MODELING AND RESEARCHING SOLUTIONS

To address climate change globally, all of society must take steps to reduce carbon pollution and adapt to a changing climate. To serve 19 million students annually, higher education contributes to our country's carbon pollution through its energy use, transportation, buildings, athletic facilities, food systems, waste, purchasing, and land use. Additionally, higher education faces climate vulnerabilities to operations, learning, and infrastructure. The 4,000 institutions of higher education across the country can model, research, and develop climate mitigation and adaptation solutions across their operations.

In serving 19 million students annually, higher education institutions collectively have an expansive physical footprint, and every college must take steps to mitigate and adapt to climate change. Hundreds of institutions have invested in renewable energy on and off campus, overhauled existing heating and cooling systems, and made existing buildings more efficient. Many others have started adapting to climate change with strategies like conserving water in the face of extended droughts or adjusting landscapes to reduce flooding. Some research institutions have developed and tested innovative climate mitigation and adaptation solutions. All institutions of higher education can accelerate action to reduce carbon pollution and build resilience to climate risks. As they take steps to reduce carbon pollution and adapt to climate change, institutions of higher education can research the effectiveness of solutions and test new solutions to extend their knowledge to the broader community.

KEY DEFINITIONS

Mitigation: Measures to reduce the amount and rate of future climate change by reducing emissions of heat-trapping gasses (primarily carbon dioxide) or removing greenhouse gasses from the atmosphere.

Adaptation: The process of adjusting to an actual or expected environmental change and its effects in a way that seeks to moderate harm or exploit beneficial opportunities.

Resilience: The ability to prepare for threats and hazards, adapt to changing conditions, and withstand and recover rapidly from adverse conditions and disruptions.[1]

Climate Mitigation in Operations

Whether it is decisions about how to power lights, heat buildings, water landscaping, or get students around campus, the 4,000 colleges and universities across the country can take steps to reduce carbon pollution and promote a healthier, more sustainable environment.

Many of the nation's 4,000 colleges and universities function like small cities, serving tens of thousands of students, faculty, administrators, and support staff. As a result they contribute significantly to our carbon emissions. For example, Texas A&M covers more than three times the land area and has two times the population of Beverly Hills, California. Collectively, higher education institutions manage over 210,000 buildings with 6.2 billion square feet of floor space. They spend $36.8 billion annually on facilities operations, maintenance, and utilities.[2] Colleges must manage large-scale heating and cooling systems, and many even run their own power plants. Higher education can also affect change through its purchasing power. Reducing waste begins with choice in purchases, and universities purchase billions of dollars of goods every year. Campuses have the opportunity to create circular economies. To reduce its impact on the climate, higher education needs to decarbonize energy sources, upgrade existing infrastructure, electrify transportation modes, and better manage waste.

To do this, institutions should understand where their carbon pollution originates. Sustainability directors, faculty members, and other staff have spearheaded important campus mitigation and adaptation efforts around the country. Second Nature has secured over 900 signatories to Presidential Climate Commitments toward mitigation, resilience, and carbon neutrality. As part of the mitigation commitment, colleges perform an extensive inventory of campus systems to identify sources of carbon pollution. Knowing where carbon pollution comes allows institution leaders to target reduction efforts where they will have the largest impact and track progress toward decarbonization goals. Similar to the largest sources of our emissions nationwide, college campuses often find that energy sources, heating and air conditioning, and transportation drive the bulk of their carbon pollution.

Top right photo courtesy of California State University. Bottom Photo courtesy of Second Nature

The imperative to reduce carbon emissions provides an opportunity for campuses to integrate mitigation efforts with their educational missions. The need to renovate buildings to ensure energy efficiency, install modern HVAC systems, and utilize clean renewable energy sources mirror the decisions that businesses, governments, and households must make throughout our society. Colleges and universities can use on-campus climate action plans to teach students about these new technologies, imparting practical skills, while also reducing carbon pollution.

Higher education institutions will not be able to take these steps alone. While better resourced institutions have the ability to invest in new, energy efficient buildings, many MSIs, community colleges, and regional state schools may lack the necessary capital.[3] Yet, making these investments can reduce the amount higher education institutions pay annually on utilities. Policymakers, including higher education system leaders, legislators, and governors, must prioritize investments to support the clean energy transition on campus.

Decarbonizing Electricity Sources

Globally, universities' largest source of carbon pollution comes from purchasing electricity—typically accounting for around 40% of their carbon footprint.[4] In the U.S., colleges and universities spend an estimated $6 billion annually on energy.[5] Some schools use so much energy that they locate power plants on campus, which historically has meant relying on fossil fuels. Given the scope of the problem, institutions often start mitigating their climate impact by switching to renewable energy.

