WASHINGTON, D.C.

UNIVERSITY of WASHINGTON

NSF

Thought leaders from colleges and universities across the country convened in Washington, D.C. on March 8 and 9, 2023, to discuss how the higher education community is responding to changes in our global climate, and how its collective power can be more effectively harnessed to meet the unprecedented challenge of climate change facing the nation and the world. They explored innovative sustainability and resilience solutions being developed, demonstrated, and taught on campuses and how these solutions can be expanded to and implemented on other campuses, in the surrounding communities, and beyond.

Many meeting participants and committee members contributed to this document. Final editing by Philip Lippel, Sang Han, Maya Tolstoy and Robert Kopp.

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This workshop on the role of higher education in an unprecedented scaling up of climate change activities was funded by National Science Foundation Grant #2310532. Participants were affiliated with 63 institutions of higher education in 48 states.

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## II. Overview

The NSF-sponsored Forum and Workshop on Campus and Community-Scale Climate Change Solutions, held in Washington, D.C. on March 8-9, 2023, explored the concept of harnessing the power of institutions of higher education in addressing climate change by creating an extensive network of such institutions that are committed to climate action.

The changing climate is among the most complex challenges facing our campuses, our local communities, and society at large. The presentations and participatory sessions at the Forum and Workshop explored the myriad ways in which institutions are engaged in addressing climate change and explored strategies for making their collective endeavors more impactful.

This report summarizes the discussions that took place at the Forum and Workshop and offers recommendations regarding effective mechanisms for deploying and disseminating climate solutions on our campuses and in our communities. On March 8th, most participants attended the Forum on Campus and Community-Scale Climate Change Solutions. The Forum, held on the White House grounds, was sponsored by the Energy Division of the Office of Science and Technology Policy. A high-level description of the Forum is included in this report. All Forum presentations remain available for viewing online.

On March 9th, the Workshop explored the breadth of activities in which climate change-active schools are engaged, the strategies they employ, and the stakeholders involved. One important objective was to stimulate thinking on how better connections among institutions could create a more coordinated and intentional collective effort that would enable a massive scaleup of current actions to other campuses and beyond. A second was to identify federal programs capable of supporting that work, and to delineate areas where additional federal opportunities would have major impact.

The Forum and Workshop shared a common goal: examining how stronger connections between colleges and universities can drive a significant increase in climate action on our campuses and in the surrounding communities. A central element of the Workshop was the role of the federal government in fortifying connections among climate-engaged schools, and the notion that an explicit government-university partnership can catalyze national efforts to address climate change.

Participants considered existing mechanisms that facilitate collaboration and information sharing, and discussed enhancements or additional mechanisms that would accelerate this work. They envisioned a network of institutions that could readily share best practices, successes, and failures, and help each other plan subsequent climate actions.

The initial conversations centered on these questions:

- How can colleges and universities work together more closely to catalyze climate action throughout the higher education sector?
- How can institutions of higher education help municipalities, Indigenous Communities, and states in their own efforts to mitigate and adapt to climate change?
- How does the federal government currently support and facilitate campus and community climate action, and how might it bolster that support?
- What are the important roles of states, municipalities, and non-governmental or philanthropic organizations?
- How will higher ed prepare the workforce needed to meet climate action goals?

Climate action leaders hold a wide variety of positions at their institutions. Workshop attendees included directors of sustainability, presidents, senior research officers, community engagement and economic development officers, climate center directors, government relations professionals, faculty, senior staff and other administrators, as well as a small number of students.

Approaches to climate action are similarly varied.

Some schools represented at the workshop have emphasized reducing their greenhouse gas emissions by converting their campus energy systems to more efficient, low-carbon technologies. Others have started with a focus on transitioning their transportation infrastructure. Vast differences in the resources available to different institutions play an important role.

Those whose missions have long included providing climate services to their states and municipalities are increasing their efforts to help constituents and partners implement climate change mitigation and adaptation projects.

Research is a strong focus of many, particularly R1 Universities, with most of the foundational understanding of climate and how it's changing coming from academia, along with research on the ecological, societal, business and policy implications. In addition, academic research is increasingly turning to climate solutions from renewable energy and carbon capture to the use of AI in improving forecasting of extreme events.

Educating and training the climate workforce of today and tomorrow is the primary focus for some institutions and is on the agenda for all.

Those with strong agricultural missions are addressing climate impacts throughout the entire food supply chain. Many also study agriculture-based approaches to carbon sequestration or the production of sustainable biofuels.

The attendees were selected from all sectors of higher education and all regions of the United States. Registered participants represented 48 states and 61 institutions, including historically Black colleges and universities, Tribal colleges, Hispanic serving institutions, community colleges, public regional institutions, private non-profit colleges and universities, and public research universities, with the following Carnegie classifications:

- 34 large research universities
- 9 emerging research or regional universities
- 8 Master's colleges and universities
- 5 Baccalaureate colleges
- 4 Associate's or mixed Baccalaureate/Associate's colleges
- 2 Tribal college
- 5 Historically Black colleges and universities
- 1 entity affiliated with multiple Associate's colleges

Given the size constraints of the Workshop, most participants were the only attendees from their state. The organizers and participants recognize that many other members of the higher education community could have made valuable contributions. As the ideas emerging from the Workshop continue to develop, there will be opportunities for many additional colleagues to join the efforts.

Workshop Rationale

Colleges and universities across the United States are addressing climate change in many ways. The challenges they face are as varied as the campuses, faculties, and student bodies comprising the American system of higher education. The actions each institution selects to address climate challenges depend on their specific needs, mission, environment, and available resources.

How can new connections and collaborations accelerate climate action and elevate solutions, not just within the higher education sector but in our communities, states, and the country? The workshop did not attempt to design a new umbrella organization as the answer to this question. Rather, participants were asked to explore existing relationships affecting their schools' climate actions, and to discuss how they might enhance those relationships to dramatically scale the impact of those actions.

Individual institutions benefit from connections to others sharing a variety of commonalities, such as size, location, mission, academic specialties, campus size and geography. A school typically participates in several groups organized around one or more such factors. Climate working groups within these can complement the existing organizations dedicated to campus sustainability and climate issues.

Enhanced connections can help address issues and concerns of common interest across many institutions.

Rural research universities could share best practices on working with their agricultural communities to generate biofuels on a commercial scale. Land-grant universities can expand climate services in their extension programs. Consortia can share ideas on the curricular changes needed to prepare the workforce and communities of tomorrow to address climate change and can collaborate on introducing new curricula at scale.

Campuses are working to decarbonize various types of living spaces, classrooms, laboratories, and other facilities. By sharing experiences, they can help each other find optimal solutions for different building types and local environments and provide better recommendations for similar deployments elsewhere in their community.

There are also many opportunities to share strategies for working in a meaningful manner with local communities and Indigenous Populations, and for ensuring that institutions serving underrepresented groups have sufficient resources to promote environmental justice.

Historically, America’s higher education sector has developed many innovative solutions to society’s grand challenges, often in close partnership with federal and state governments. A recent example of the power of this model is academia’s role in the U.S. response to the COVID-19 pandemic. Colleges and universities across the country responded rapidly to the discovery of the novel coronavirus and its spread around the world. They quickly modified their physical facilities and educational practices to keep their students and staff safe, and to help limit infections in their communities. Research universities led in the development and rapid deployment of testing and treatment protocols. Many also operated frontline healthcare facilities, provided advisors to state and local health officials, and served as trusted sources of information on COVID. Our experts helped inform the public and policymakers throughout the pandemic and continue to work on the challenges COVID still presents.

The global threats caused by a changing climate demand a similarly comprehensive suite of actions from the higher education sector – on our campuses, in our communities, and as trusted leaders and advisors. With many strong connections among institutions, as well as to local and regional communities, the

sector is uniquely positioned to accelerate actions addressing short- and long-term climate-related needs, from disaster preparedness to workforce training to knowledge creation and technology development. It is hoped that the Workshop will serve as a starting point in the development of a strategy for implementing such actions collectively.

Summary Recommendations

The energy and enthusiasm for engaging across education sectors and government agencies was significant. Participants identified many areas where enhanced coordination and communication could better catalyze climate action, facilitate rapid delivery of resources to where they are most needed, and ensure that the higher education system is preparing the workforce needed for the green economy goals. Areas identified that would benefit from further discussion and an enhanced network include:

1) Coordinating and partnering with Federal Agencies and resources to better harness the power of the national higher education community for workforce preparation, knowledge generation and solution implementation.
2) Empowering higher education to grow the climate-ready workforce and building on existing ties to communities to accelerate delivery of climate solutions, resources and training.
3) Recognizing and supporting the importance of environmental justice, engaging diverse voices and delivering resources equitably.
4) Utilizing networks to accelerate the transfer of successful ideas, practices, and techniques across higher education institutions for campus sustainability, resilience, climate workforce development, climate services and living laboratories.
5) Securing participation at the highest levels of the Federal Government in harnessing the power of the higher education community to accelerate the scaling of climate solutions to scale nationwide.
6) Formalizing the role of higher education in developing and disseminating sustainable climate adaptation and mitigations solutions, by establishing a network of climate-grant universities and climate extension offices styled after the land-grant model.

The federal government has a special role to play in addressing these recommendations. This can include providing resources, serving as an information clearinghouse, and improving coordination among the many federal entities that interact with the academic community on climate solutions. This will be a multi-decadal effort and will need to be nimble as the nature of the threat continues to evolve and be better understood.

## III. FORUM: SETTING THE STAGE

The March 8 White House Forum explored how campuses are piloting technology and policy innovations to address climate change and presented ideas for how those activities might be scaled for national impact. It showed how the resources and expertise of our federal partners can guide and support actions on many fronts, and how colleges and universities in many states are organizing to work with local, regional, and statewide communities. (A recording of the forum is available here.)

Sally Benson, Deputy Director for Energy and Chief Strategist for the Energy Transition at the Office of Science and Technology Policy, opened the Forum by welcoming the representatives of colleges and universities across the United States who came to explore the roles their institutions play in addressing the changing climate and how, collectively, they can accelerate the development of climate solutions.

In her opening remarks, Benson called the Forum the first step in an inclusive effort to marshal the strengths of campuses, including the nearly 20 million students enrolled in our post-secondary education system, to help address one of the defining issues of our time. But that step, as subsequent speakers described, is built on decades of involvement in climate science and climate action by colleges and universities.

Benson compared campuses to towns and cities, each with their own infrastructure, residential facilities, commercial buildings, and transportation services. As communities grapple to find appropriate local responses to climate-related challenges and opportunities, campuses are exploring the same issues. The intellectual resources of and fundamental knowledge generated by academia, and its experience with industry and workforce innovation, provide capacity for informed decision-making as campuses and communities alike consider options for obtaining clean energy, readying the workforce for a new economy, and enhancing infrastructure and ecosystem resilience as extreme weather events become increasingly common.

The Forum then proceeded to panel presentations featuring representatives of academic institutions and federal agencies.

The academic panelists discussed their campuses' approaches to climate action, highlighting examples of activities already underway on campuses and with local and state partners. The federal panelists discussed current federal programs supporting university-based climate action.

Presentations by government officials sketched out the federal climate agenda on a broader scale, highlighting areas where institutions of higher education might play additional roles in the accelerating federal efforts to address climate change and ensure a transition to a clean and just energy economy.

To close the forum, Maya Tolstoy, Dean of the University of Washington College of the Environment, reminded the audience of the long history that universities and colleges have in working together for the betterment of society. "When we commit collective resources toward shared purpose, we are capable of achievements far beyond what we could accomplish alone," she said. "Every size and specialty of college and university has something important and vital to contribute to such a collective effort."

Tolstoy charged the attendees with examining four sets of activities in greater detail during the Workshop the following day at the University of the District of Columbia, which was designed to consider mechanisms for enhanced collaboration that would accelerate the scaling of climate solutions while consciously advancing equity and justice. Those activities are:

- Making campuses more sustainable and resilient, including pathways to achieving net-zero emissions
- Enhancing climate services provided to communities
- Ensuring that students have the knowledge and skills to lead the clean industries of tomorrow and to build and maintain a green and resilient infrastructure; and
- Increasing the use of campuses as proving grounds for new climate solution concepts and technologies

See the full agenda in Appendix 1, and further details on the presentations by panelists from the academic community in Appendix 3.

## IV. WORKSHOP PANELS AND DISCUSSION SESSIONS

The workshop began with a welcome by Victor McCrary, Vice President of the University of the District of Columbia and Vice Chair, National Science Board. Sally Benson and Maya Tolstoy then gave introductory remarks, encouraging the attendees to think throughout the day about creating networks of institutions to scale up the already-impressive activities of individual institutions.

Reiterating their charge from the end of the previous day's Forum, Benson and Tolstoy asked the participants to reflect on the role university-government-community partnerships are playing in their climate action, and to think about how forming a network and working together could elevate those partnerships and multiply their impact.

The workshop interspersed plenary panels with participatory discussion sessions on climate action in areas such as decarbonizing campus infrastructure, improving the function of campus ecosystems, and assisting municipalities and states in climate mitigation and adaptation efforts. One objective of the sessions was to share information on effective tools and technologies as well as perspectives on sustainability, economics, workforce issues, and environmental justice. A second objective was to explore how our collective wisdom -- which is richer and deeper than any one institution's – can support the transition of the country's energy and agricultural sectors more broadly, both by example and through community services, on a time scale consistent with the urgency of the climate challenge. See Appendix 2 for the full agenda.

Plenary Panels

The first panel featured the leaders of three organizations focused on climate action in the higher education sector: Second Nature, the Association for the Advancement of Sustainability in Higher Education (AASHE), and the International District Energy Association (IDEA). They discussed the missions and activities of their respective organizations, as well as their boundaries and limitations.

A second panel featured speakers representing the Executive Office of the President and four different federal agencies: the White House Office of Clean Energy Innovation and Implementation; the Department of Energy (Office of State and Community Energy Programs); the National Oceanic and Atmospheric Administration (Climate Education Program); the United States Department of Agriculture (National Institute of Food and Agriculture); and United States Geological Survey (Climate Adaptation Science Centers). The presenters discussed the scope of their respective organizations' support for climate change-related efforts, highlighting the role of the academic sector. Sally Benson closed the panel's question and answer session by asking each agency how they planned to ensure that their work with the higher education community helps build long-term capacity to accelerate national climate action, rather than just supporting individual projects.

Breakout Sessions

The participatory discussions were organized around four broad themes:

1. **Campus Sustainability and Resilience**
2. **Providing Climate Services to Communities**
3. **Campuses as Living Laboratories**
4. **Climate Action in the Classroom**

These categories may not capture every climate action undertaken in the higher education community, but with virtually all participants engaged in activities fitting under one or more themes, they served as a meaningful framework for sharing experiences, comparing approaches, and identifying needs.

Concurrent sessions were held on **Themes 1 and 2** in the morning, and on **Themes 3 and 4** in the afternoon. Each session began with an introduction and brief "lightning round" presentations from three or four attendees, followed by facilitated discussions in smaller groups. Attendees chose one morning session and one afternoon session.

For the morning breakouts, approximately 60% of participants selected the **Providing Climate Services to Communities** theme, and 40% selected the **Campus Sustainability and Resilience** theme.

For the afternoon breakouts, approximately 70% of participants selected **the Campuses as Living Laboratories** theme, and 30% selected the **Climate Action in the Classroom** theme.

Each concurrent session was divided up into smaller groups for discussions guided by the following questions:

- What climate solutions are now successfully deployed on campus or in service to the community?
- Are these solutions suitable for scale-up? Can they be readily replicated and disseminated, or is significant development needed as they are scaled up in stages?
- Who are the stakeholders involved in development and implementation of these solutions, both allies and opponents? How are they connected to the college or university?
- What barriers and challenges have you faced in taking climate action by deploying these solutions? How have you addressed them?

Initially the groups discussed one topic within their theme, as detailed in the following sections. A second round of discussions allowed attendees to regroup, sharing insights from their initial group and looking for commonalities across topics within their theme.

Group members were asked to look for a particular role for students when identifying stakeholders, and to consider equity and environmental justice aspects of the solutions under consideration.

Each session addressed some or all of these questions. The following summaries cannot capture the full richness of these discussions. They attempt to highlight a variety of examples and capture the most salient take-aways within and across the workshop themes.

THEME 1: Campus Sustainability and Resilience

*Making colleges and universities more sustainable and more resilient, including paths to net zero emissions.*

Lightning Round Presenters

- Victor Udo, Bucknell University
- Nayla Alcocer, Florida International University (Student)
- Jesse Keenan, Tulane University
- Aurora Winslade, Stanford University

*Breakout Discussion Topics*

***Decarbonizing the Built Campus Environment:*** This discussion explored ways to reduce greenhouse gas emissions from campus buildings and infrastructure, and to transition towards a more sustainable and decarbonized campus environment. What opportunities are there to work together to tackle the difficult challenges in getting to net zero emissions?

***Making Campuses More Resilient:*** This discussion focused on making campuses more resilient to fire, flood, and other threats that are exacerbated by climate change. Participants shared case studies and best practices for enhancing resilience, mitigating the impacts of extreme weather events, and developing emergency planning and response strategies.

***Modernizing Transportation:*** This discussion focused on transitioning to sustainable, low-emissions transportation options. Examples included policies and incentives such as public transportation subsidies, bike share programs, charging infrastructure for electric vehicles, and electric or alternative fuels for campus vehicle fleets.

***Campuses as Functioning Ecosystems:*** This discussion explored ways to promote biodiversity and resilience in the campus environment and connected local ecosystems. Participants discussed methods for planning and managing campuses as functioning ecosystems. Examples included campuses with functioning lakes and wetlands, or instrumented and revegetated coastal shorelines.

The participants pointed to significant progress in mitigation and adaptation efforts that are making campuses more sustainable and resilient. But much work remains. As Sally Benson noted in the opening plenary, many campuses can be thought of as small or medium-sized cities. Many have created climate action plans that address land use, transportation, and the built environment, while setting targets against which progress can be measured.