Setting a national example, more than 40 colleges and universities across the country now receive all of their power from renewable sources.[6] Colleges are increasingly producing large amounts of renewable energy on campus. To shift to renewable sources for electricity, institutions of higher education can consider direct installation on campus through options like solar panels or purchasing renewable energy from utilities. The dramatic fall in solar panel prices has made shifting to solar energy more cost-effective than fossil fuels.[7] In 2011, California's Butte College became the first higher education institution to generate all of its electrical power through renewable sources by installing over 25,000 solar panels on campus.[8] The college now gives excess energy back to the grid and estimates it will save up to $100 million over 30 years.[9]

Bright Spot: University of Delaware

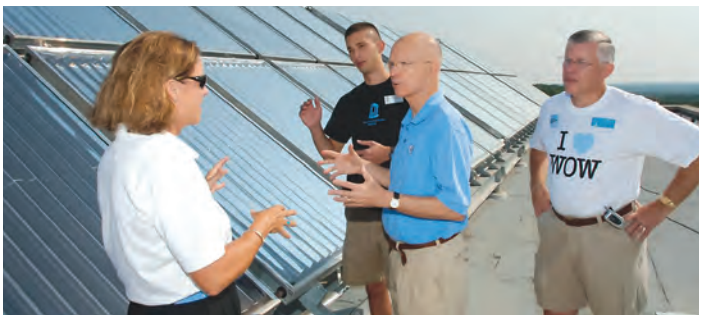
The University of Delaware (UD) installed a wind turbine that powers its Lewes campus and dozens of homes in the local community.[11] UD's wind turbine has facilitated research on avian and bat mortality, sea-air corrosion, and drivetrain optimization while serving as an adjunct training tool for the university's wind power program.[12]

While solar panels are the most common on-campus source of renewable electricity, they are not the only one—some institutions are installing other systems, including wind turbines and geothermal systems. Nebraska's Central Community College built a series of wind turbines and solar installations that not only provide electricity to the institution but also serve as training facilities for the college's energy technology program.[10] Following these examples, higher education institutions can invest in clean energy production while providing students with hands-on experience with new technologies.

Not all universities have the space or resources to install renewable energy generation on campus, but they can still choose to purchase power from renewable sources. Several institutions purchase more renewable power than they directly consume either to account for carbon emissions elsewhere or to prepare for future growth. Georgetown University in Washington, D.C. has led the way nationally, generating 130% of its energy needs from renewable sources.[13]

For institutions concerned about costs or finding renewable power companies, a financial tool known as a power purchasing agreement (PPA) can help. A PPA is a long-term contract for power between a college and a renewable energy provider which can be used to generate on-site or off-site renewable energy. For off-site generation, the security of the contract allows the energy company to build a renewable energy facility such as a solar power plant. In exchange for the long-term financial commitment—usually between 15 and 25 years—the university receives consistent clean power without having to invest up front capital or handle maintenance costs.

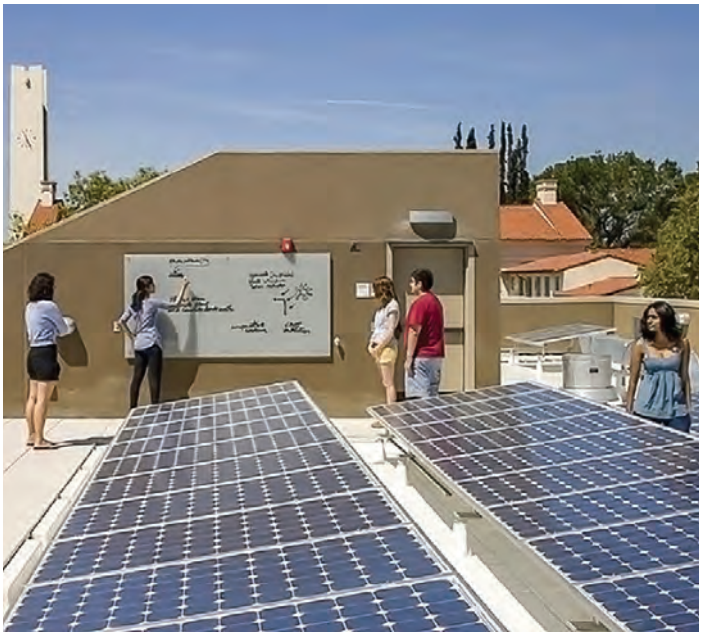
Shifting to renewable energy also saves colleges and universities money on their annual energy costs. For instance, Penn State's 25-year solar energy purchase agreement saved the university $2.5 million in energy costs over just the first two years—more than four times what it expected.[15] This is money that can be redirected to support the educational mission of higher education.