For example, campus climate action plans typically include targets for reducing campus energy use and minimizing the carbon footprint of that energy. Common strategies, such as electrification of heating, cooling, and transportation systems, are generally implemented in stages. Short term goals often emphasize reducing emissions by procuring renewable energy and beginning the process of electrifying campus buildings and vehicles. Long-term goals usually include eliminating direct emissions from all campus energy generation and use. There is significant interest in both on-campus solar electricity sources and purchasing agreements for electricity generated at larger off-campus solar or wind sites. The appropriate mix of on-and off-campus sources varies substantially with geography, campus size and building density, and financial resources.

Examples and key discussion points

Most campus decarbonization plans rely on a two-tiered strategy for eliminating greenhouse gas emissions. First, incremental steps utilize a variety of means to increase efficiency and sustainability, including procuring clean electricity and lowering the carbon intensity of other sources of energy consumed on campus. In some cases, this tier has included converting oil burners to natural gas. Next, additional steps are taken to reduce direct emissions from campus to near zero. In this phase, most remaining use of fossil fuel as an energy source is likely to be eliminated. Such a strategy is consistent with the federal goal of achieving a carbon pollution-free power sector by 2035 and net zero emissions economy-wide by no later than 2050.

The first phase can be accomplished with known technologies, including electrification of some building and transportation systems, assuming a sufficient supply of clean electricity supply is available. On the efficiency front, "wet" biology and chemistry labs are among the worst offenders for many research campuses. Billions of dollars in deferred maintenance stands in the way of increasing laboratory efficiency. Programs that address this deferred maintenance could make a big contribution toward meeting campus climate goals.

The second phase, in which difficult-to-decarbonize infrastructure is addressed, requires the development of significant new technology. The academic role in the innovation ecosystem and the living laboratory approach explored in Theme 3 will be important if colleges and universities are going to lead the way to meeting federal and corresponding international emissions reduction goals. Our on-campus timelines for decarbonization must be compressed.

Many institutions are transitioning their campus fleets to electric vehicles and support EV use by faculty, staff, and students who drive their own vehicles in order to reduce their carbon footprint. For schools that are served by public transportation systems, providing subsidies to encourage their use is a powerful opportunity. And some schools are working with municipal partners to electrify public transportation systems.

Light electric vehicles, such as electric scooters, are now encouraged on many campuses. And schools often incorporate renewable energy sources, such as solar docks, as they build new infrastructure to support sustainable transportation options. Students have been major proponents of these developments at many schools. These new campus transportation options are generally well regarded despite frequent reports of growing pains.

State-level climate goals and incentives can help drive campus sustainability efforts. By 2020, the entire California State University system had reduced its carbon footprint to 1990 levels. The Board of Trustees has approved a new 2040 carbon neutrality goal aligned with state-wide targets.

Miami University is deploying an extensive system of geothermal wells to meet most of its heating and cooling needs. As a public institution and steward of public trust, it was important for Miami to gain consensus approval from the community as it transitioned its building systems away from carbon-intensive steam heating and improved the efficiency of its cooling equipment. For many community members, the potential cost-saving potential of high efficiency geothermal technology was its most attractive asset. By 2023, with about half the buildings on campus heated by geothermally produced hot water, the university has already demonstrated substantial cost savings while reducing its carbon footprint. Miami students have been involved in many aspects of this transition, including community relations. The university reports that many students consider its sustainability profile an important

factor in their decision to matriculate at Miami. Geothermal systems are also being installed in several other schools where campus density and geology are suitable.

Campus sustainability professionals must simultaneously work to reduce greenhouse gas emissions and plan for the increased risks of flood, wildfire, and other hazards due to the climate change-induced increase in extreme weather events. This creates opportunities to co-design for resilience and mitigation.

Schools have employed a variety of tactics to improve the sustainability of their campuses and the encompassing ecosystems. Examples include promoting the use of sustainable indigenous garden systems, replacing non-native plants with native species, reducing fertilizer use, and the design and installation of an “eco commons” that runs throughout campus and catches clean water for return to the local watershed.

Campus resiliency work is inherently connected to surrounding communities. MIT, for example, has worked closely with the City of Cambridge to update and harmonize flood maps for the campus and city. This work combined high-spatial resolution storm predictions generated via a customized version of a NOAA General Circulation Model with detailed building, street, and drainage system data from both MIT and the city. Such projects have co-benefits in developing relationships with municipal authorities and local residents.

Challenges and Needs

The capital costs associated with ongoing transitions in how colleges use land, provide transportation options for students, faculty, and staff, and manage their built environments have been challenging. Subsidies and incentives, including those newly created in the Bipartisan Infrastructure Law and the Inflation Reduction Act, are essential if these transitions are to be completed in time to mitigate the worst impacts of climate change.

Some institutions have received pushback from internal constituencies or from neighbors regarding their actions to improve campus sustainability and resilience. Conversely, some constituencies criticize institutions for not acting quickly enough. Continual engagement with internal and external stakeholders is essential not just in executing campus plans, but in positioning institutions of higher education as trusted and expert advisors on issues including transportation, land use, and the built environment.

THEME 2: Providing Climate Services to Communities

*Providing climate services to states, municipalities, and indigenous communities, including assistance with adaptation, mitigation, and resiliency planning*

Lightning Round Presenters:

- Ann Marie Chischilly, Northern Arizona and Institute for Tribal Environmental Professionals
- Zach Berzolla, Massachusetts Institute of Technology (Student)
- Lesley-Ann Dupigny-Giroux, University of Vermont and Vermont State Climatologist
- Kathie Dello, North Carolina State University and North Carolina State Climate Office

*Breakout Discussion Topics*

***Resilience and adaptation partnerships:*** This discussion explored partnerships with communities to develop and implement resilience and adaptation strategies in response to climate change's impact on sea level rise and natural disasters such as extreme weather events and wildfires. Discussion topics included community-driven planning and decision-making, participatory risk assessment and management, and building social, economic, and ecological resilience to climate change.

***Local transitions to clean energy and renewable technologies:*** This discussion considered collaborations with communities that wish to deploy green technologies, reduce greenhouse gas emissions, transition to renewable energy sources, and promote energy efficiency. Discussion topics included local renewable energy projects, engagement of lower-income and marginalized communities in clean energy initiatives, and the role of renewable energy in supporting local economic development.

***Climate resilient agriculture and ecosystems:*** This discussion focused on services to support the agricultural community as it adapts processes and changes crop selections in response to climate change and works to reduce the ecological impacts of climate change. The discussion covered topics such as regenerative agriculture, ecological restoration, conservation of native species, and ecosystem-based approaches to adaptation and mitigation.

***Building capacity for community-based climate research and action:*** This discussion explored issues in building institutional and workforce capacity for community-based efforts, including engagement of community members in research processes, building relationships with local organizations, and developing effective outreach and communication strategies. Discussion covered topics such as the use of participatory science to support climate research, monitoring, and adaptation; strategies for building capacity and creating effective collaborations to support local climate action; and developing a climate-engaged workforce.

Participating campuses are successfully delivering a variety of climate services to partner communities. The reach of these partnerships varies from near neighbors to statewide to multistate regions. Examples include urban heat mapping and flood mapping within a metropolitan area; focusing on extreme weather events with state agency partners; addressing energy generation, transmission and efficiency measures within a utility's service area; and coastal resilience work.

Existing service-oriented, federally funded networks such as the USDA Cooperative Extension Service, the USGS Climate Adaptation Science Centers, and NOAA's Sea Grant program are stepping up efforts to address the changing climate within current resource constraints. Universities participating in these

programs engage with communities throughout their region, and often involve students in community-oriented work. Several schools have successfully embedded public policy students in local governance work.

Among the shared lessons learned is the critical role of understanding the needs and capacities of the communities served. Needs and capacities differ among and within urban, rural, and tribal communities. To be authentic partners, universities must be able to truly listen to the stakeholders in each particular community engagement and must be committed to understanding the culture of that community.

To build trust, stakeholders should be engaged early in the process of providing a service. To maintain trust, stakeholders should be given a significant role in co-designing and implementing climate solutions that are culturally and economically appropriate, as well as effective. The breakout participants noted that the engagement of private sector entities alongside government is an important element of successful community partnerships.

Examples and key discussion points

George Mason University trains master's students to gather the data needed for municipal climate plans and to partner with small- and medium-sized communities on plan development. The university has leveraged the similarities between campus and municipal climate planning to develop long-term partnerships with local governments. Efficiencies such as using the same software across communities provide significant cost savings. Students learn to use these tools in real-world settings while making valuable career contacts.

At the University of Nebraska-Lincoln, the Chancellor identified climate resilience as a grand challenge in the long-range strategic plan. As an example of climate action under the plan, the university's award-winning program in building engineering is now partnering with architectural engineering and construction firms to develop resilience strategies that minimize the impacts of climate variability, climate change, extreme weather events, and natural disasters on communities.

Within MIT's School of Architecture and Planning, the Building Technologies group is working to mitigate the substantial greenhouse gas emissions from residential buildings by accelerating electrification and the adoption of energy efficiency measures. One strategy is to partner with communities to identify groups of homes that have similar designs and construction methods, appliances, and heating and cooling systems. The university and community then can work together to design retrofit packages and train local installation contractors to deploy them.

Many schools have developed important relationships with agricultural communities that can provide a foundation for trusted engagement on climate change and agriculture. The land grant universities' role in the USDA Cooperative Extension System, which has presence in nearly every U.S. county, is an important example. Several land-grant universities also host State Climatologists, who can amplify climate change education and outreach efforts statewide. Maintaining existing relationships with neighboring Indigenous Communities is critical as well. These partnerships all need additional resources if they are to significantly expand their climate-related activities. In addition, increased reporting requirements in many of these programs are a substantial burden that could hinder scaling.

Agricultural extension programs at land-grant institutions are using a variety of methods to communicate with the diverse constituencies they serve on climate-sensitive topics including selection of crop types or animal breeds and sizing of fields and pastures. Urban institutions run mobile classrooms and harvest rain as a water resource. Rural institutions work with growers on crop resilience.

Many institutions are working on geographically important issues such as the impact of sea level rise on the built environment along the coasts or increased flooding in river basins.

Participants identified several other federal programs with capacity to support community engagement on climate, including the National Science Foundation's Convergence Accelerator, Coastline and Peoples, and Regional Innovation Engine programs; and the National Oceanic and Atmospheric Administration's Sea Grant program and Climate Adaptation Partnerships.

Participants involved in community capacity building stressed the importance of identifying capable leaders. The skills and abilities of individuals who lead partnerships can affect the level of mutual trust and maintenance of partner relationships. Sensitivity to the use of culturally appropriate language is a particularly important skill to nurture in students and early career professionals. Appropriate financial and other incentives are also important in enabling effective academic-community engagements. At many higher ed institutions, career advancement criteria do not give much weight to community engagement and relationship building, nor to the scholarship of engagement.

Challenges and needs

The transition to climate-resilient agriculture has significant long-term benefits but requires substantial capital investments. The communities that are most at risk from climate change are often least able to make such investments and are particularly in need of collaborative assistance and supportive resources.

Human resources are also in short supply. Several participants noted that limited workforce capacity is a barrier to fulfilling the promise of academic-community collaborations and partnerships in addressing the climate challenge. Some existing training programs target expansion of the sustainability and resilience workforce, and additional programs are in development. But these programs are limited in scope and poorly cataloged. There are few roadmaps showing learners potential paths to climate-aware careers that fits their interests while meeting local needs.

Continuity can be a challenge for the academic partners in collaborations. Faculty-led or student-centered initiatives can flounder when a faculty member leaves or takes on new roles on campus, or when student leaders graduate.

THEME 3: Living Laboratories for Climate Solutions

*Serving as living laboratories that develop new climate-friendly technologies or strategies and bring them into the innovation ecosystem, including on-campus deployment*

Lightning Round Presenters:

- Derris Devost-Burnett, Mississippi State University
- Teryn Scott, Miami University of Ohio (Student)
- Lisa Shulte Moore, Iowa State University
- Melanie Derby, Kansas State University

*Breakout Discussion Topics*

***Assessing campus-generated climate solutions:*** This discussion explored how campus-based facilities can be used to further develop climate solutions that emerge from college or university research. It considered the critical components of a pilot-scale campus testbed within a climate-focused ecosystem management plan.

***Piloting commercial innovations:*** This discussion was centered on the first use of commercial innovations to address climate challenges, and the unique resources that campuses can provide to help companies test and refine new technologies or processes. It included discussion of how acting as a living lab for new commercial products can provide valuable experiences for students and improve their workforce readiness.

***Refining models and tools through campus and community testing:*** This discussion explored testing software tools and models developed by campus researchers in real-world settings. Moving these products from the lab to the campus and nearby communities is an important step in addressing their accuracy, usability, and acceptance. Students often play important roles in these processes.

***Empowering student-led innovation for climate solutions:*** This discussion covered methods for supporting students as they explore their own ideas for climate action, including identification of the resources needed for project design, construction, and execution. Experiential learning opportunities connected to climate action can be integrated into many different courses of study.

The living laboratory concept is widely perceived as a valuable approach to climate action, which can be used to integrate research, education, and demonstration activities. Various implementations of the living labs concept can be employed regardless of the size, focus, and character of the school. Examples that were discussed include the piloting of new clean energy technologies, behavioral and operational strategies, agricultural practices, and ecosystem preservation and restoration. On-campus experimentation can also be an important step in the real-world deployment and validation of new models and planning tools for resilience and mitigation strategies, and for monitoring their effectiveness.

Research-intensive institutions are using their campus infrastructure as testing grounds for new technologies and operating strategies emerging from small scale experiments or modeling. Some campuses are taking this approach further and setting up well-resourced programs and user facilities focused on lab-to-market translation, often in support of a particular industrial sector. Schools with less research activity are offering students opportunities to use campus facilities for experiential learning,

often with the inclusion of community and industry partners who bring real-world problems to the table.

A "laboratory campus" can benefit from partnerships with local industry in several ways. The ties between an institution and its local innovation ecosystem are bidirectional. They can be used to explore further development and deployment opportunities following on-campus testing. Or the institution can become an early customer for cleantech firms. Colleges and universities are desirable beta testers, well equipped to monitor performance and provide feedback as companies refine a new product.

Examples and key discussion points

Several schools have completed or are in the process of implementing campus-wide facilities upgrades based on technologies tailored to local resources. One notable example is Cornell's lake source cooling system, which has supplied chilled water to the campus for over two decades, eliminating energy-intensive refrigeration systems. A second example is Stanford University's fully electrified district heating and cooling system. Both are bespoke systems that cannot be directly replicated but provide important proofs of concept, lessons learned, and inspiration to other schools. The living lab aspect of such systems is illustrated by student-designed software upgrades that allow the Stanford system to respond to the local utility's demand signals, providing significant cost savings while improving grid stability.

Schools in automotive manufacturing states, including Georgia Tech and the University of Michigan, are helping car companies develop electric vehicles, for example, through work on battery performance and manufacturing. Iowa State University has created a sophisticated facility for pilot-scale evaluation of bioenergy products. North Dakota State University researchers invented and patented a multifunction robotic system to help farmers monitor their crops and adjust parameters like fertilizer use. Purdue University has a venture fund dedicated to agricultural technology, including financial support and innovation training for research fellows.

Several institutions fund living laboratory projects through a revolving fund. Once a fund is established, cost savings from successful projects are used to replenish it. Value can also be assigned to projects and credited back to the fund to account for externalities such as reductions in greenhouse gas emissions and avoided costs from successful ecosystem preservation projects.

Sharing information about successful student-oriented research programs at the undergraduate and graduate level, can help disseminate student-led innovations among additional colleges and universities, enhancing student skills and readiness to work at climate-friendly American companies.

The participants shared several ideas and suggestions for efficiently translating campus-based innovations into community-based solutions. They also highlighted the value of campus facilities and infrastructure for testing ideas that originate in the community. On-campus evaluation of community-developed solutions and co-developed solutions can help build trusted relationships and mutual cultural respect, laying the foundation for successful partnerships.

Challenges and Needs

The coordination of an institution's operations, research, and education functions inherent to the living laboratory approach is not without challenges. Staff and faculty need to be trained to seek out and encourage new collaborations. Policies need to be created to facilitate new interactions and reward successful participants.

The resources available to operationalize innovations on campus vary widely. Demonstration projects can quickly outgrow the available space and infrastructure capacity. Many schools do not have expertise or adequate resources for addressing intellectual property and technology transfer issues, such as the cost of patenting and attracting licensees; they would benefit from shared technology transfer services.

When the living lab approach extends beyond the campuses, some institutions must overcome stigma caused by past interactions with their community. Differences in regulatory requirements and governance mechanisms can also complicate campus-community partnerships.

The campus-as-living labs model is a rich environment for active, hands-on learning experiences across disciplines. When concepts and ideas for combating climate change, borne out of on-campus research, are assessed within the campus environment, new issues are bound to arise. The need to address complications like unexpected scaling behavior, interoperability, and commercial viability offers opportunities for students involved in the initial research to acquire new skills, and for additional students (perhaps from other disciplines) to bring new ideas and perspectives to the project.

Students are already serving as drivers of change on many campuses and are eager to do more. Thoughtful design of living lab programs should include the identification and creation of opportunities for student participation, leveraging their engagements in climate change issues across many different sectors. Participants agreed that colleges and universities should encourage student activism and develop additional pathways to channel students' energy and enthusiasm into effective climate action.

THEME 4: Climate Action in the Classroom

*Ensuring that our students are ready to work within and lead the climate-friendly businesses and industry of tomorrow, and to build and maintain the green, resilient infrastructure we need; enabling fact-based public discussions and decision-making.*

Lightning Round Presenters

- Adam Kalkstein, U.S. Military Academy (West Point)
- Zoe Byham, Rutgers University (Student)
- Erica Harvey, Fairmont University

*Breakout Discussion Topics*

***Engaging in Climate Change Across the Curriculum:*** This discussion explored ways to integrate climate change into the curriculum across different disciplines and levels of education. Discussion topics included course development and design, innovative teaching methods, and effective ways to engage students in climate-related topics. The group also addressed how to encourage cross-disciplinary faculty collaborations which can better integrate climate change information across multiple subject areas.