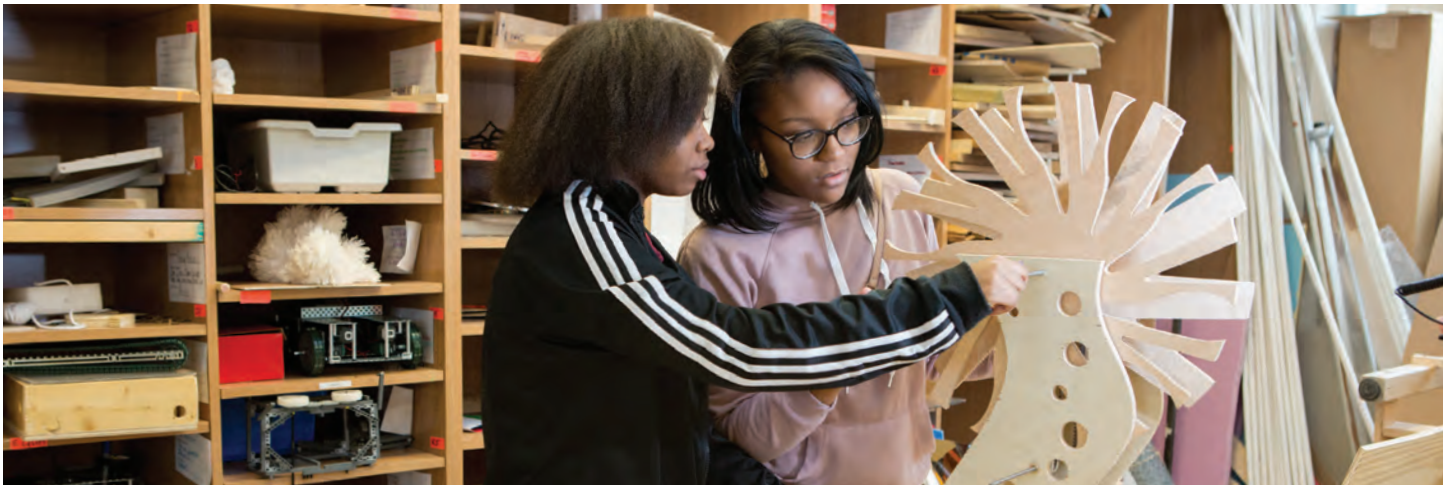
Bright Spot: The University of California System

The University of California (UC) system sets a goal of using 100% carbon-free electricity by 2025 across all 10 of its campuses and six academic health centers, setting the bar for large-scale institutional change.[14] The UC system runs its own power company, allowing it to centrally provide clean power to seven of its campuses at below market rates. In addition, campuses across the state are improving energy efficiency, building solar power plants, and purchasing solar, wind, and hydroelectric power from other sources.

Many colleges and universities around the country could benefit from power purchase agreements, although they are not yet legal in some states.[16] Policymakers can help higher education institutions and other large institutions secure cleaner, cheaper power by permitting these relationships.



Top right photo courtesy of California State University. Bottom left and right photo courtesy of Second Nature



CLEAN AND EFFICIENT INFRASTRUCTURE

A related avenue to reduce campus carbon pollution involves shifting heating and cooling systems to renewable power sources while investing in energy efficient buildings. Many higher education facilities in the U.S. are over 50 years old, and state underinvestment in higher education has contributed to an enormous maintenance backlog.[17] Colleges require an estimated $112.3 billion to close the gap.[18] Reducing higher education's carbon pollution will require addressing this backlog and replacing outdated systems with modern, efficient technologies.

Heating water and buildings consumes over half of the energy at colleges and universities, powered primarily by gas and other fossil fuels.[19] Colleges at the forefront of decarbonization have applied several strategies. Electrification of HVAC systems is often the first step. Shifting to energy efficient air-source heat pumps and powering them with renewable sources reduces carbon pollution and often saves universities money in the long run. In 2015, Stanford University exchanged its natural gas heating system for an electric one, powering part of it with solar energy. The investment reduced carbon emissions by 65% and will save the university an estimated $420 million over 35 years.[20]