***Programs and Majors for Climate Action Leaders:*** This discussion focused on developing programs and majors for students who want to pursue careers in climate action, such as sustainability, renewable energy, climate policy, and environmental science. Discussion topics included developing a comprehensive curriculum, promoting student involvement in research and community-based projects, and building partnerships with industry and government to create career opportunities for graduates.

***Skilled Workforce Development:*** This discussion explored programs that train individuals for skilled trades in fields that support climate action, such as green construction, renewable energy, and sustainable agriculture. Programs offering associate degrees in skilled trades were considered along with non-degree continuing education and certification programs. The role of trade associations as partners in developing programs and curricula was also discussed.

***Public Engagement and Informal Science Education:*** This discussion explored ways to engage the public in climate action through activities on campuses and in collaboration with organizations such as museums, zoos, and nature centers. Discussion topics included developing effective exhibits and interactive experiences, engaging the public in citizen science projects, and promoting public understanding of climate change and its impacts.

The word “Classroom” in this theme title is shorthand for wherever teaching and learning take place, not just the traditional lecture hall. Virtually all the climate actions discussed at the Workshop have educational components. The discussions under this theme explored a wide variety of formal and informal educational opportunities currently available. “Classroom” efforts include survey or general education courses in climate science and sustainability and focused courses at every level, from associate’s degree to Ph.D. programs. They also include experiential learning opportunities such as internships, apprenticeships, and research assistantships, and informal learning through museums, extracurricular activities, and public forums.

At the undergraduate level, many institutions now offer climate-focused tracks within existing departments ranging from Atmospheric & Oceanic Science to Environmental Science or Engineering to

Sustainable Business. Others offer minors or certificate programs to students concentrating in a variety of fields. And a growing number of schools have developed new undergraduate majors such as Environmental Policy Analysis and Planning; Climate System Science and Engineering; Earth and Climate Science, or Urban Sustainability.

In skilled trade education, schools with strong existing labor and industry ties are revising their programs to account for new low-carbon technologies and an increased focus on sustainability. Programs supporting the agricultural, transportation, and building sectors, as well as energy-intensive manufacturing and chemical processing, are revising curricula with added course modules and new courses and laboratories. Entirely new programs and revised industry standards are also emerging, targeting the training of new workers and enhancing and updating the skills of incumbent workers.

Colleges and universities are also providing climate education as a community service outside of degree and certificate programs. Examples range from public lectures and collaboration with local science museums to the incorporation of materials on adaptation and mitigation in Cooperative Extension Service offerings. Student participation in preparation and delivery of many of these activities also provides valuable experiential learning opportunities.

Examples and key discussion points

At West Point, students were assigned a book that takes a contrarian view of climate science and asked to analyze the book's arguments using the tools and information they had learned in other science and engineering classes. Individual assignments and classroom discussions led them to a good understanding of anthropogenic climate change while also teaching them how to discuss and refute distorted and misleading information.

Capstone courses in several programs have incorporated climate-oriented, service-based projects that combine practical applications of students' technical knowledge with an opportunity to understand the needs and concerns of the community. Such courses have had good success in solidifying learning within a student's core discipline while exercising complementary soft skills.

Several schools employ students to quantify their campus' sustainability efforts as part of their studies, often using AASHE's Sustainability Tracking, Assessment & Rating System™ (*STARS*®) system.

At Fairmont State University, junior and senior honors students in an interdisciplinary seminar on campus sustainability became interested in the use of power purchase agreements to simultaneously reduce greenhouse gas emissions and the campus electricity bill. After extensive research, including interviews with on- and off-campus stakeholders, they made a well-received pitch for a solar power purchasing agreement to the President's Council. They are continuing to push the project forward.

The National Green Job Advisory Council is developing curriculum modules for integration into noncredit workforce training programs at community colleges serving three industry sectors: heating, ventilation, air conditioning and refrigeration; construction, and transportation. The goal is to future-proof legacy careers in these sectors. For example, both building operations technicians and automotive technicians need to be more comfortable with electrical work if they are to maintain solar power systems and battery electric vehicles.

The National Science Foundation has supported training efforts for workers in renewable energy and battery electrical vehicles through Advanced Technological Education and other programs.

Challenges and Needs

Many workshop attendees supported the goal of ensuring that all college students are exposed to climate and sustainability issues during their formal studies. As employers adapt to a changing climate, programs of study in various professional disciplines must be revised to prepare students for jobs that are evolving. It is widely recognized that skilled technicians will be a significant part of the climate workforce, and their training programs must also evolve to match future needs.

The curriculum revisions and expanded teaching capacity needed to support these changes will require substantial resources, including for faculty retraining and new hires. New curricula must look beyond traditional academic tracks developed to feed legacy careers. Important tactics include incorporating transdisciplinary concepts and providing hands-on training in new technologies.

New resources are also needed to support the related goal of providing relevant experiential learning opportunities for all students interested in climate and sustainability. For example, internships are too often unpaid. University-wide support for climate-focused internships would be a gamechanger for the many students who cannot afford to pass up a paid job for an unpaid internship.

Institutions must ensure that teachers, trainers, and curriculum developers are appropriately rewarded for efforts to elevate climate awareness and expand climate actions at their institutions and beyond.

Colleges and universities, industry, professional organizations, and state and federal agencies should work together to identify career paths along which current students or workers can find rewarding work while making meaningful contributions to meeting the climate goals of their communities, their employers, and the nation. Students at all educational levels need guidance to help them translate their interests in climate action into viable careers. Pathways to middle-skills technical careers supporting climate action deserve special attention, including federal support for the vital role community colleges play.

Well-informed estimates of job creation are an essential component of program capacity planning and educational advising, and should be developed with input from diverse local stakeholders.

# V. CONCLUDING THOUGHTS

The Campus and Community-Scale Climate Change Solutions Workshop brought together experts from colleges and universities around the country to examine the following assertion:

> *America's institutions of higher education represent a powerful network of innovators, educators, and students with the potential to catalyze climate action – activities that can help the nation mitigate and adapt to the impacts of climate change.*

The descriptions elsewhere in this report of the Workshop activities and the previous day's White House Forum illustrate the rich variety of innovative climate solutions colleges and universities across the country are employing on their own campuses and in surrounding communities.

But those summaries cannot capture the depth and nuances of the interactions among the attendees. Workshop participants recounted their own efforts, successes, and challenges. They were energized by the prospect of additional opportunities to work with each other, more recognition from their own institutions and the federal government, and greater opportunities to contribute to nationwide climate action through a more deliberate government-university climate partnership.

The next challenge is to find ways to build on the Workshop conversations to generate momentum for elevated engagement in climate action by the higher education community writ large. This section addresses structures, resources, and tactics needed to develop resilient, sustainable, climate-friendly campuses, provide university-based climate services on a vastly greater scale, and educate a supporting workforce, along with obstacles to those efforts and a discussion of the federal role.

## The Partnership

*Building a catalytic government-university partnership*

The assertion that a government-university partnership focused on climate action would be catalytic rests on the strength of the connections academic institutions have to their local communities, states, and regions. This largely informal network encompasses municipal and state government, industry, and philanthropic and non-governmental organizations throughout the country, as well as the higher ed institutions themselves. The Workshop highlighted the opportunity to leverage these connections as a higher education network for climate action, including but not limited to through expanded engagement with federal agencies.

Three important precedents to our approach are the great historical government–university partnerships that created the land-grant system 160 years ago, developed critical technologies the Allies used to defeat the Axis powers 80 years ago, and have helped bring the COVID pandemic under control in the current decade. In each case, the federal government called on colleges and universities, who then focused their educational and research resources on community, state, national, and global needs. **Activating this historically successful approach to address climate change, a crisis of no less magnitude, requires similar commitments from governmental and institutional leadership.**

The campus climate action network envisioned as the circulatory system of such a partnership is not a top-down hierarchical structure. It would be overlayed on the informal, loosely structured network described above by identifying climate-relevant connections and adding a lean coordination hub. The coordination hub would support management and communication functions, stimulate new connections, and accelerate the dissemination and diffusion of ideas. Cross disciplinary conversations at

the Workshop exposed many potential synergies across institutions, localities, and fields of expertise. By facilitating communication and coordination *between* existing climate action communities, a campus climate action network could exploit these synergies to make actions more effective and accelerate scaling.

The historical successes of the government-university partnership model suggests that a strong climate-focused partnership can help position the United States as a global leader in shaping the transitions of the energy, transportation, and agricultural sectors in response to climate change, simultaneously addressing national climate goals and stimulating economic growth. Workshop participants described ongoing work at numerous institutions supporting sustainable transitions in each of those sectors.

## Federal Adaptations

*A Coordinated approach to higher education interactions across federal agencies*

Better coordination across federal climate programs, and between the government and the academic community would solidify the relationship between the two sectors and help build the foundation for creating change at scale. A consistent approach to higher ed participation in federal climate programs and an efficient interface with sponsoring agencies would facilitate effective participation in programs sponsored by single agencies, as well as evolving climate education and climate-related workforce programs spanning multiple agencies.

The Executive Office of the President (EOP) should work with agencies to ensure that roles for universities are considered in the development of climate change programs. For established programs, EOP should provide a first point of contact for interested colleges and universities and work to harmonize their lines of communication across EOP offices and with individual agencies. EOP offices that could serve as a centralized liaison to the academic community include Office of Science and Technology Policy, US Global Change Research Program, Domestic Policy Office, and Climate Policy Office.

Designated points of contact should also be established for agency programs applicable to campuses and communities. Municipal governments and community organizations seeking higher education partners to assist them in navigating federal funding opportunities would benefit from centralized contacts, as would the partnering colleges and universities.

## Higher Education Adaptations

*Preparing the climate-ready workforce*

Higher Education plays a vital role in ensuring that the nation's workforce is ready to grow the green economy and in providing trained experts to work on decarbonization and climate adaptation. As the impacts of climate change become more apparent economy-wide, sustainability, mitigation, and adaptation experts will become increasingly in demand.

Institutions in all sectors of higher ed are examining their curricula with changing workforce needs in mind. Weaving topics relevant to climate science, sustainability, and clean technologies into individual courses and degree programs provides insight into emerging career pathways in research, industry, and government for students with an interest in climate change. Contemporary examples and case studies related to climate change and climate action can be introduced across many fields of study, building

awareness and imparting knowledge that students can draw on in the future, whether as leaders in efforts to address climate change or informed members of civil society.

Greening the national energy network, transitioning to electric vehicles, and reducing energy use and greenhouse gas emissions in the building sector require workers with new competencies. Shortages of qualified electricians, HVAC technicians, and other specialized workers are already limiting the pace of progress in some regions. Community colleges have a critical role in training skilled workers and upskilling current workers to meet workforce needs. The availability of resources for recruiting and retaining students can have a significant impact on the success of skilled worker training programs and should be considered in program planning.

*Engaging students to catalyze change*

Today's students will become the policy makers and the climate workforce of tomorrow. They are important stakeholders in campus climate policies and practices and can be catalysts for change. Opportunities for interested students to be fully engaged in their school's response to climate change through courses, experiential learning, and participation in debate and decision-making provides a foundation for future leadership roles in civic, municipal, and industrial climate action.

*Ensuring that institutional policies support climate engagement*

Workshop participants noted the need for institutional policies that fully recognize contributions to climate action, including some that may be outside the traditional academic and scholarly achievement framework. Climate action often involves collaboration across disciplines, community-based and service-oriented projects, and similar activities that are undervalued at some academic institutions.

Institutional reward structures should be reviewed and if necessary revised to encourage climate action leadership. This includes tenure and promotion policies as well as career pathways for staff and non-tenure track faculty. Institutional recognition of the importance of such work will encourage faculty and staff to develop cross-disciplinary activities, build community partnerships, and engage with local governments and industry on climate adaptation and mitigation efforts.

## Environmental Justice & Equitable Access

*Engaging diverse voices*

Diverse voices must continue to be heard as the higher education community envisions, selects, plans, and implements locally appropriate climate solutions. There was consensus among the participants that a commitment to environmental justice must permeate campus and community climate actions and should include efforts to redress prior environmental injustices. Tools for identifying underserved and historically disadvantaged environmental justice communities are now available from the Environmental Protection Agency and the Council on Environmental Quality, and can help in prioritizing the allocation of resources.

Well-resourced institutions acting in isolation will not be able address environmental justice issues at scale. Contributions from all parts of the higher education sector are needed to implement equitable and culturally sensitive solutions to the problems created by climate change. The campus climate action network must be inclusive, which will require marshaling of resources.

*Working with Local Communities*

The theme of effective partnering with local communities was woven throughout the Workshop. Community partnerships are inherent in provision of climate services work, work with indigenous populations, and the land-grant system and extension programs. Partnerships with communities are also components of climate projects focused on energy technology, transportation, and natural ecosystems, and in efforts to identify and address workforce training needs. In each of these areas, the work of devising and implementing climate solutions must be undertaken with great respect for local residents and organizations.

The mantra that authentic partnerships, meeting the needs of all parties, create appropriate solutions is an essential element of our concept for stimulating broad diffusion of climate-friendly technologies and strategies. There is no uniform model of community-academy partnerships. While climate change poses threats to tribal lands in the Pacific Northwest and to the Menominee forests in the Midwest, neither the threats nor the tribal cultures are identical. The economic and environmental impacts of renewable energy development in the Northeast differ from those along the Gulf Coast. The natural ecosystems of the United States are diverse, as are the built environments.

These examples all point to the need for tailored climate solutions. Climate-engaged colleges and universities must work with individuals and organizations from each of their partner communities, first to understand their cultural view of climate change and their particular circumstances, and then to co-develop climate action plans incorporating solutions appropriate to that culture and context.

Researchers and educators should not 'parachute in' with technological solutions to problems as they perceive them. Yet many technologies and strategies for mitigating or adapting to the impacts of climate change are widely applicable. There is great value in sharing stories of success and failure across communities, and in providing insight from the solving process along with the solutions themselves. Higher education can bring a catalog of technologies, processes, and case studies to the table, while community members bring specific knowledge of local climate impacts, regulations, attitudes, and capabilities. Candidate solutions can then be collaboratively assessed through culturally respectful dialog. How issues are identified and approaches are discussed is critical to the successful tailoring of appropriate local solutions.

*Expanding equitable access to resources*

Expanding climate action requires expanded resources for climate action. The inadequacy and unequal distribution of current resources, financial and otherwise, is a major barrier to expanding higher education's role in climate action. New government, institutional, and philanthropic support must be mustered to maximize the scale of the sector's climate actions and realize its catalytic potential. Funding should be available to build capacity for sustained engagement in climate education, service, and research, not just to support a succession of unrelated projects with little collective impact on institutional capabilities.

As the question-and-answer session with the Workshop's government panelists made clear, the impacts of resource limitations are not felt equally across post-secondary institutions. Institutions with strong ties to communities that have been marginalized and overburdened by pollution and environmental degradation can play a disproportionate role in environmental justice efforts. But these institutions often face severe resource shortages. It is not enough to make a network open to all; resources must be made available for all institutions to participate.

## Networking & Information Sharing

*Building on Existing Foundations*

Many climate-active campuses are already connected through existing organizations. These entities include the private sector organizations represented at the workshop (Association for the Advancement of Sustainability in Higher Education, Second Nature Higher Education Climate Leadership Network, and IDEA) and the climate centers, hubs, and programs supported by federal agencies (USGCRP, USDA, USGS, NOAA , NSF, NASA, and DOE, (for instance CAP/RISE and Sea Grant (NOAA), and Coastlines and People Hubs (NSF)).

The private sector organizations currently focused on campus climate action have limited capacity for expansion but are interested in growing the number of participating institutions and strengthening connections with other stakeholders while meeting their missions. They have already suggested follow-up activities and will be valuable partners as the community forges a path forward.

In addition to these dedicated forums for climate-active institutions, many broader national organizations are ripe for engagement. A few examples are the American Association for the Advancement of Science, the American Association of State Climatologists, the American Geophysical Union, and the National Academies of Science, Engineering and Medicine. Higher education sectoral organizations such as the Association of American Universities, the American Council on Education, and the Association of Public and Land-grant Universities could also play an important role in coordinating climate action among their members. Some of these organizations have expressed great interest in the government-university climate partnership model and are taking steps to explore it further.

*Accelerating Climate Actions by Improving Access to Information*

The federal government and the higher education community can accelerate climate action by improving the dissemination of information they each produce or collect.

Federal agencies speak enthusiastically about schools' access to many new climate funding programs through the Bipartisan Infrastructure Law and the Inflation Reduction Act. But schools must navigate numerous offerings and proposal policies from multiple agencies to identify relevant programs and verify their eligibility. A user-friendly central repository of essential information from all relevant federal agencies would go a long way toward ensuring that the entire academic community can make the best use of newly available resources. Timely, easy to use information regarding support for campus and community climate efforts would be helpful to all and could be critical for less-resourced institutions.

Higher educational institutions should also share information more widely among themselves and with their communities. For example, institutions are using a variety of strategies and tactics to make their campuses more sustainable, resilient, and energy efficient. Widespread sharing of best practices and lessons learned through these individual efforts, along with data quantifying the outcomes, would make it easier for other schools to emulate successes, overcome hurdles, and avoid failures.

## Active Federal Participation is a Key Signal and Enabler

The federal government is, and must remain, an irreplaceable partner to the higher education sector. It has countless mechanisms at its disposal which could provide resources to drive campus climate and community action to a new scale. Future efforts by the higher education community will not be as

successful in addressing climate challenges without the full participation of the federal government in capacity building, resource allocation, and co-design.

Within current climate programs and initiatives, the federal government could easily take incremental steps to strengthen its engagement with the higher education community. For example, it could streamline access to information regarding roles for colleges and universities in climate assistance programs, establish higher education climate liaisons within executive branch agencies, and identify industry and community partnership opportunities.

With additional resources, it could directly support expanding the scope and reach of federally supported climate centers and hubs. Even modest additional funding could enable broader dissemination of the wealth of knowledge generated by participating colleges and universities and greater access to their experts.

Additional steps could include developing and funding new models for expansion of current programs. Options include creating a multiagency network connecting existing centers and hubs, and giving the United States Global Change Research Program a direct role in supporting campus-based climate service programs, in line with its own expanding climate services mission.