Another option is using geothermal heat pumps to heat and cool campus buildings. Several colleges and universities installed geothermal systems in the 1970s and 1980s in response to rising oil prices.[21] Now decarbonization commitments are driving interest again. For instance, Carleton College in Minnesota recently replaced a fossil fuel steam heating system for a geothermal system as part of its plan to eliminate greenhouse gas emissions by 2050 or sooner.[22]

Alongside changing energy sources for heating and cooling buildings, colleges can save money by upgrading buildings to be more energy efficient, including through using LED lighting and energy management systems. The U.S. Department of Energy recently highlighted the work of Allegheny County Community College (ACCC). ACCC reduced its overall energy usage by 22% across 18 buildings and 1.5 million square feet of floor space through replacements and upgrades to its HVAC and lighting systems. It also implemented an innovative power management system across 4,000 personal computers and its campus data center that reduced their energy use by 74%, driving $70,000 in annual savings.[23]

WHAT WE HEARD: "It's really important that—as institutions that own buildings, that oftentimes have power plants on our own campuses—we actually think about the fossil fuel infrastructure in our own systems." - Dr. Leah Stokes, Associate Professor, University of California, Santa Barbara

Top photo by Allison Shelley for American Education: Images of Teachers and Students in Action.

ELECTRIFYING TRANSPORTATION

Transportation typically forms the third largest source of carbon pollution generated by college campuses.[24] Students, faculty, and staff account for most emissions commuting to and from campus, while college-owned vehicles contribute as well.

Leading colleges have found multiple ways to reduce transportation emissions, including transitioning vehicle fleets to fully electric. Ringling College of Art and Design (RCAD) in Florida has led all colleges and universities nationally with 85% of its 41 campus vehicles fully electric. With a student body of just 1,600 students, RCAD's smaller campus footprint demands a smaller investment compared to other institutions. Replacing vehicle fleets at larger campuses can require upgrades to campus electrical grids to support continuous charging by large numbers of vehicles. That has not prevented California State University, Northridge—with a campus of over 350 acres and a student body of over 30,000—from acquiring 70% electric vehicles. Large institutions can learn from CSU Northridge's example.

Although universities do not directly control how people move to and from campus, they can influence commuters. The University of California Irvine's (UCI) Pump2Plug program incentivizes adoption of zero-emission vehicles for faculty and staff.[25] UCI provides complimentary charging for all electric vehicles using normal electric power outlets and subsidized charging at more intensive power levels. The campus also plans to add incentives for faculty and staff to purchase cars at local dealers in Southern California. By purchasing electric vehicles, investing capital in charging stations, and encouraging community members to use zero-emission forms of transportation, colleges can dramatically reduce carbon pollution.

OTHER SOURCES OF CARBON POLLUTION

While electricity, heating and cooling, and transportation account for a large proportion of colleges' carbon pollution, a number of other campus sources contribute. Food is a common indirect source of carbon pollution because certain agricultural processes, particularly related to animal products, can emit potent greenhouse gases like methane. Supply chains can be highly carbon intensive, and higher education leverage their purchasing power to alter their own supply chains toward more carbon neutral goals. Creating more circular economies on campus can lead to reductions in emissions, waste, costs, and create opportunities for enhanced learning about consumption patterns and their impact. Some higher education institutions also lease their lands for fossil fuel production which further accelerates climate change. Achieving carbon neutrality at America's colleges and universities requires an extensive review of all operations to assess and mitigate direct and indirect sources of emissions.[26]