While largely incremental, these kind of changes in federal policy and complementary changes in institutional policies can accelerate campus and community climate action in meaningful ways. But more foundational changes are needed to transform the relationship between the government and the academic community into a catalytic partnership supporting action on a scale commensurate with the impacts of climate change.

Such transformations do not happen instantaneously or in isolation. The land-grant grant university system we know today, for example, was born in the midst of the Civil War and the rise of Industrial America. Over 160 years it has taken on an expansive research role, made cooperative extension services available nationwide, and become far more inclusive. At several points in time, federal actions punctuated this evolution, serving as powerful charges to the academic community and delivering new resources for their implementation.

One suggestion for using a university-government partnership to change the nation's climate trajectory is to create a climate-grant system, inspired by the land-grant model but focused on climate change-related needs. Ambitious approaches like this require Congressional action to give federal agencies new authorities and to fund their implementation.

The schools represented at the workshop are but a few of the many institutions of higher education already involved in climate action. They are working at greening their campuses, piloting and disseminating tools for climate change mitigation and adaptation, educating a climate-ready workforce, and helping nearby communities address their own climate challenges. Federal support for a campus climate action network could start the process of transforming these ongoing efforts into an enduring government-university partnership.

The Forum and Workshop offered powerful evidence of support for such a partnership. Additional work should consider in detail how a campus climate action network would operate and scale. Scoping should be undertaken in collaboration with potential community and industry partners and government and philanthropic sponsors. Topics could include formalizing current climate-related connections to seed the network, mechanisms for sharing best practices and key program information, and coordination and governance mechanisms, as well ambitious models such as a system of climate-grant institutions. A well-

designed university-government climate partnership will be able to evolve over decades to support sustainable solutions to climate challenges on our campuses, in our communities, and beyond.

## Appendix 1: Forum Agenda

Workshop participants attended the *White House Forum on Campus and Community-Scale Climate Change Solutions* on March 8, 2023 at the Eisenhower Executive Office Building. A live webcast of the Forum was available to the general public and is archived online.

**1:00 PM | Opening Remarks**

- Sally Benson – Deputy Director for Energy, OSTP
- Mary Frances Repko – Deputy National Climate Advisor, White House
- Alexandra Isern – Assistant Director for Geosciences, NSF

**1:15 PM | U.S. Government Panel: Leveraging Higher Education Institutions for Developing Regional Climate Solutions**

- *Moderator* – Costa Samaras – Principal Assistant Director for Energy, OSTP
- Caitlin Simpson – CAP/RISA Program Manager, NOAA
- Julian Reyes – National Coordinator for the Climate Hubs program, USDA
- Anjuli Bamzai – Senior Advisor on Climate, NSF Directorate for Geosciences
- David Nemtzow – Senior Advisor, DOE Loan Programs Office

**1:55 PM | College and University Panel: Accelerating Community Climate Solutions through Higher Education Partnerships**

- *Moderator* – Todd Crowl – Director, Institute of Environment, Florida International University
- Matthew Richardson—Acting Director, Center for Urban Research, Engagement, and Scholarship, University of the District of Columbia
- Robert Kopp – Co-director of the University Office of Climate Action and Director of the Megalopolitan Coastal Transformation Hub, Rutgers University
- Girard Melancon—Program Director, National Green Jobs Advisory Council, National Council for Workforce Education
- Lara Skinner – Executive Director, Climate Jobs Institute, Cornell University
- Erica Fleishman – Director, Oregon Climate Change Research Institute, Oregon State University

**2:35 PM | College and University Panel: Campuses as a Proving Ground for Sustainability, Climate, and Energy Solutions**

- *Moderator* – Matt St. Clair, Chief Sustainability Officer, University of California System
- Jennifer Haverkamp – Director, Graham Institute for Sustainability, University of Michigan
- Chris Caldwell – President, College of Menominee Nation
- Julie Newman – Director of Sustainability, Massachusetts Institute of Technology
- Randi Thomas – Vice President of ASPIRE, Miami University
- Peter Dorhout – Vice President of Research, Iowa State University

**3:15 PM | Closing Remarks**

- Laura Petes – Chief of Staff for Climate & Environment and Assistant Director for Climate Resilience, OSTP
- Maya Tolstoy – Dean of the College of the Environment, University of Washington

## Appendix 2: Workshop Agenda

The plenary and discussions sessions of the workshop were held on March 9, 2023, at the David A. Clarke College of Law of the University of the District of Columbia

**PLENARY SESSION**

**8:30 AM** | Welcome to University of the District of Columbia and Opening Remarks

- Victor McCrary – Vice President for Research and Vice Chair, National Science Board

**8:40 AM** | Workshop Charge

- Sally Benson – Deputy Director for Energy, Office of Science and Technology Policy
- Alexandra Isern – Assistant Director for Geosciences, National Science Foundation
- Maya Tolstoy – Dean of the College of the Environment, University of Washington

**9:00 AM** | Panel: Organizations Connecting Colleges and Universities to Increase Impact and Inclusion

- *Moderator* – Meghan Chapple – Vice President of Sustainability, Georgetown University
- Tim Carter – President, Second Nature
- Meghan Fay Zahniser – Executive Director, Association for the Advancement of Sustainability in Higher Education (AASHE)
- Rob Thornton – President and CEO, International District Energy Association (IDEA)

**9:45 AM CONCURRENT SESSIONS**

*From. 9:45 to 11:10, Attendees participated in one of these two simultaneous sessions, each addressing a major workshop theme.*

**THEME:**
**CAMPUS SUSTAINABILITY AND RESILIENCE**

Introduction and lightning round

**10:10 AM Breakout Discussions**

Modernizing transportation

Campuses as functioning ecosystems

Decarbonizing the built campus environment

Making campuses more resilient

**10:40 AM**
Shuffle groupings for discussion across Sustainability and Resilience topics

**THEME:**
**PROVIDING CLIMATE SERVICES TO COMMUNITIES**

Introduction and lightning round

**10:10 AM Breakout Discussions**
Resilience and adaptation partnerships

Transitions to clean energy and renewable technologies

Climate resilient agriculture and ecosystems

Building capacity for community-based climate research and action

**10:40 AM**
Shuffle groupings for discussion across Climate Services topics

**PLENARY SESSION**

**11:15 AM** | Panel and Q&A: U.S. Government Support for Campus and Community Climate Action

- *Moderator* – Philip Lippel – Assistant Director, MIT Washington Office
- Joshua Peck – Senior Policy Advisor, White House Office of Clean Energy Innovation and Implementation
- Chris Castro – Chief of Staff, DOE Office of State and Community Energy Programs

- Meade Krosby, University Director, Northwest Climate Adaptation Science Center, University of Washington, representing USGS National and Regional Climate Adaptation Science Centers
- Frank Niepold – Senior Climate Education Program Manager, NOAA
- Brent Elrod – Acting Director for Programs, National Institute of Food and Agriculture, USDA

**LUNCH 12:00N – 12:45 PM**

**12:45 PM CONCURRENT SESSIONS RESUME**

*From. 12:45 to 2:10, Attendees participated in one of these two simultaneous sessions, each addressing a major workshop theme.*

**THEME:**
**CAMPUSES AS LIVING LABS**

Introduction and lightning round, Room 506J

**1:10 PM Breakout Discussions**

Empowering student-led innovation for climate solutions
Assessing campus-generated climate solutions
Piloting commercial innovations
Refining models and tools through campus and community testing

**1:40 PM**
Shuffle table groupings for discussion across Living Labs topics.

**THEME:**
**CLIMATE ACTION IN THE CLASSROOM**

Introduction and lightning round, Room 506

**1:10 PM Breakout Discussions**
Engaging in Climate Change Across the Curriculum
Programs and Majors for Climate Action Leaders
Skilled Workforce Development
Public Engagement and Informal Science Ed

**1:40 PM**
Shuffle table groupings for discussion across Action in the Classroom topics.

**CLOSING PLENARY SESSION**

**2:15 PM |** Summary of Breakouts and Next Steps

- Meade Krosby (University of Washington), Julie Newman (MIT), Peter Dorhout (University of Iowa), Aurora Winslade (Stanford University), Todd Crowl (Florida International University)

**3:25 PM |** Closing Remarks

- Philip Lippel (MIT), Sang Han (University of Washington), Sally Benson (OSTP)

**3:30 PM |** Adjourn

## Appendix 3: Highlights of the White House Forum on Campus and Community Climate Solutions

The White House Forum on Campus and Community Climate Solutions, held on the White House grounds March 8, 2023 under the sponsorship of the Energy Division of the Office of Science and Technology Policy, featured speakers from both government and academia. The event was live-streamed to the general public, attracting about 900 viewers. All Forum presentations remain available for viewing online.

The college and university panelists at the Forum discussed innovative sustainability and resilience strategies and solutions emerging from the higher education community, and how they can be taught and implemented on campuses, in the surrounding communities, and beyond.

Their remarks set the stage for the presentations and robust discussions among all the participants at the Workshop, held the following day at the University of the District of Columbia. The following highlights of the academic panelists' remarks at the Forum are selected to illustrate exemplary ongoing work in these areas.

**Todd Crowl** of Florida International University, one of the largest minority-serving institutions in the country, moderated the *Community Solutions* panel. He noted that campuses nationwide are deeply engaged in helping their states and communities increase equitable resilience, clean energy, and sustainable infrastructure. He commented that communities and campuses must work together to understand the knowledge needed to build trust and communicate.

**Lara Skinner**, director of the Climate Jobs Institute at Cornell University, described how the School of Industrial and Labor Relations (ILR) studies the labor and employment impacts of climate change and serves as a resource to the labor movement, legislators, and others, ensuring that efforts to address climate change lead to the creation of high-quality jobs. Dealing with climate change is a historic and disruptive transition affecting every part of the United States' economy. ILR starts with the premise that the climate crisis and the crisis of inequality with respect to income, race, gender, wealth, and opportunity must be addressed at the same time. She suggested that educational institutions focus on the activities that will create the most jobs locally, centering frontline communities while building a new economy.

For **Girard Melancon** of The National Green Job Advisory Council, the economic disruption and new job creation caused by climate change represents a once-in-a-career opportunity for community college practitioners. As they redesign courses and programs to support more sustainable industrial practices, he said, educators must work strategically with employers and truly progressive community-based organizations. The council, working under the umbrella of the National Council for Workforce Education, has selected three broad areas as the focus of their skilled-career training efforts – heating, ventilation, air conditioning, and refrigeration; transportation; and construction. The council seeks to design inclusive new education models that bring in more people who are Black, Indigenous, People of Color, and women.

**Erica Fleishman** of Oregon State University pointed out that the Oregon Climate Change Research Institute, which she directs, was created by the people of Oregon, through the state legislature, to

conduct research and provide information on climate change and its effects on natural and human systems. The institute's mission explicitly includes collaborations with the state government.

**Matthew Richardson** of the University of the District of Columbia (UDC) spoke of the Center for Urban Research Engagement and Scholarship's work to create healthy cities, with a focus on marginalized groups that are disproportionately impacted by the climate crisis and other environmental degradation. He challenged the university community to take the full urban experience into account and to invite urban residents in to help educate us as institutions. UDC, an urban land-grant institution, engages with people of all ages in the DC community. The environmental and social-justice challenges that are getting attention today have been part of their reality for generations, and past solutions have often been inequitable. It can be difficult to create the right community partnerships. UDC's suggestion is to find well-established community organizations that are doing good work in the areas where you want to provide expertise. He encouraged institutions to support those initiatives instead of trying to take them over or replace them.

As co-director of the University Office of Climate Action at Rutgers University, **Robert Kopp** provides oversight to the university's climate action plan. He also leads a collaborative National Science Foundation Coastlines and People Hub focused on urban coastal climate risk management and co-leads a Rutgers graduate program in climate risk management. For a decade, Rutgers has convened an alliance of governments, communities, and businesses to address the state's climate challenges and helped to deploy nature-based solutions for coastal resilience. More recently, it has become the host of the New Jersey Climate Change Resource Center, a state-authorized and -supported effort modeled in part on the Oregon Climate Change Research Institute. The new center leverages the expertise of the entire New Jersey higher education sector to help the state and communities adapt to and mitigate climate changes, working in areas such as the development of climate-smart municipal plans and state involvement in climate-related regional transportation initiatives.

Noting the strong participation of land-grant universities in the Forum and Workshop, Kopp called attention to the USDA Cooperative Extension System as a long-established example of a service focused on effective community problem-solving at scale, with a presence in nearly every U.S. county. That model, he pointed out, requires staff whose primary job is convening people to link societal needs to university research and education. In his words, "It cannot be done by moonlighting research and teaching faculty alone." Replicating such a model for climate would require investment in a national climate extension capacity.

**Matthew St. Clair**, Chief Sustainability Officer for the University of California system, moderated the next panel, *Campuses as a Proving Ground for Sustainability, Climate, and Energy Solutions*.

**Chris Caldwell,** President of the College of the Menominee Nation, began the presentations. The college was created 30 years ago to prepare students to operate in a multicultural world by coupling the tribe's worldview with Western-based understandings. In 2010, the college's Sustainable Development Institute began to focus on what climate change means to the Menominee as an Indigenous People, in our relationship with our land and our forest. The college's climate change activities emerge from a sustainable ecosystem perspective that is deeply engrained in the tradition of the Menominee and many other Native American tribes. The Native community's view that everyone is connected to and impacted by the physical environment—the formative notion that we are responsible for the well-being of "All Our Relations," human and non-human – struck a chord with many participants and was brought up repeatedly in Workshop discussions.

Soon after arriving at the University of Michigan four years ago, **Jennifer Haverkamp** was asked to co-chair a commission to map the university's path to carbon neutrality, with a clear charge to identify solutions that were scalable and transferable. That, she was soon convinced, should be the definition of campus sustainability. Given the intensity of the climate crisis, it's our responsibility to take our solutions outside of the ivory tower. Reaching carbon neutrality is a process involving every member of the campus community, not something that is achieved at one point in time. Every wave of students coming through must be brought into that new culture. They have to see it, feel it, believe it, and graduate wanting to do something about it. A demonstrable example of Michigan's drive towards greater sustainability is purchasing 50% percent of electricity from carbon-neutral sources today, on the path to 100 percent by 2025. The university is installing 25 megawatts of solar generation on campus and around campus. A $25-million revolving energy fund helps schools and colleges fund energy efficiency projects, with the savings replenishing the fund. And given Michigan's role in the automotive industry, the university of course, has a variety of sustainable transportation initiatives, including hosting a state-funded center working to accelerate the transformation to electric vehicles.

Iowa State has been recognized as a Top 10 Sustainable Impact Campus by the Association for the Advancement of Sustainability in Higher Education. It's also a partner in USDA's Midwest Climate Hub. Vice President **Peter Dorhout** spoke about their work from the perspective of a chemistry professor and senior research officer. As a land-grant university, Iowa State has a sustainability gene coded into their DNA. It is expressed in the university's education and research activities and through its cooperative extension, propagating new generations of people trained to develop and implement sustainable innovations. Cooperative Extension is the trusted voice of our universities in the surrounding communities. That trust comes about through engaging folks in projects from the beginning, engaging them in design and development decisions. The agricultural sector has a daunting task ahead. It needs to promote a culture of sustainability – you can't have agriculture without culture – while preparing to feed 10 billion people by 2050. Several of Iowa State's flagship projects tackle this challenge with a circular bioeconomy model. Researchers at the Bioeconomy Institute, for example, are looking at new uses for corn stover, the leftover plant material that remains after harvest. It is typically left to compost in the field, releasing greenhouse gasses. The Biochar Project has developed a process to turn the stover into valuable oils and char, a form of carbon which can be sequestered or used as a soil amendment. And it does so without external energy input. The process has been scaled up from the research lab to a larger on-campus demonstration facility, where it won an X-Prize Milestone award. That has attracted corporate and community partners to build a production-scale facility with the capacity to produce 3,500 tons of biochar and 5,000 tons of bio-oil per year, removing an equivalent of 4,500 tons of $CO_2$.

The signature campus sustainability effort at Miami University in Oxford, Ohio, is its decision to convert to geothermal energy systems. Vice President **Randi Thomas** said that all Miami's stakeholders agree that the public university is obligated to be a good steward of the public trust. That may have started with finances, but it extends to sustainability. With over half of the buildings on campus now utilizing geothermal heating and cooling, the school has been able to satisfy both those obligations simultaneously. Combined with other energy efficiency measures, the geothermal conversion has delivered $68 million in energy savings over 10 years. The economic payoff has brought around some stakeholders who are less sophisticated on sustainability issues than most of the Forum audience. But economic benefits are not the only reason to do it. When Miami President Gregory Crawford greeted 4,000 incoming students at this year's convocation, he spoke about the many activities and opportunities on campus. When he got around to what the university is doing on sustainability, he got a standing ovation. Students want to do something about climate change. The institution needs to harness their enthusiasm. As Miami moves forward towards zero emissions, it is looking at solar to get

the last bit of fossil fuel burning out of its energy mix. The city of Oxford is also now looking at solar energy. Right now, they can't find a way to collaborate, the approval processes and timescales are too different. We need to find ways to incentivize collaborative work, perhaps through some of the new federal programs.

**Julie Newman**, Director of the Office of Sustainability at the Massachusetts Institute of Technology, noted that many of the participants had already worked to increase the scope of sustainability efforts. Institutions of higher education must now increase their collective scaling capacity by several orders of magnitude. Our institutions can continue to build on the campus sustainability models built over the past two-plus decades. But, she said, our institutions also have to plan for the essential, complex role higher education must play in the future to combat and prepare for a changing climate. Transformed colleges and universities will be capable of responding to the changing climate and models of sustainability. Campuses are integrated into and reliant on local, state, regional, and global systems. So a systems approach is necessary, with social and technical efforts by the individual, campus, city, state, nation, and beyond. Her mission at MIT is to transform the institution into a generator of just, equitable, applicable, and scalable climate solutions. She suggested that this should be every campus's mission. At MIT, every sustainability office project must have an educational component and a research partner. That turns the campus into a collaborative test bed where data collection, analysis, and iterative refinement are the norm. Newman wants to realize a fully scalable laboratory where teams can devise, pilot, implement, and evaluate the best new ideas in climate mitigation and resilience.