Credit: CHUYN via Getty Images

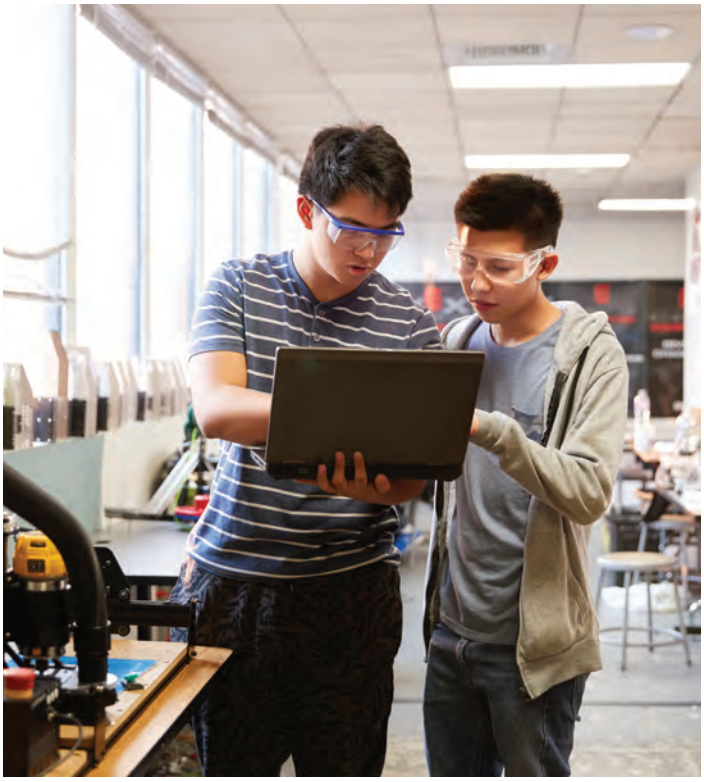
EQUITABLE CAPITAL INVESTMENTS AT UNDER-RESOURCED INSTITUTIONS

Though addressing expensive maintenance backlogs can provide an opportunity to upgrade HVAC systems and improve overall efficiency, major renovations or transportation transitions require large financial investments upfront to realize long-term savings. Capital costs are a key challenge for MSIs, HBCUs, and TCUs pursuing sustainability. Expert Anastasia Rodriguez, Vice President for Finance and Administration at the HBCU University of Maryland Eastern Shore (UMES) identified the need to be entrepreneurial in the face of resource constraints. For instance, UMES is collaborating with the Maryland Department of Energy and a private company to develop a micro-grid, upgrading aging electrical infrastructure, and reducing its carbon pollution, all while increasing power reliability. The project uses creative partnerships to make the most of limited funding and will ultimately improve the school's bottom line. However, UMES lacks the financial capital for many cutting-edge construction projects.

Community colleges and some state colleges and universities also routinely face greater resource constraints compared to state flagship universities. A study by the National Association of College and University Business Officers showed that over 800 colleges have a median endowment above $142 million while the median community college endowment amounted to just $12 million.[27] This leaves little room for major clean energy investments compared to elite private institutions or major public research universities.

Even the most innovative under-resourced institutions may struggle to fully eliminate their carbon pollution by themselves. Policymakers must address historic state underinvestment experienced by MSIs, HBCUs, TCUs, community colleges, and regional public universities and provide necessary support to help these institutions decarbonize. In particular, increasing awareness and removing barriers for these institutions to access the resources in the Inflation Reduction Act (IRA) and Infrastructure Investment and Jobs Act (IIJA) can support a more equitable transition to sustainable infrastructure in higher education.

WHAT WE HEARD: "We need a sustainable mindset to think about how to make improvements and maintain our campus in a way that also advances environmental justice and maintains the affordability of the education provided here at UMES." — Anastasia Rodriguez, Vice President for Administration and Finance, University of Maryland Eastern Shore (UMES)



ACCESSING RESOURCES FROM THE INFLATION REDUCTION ACT

The Inflation Reduction Act's largest area of investments come in the form of tax credits. Most higher education institutions, as nonprofit, tax exempt entities, do not typically benefit from tax incentives. However, the IRA permits non-taxable entities to claim and obtain credits. For instance, under the Investment Tax Credit if a college builds a $1 million solar facility, it could be entitled to a base 30% credit worth $300,000, cutting the cost of the project by nearly a third. Additional stackable credits can be added if the project is located in a low-income community or uses domestic materials. In addition to non-competitive tax credits, the IRA also creates financing opportunities for clean energy projects and a variety of grant programs that colleges can secure, often in partnership with their local communities. These opportunities to access resources can help catalyze efforts to decarbonize institutions of higher education.

Adaptation and Resilience

The pandemic's severe disruption of higher education signals important lessons for college leaders addressing climate risks to their institutions. Enrollment dipped significantly after COVID-19 arrived.[28] More extreme weather already threatens campus operations and impacts student and staff mental health. Colleges and universities must prepare now to consider systemic risks resulting from our changing climate and adapt and build resilience to the challenges ahead.

By 2050, scientists expect locations in Southwestern Texas and South Florida to average 125 days per year over 100 degrees Fahrenheit.[29] Much of the Southwest U.S. could face severe water shortages that impact agricultural and drinking water availability.[30] Under these circumstances, colleges will need to rethink basic functions like whether to hold class on extreme heat days and when to begin and end the academic year. During a West Coast heat wave in 2022, college students in older dorms without air conditioning struggled to focus on academics.[31] Research backs up the students' experience: K-12 students without air conditioning experience academic declines on hot days.[32]

The risks extend beyond heat. Consistent with climate model predictions, hurricanes, floods, and wildfires have already grown more intense.[33] As the trend continues, many higher education institutions will find themselves in harm's way. Eighteen of California's public universities are in wildfire-prone zones.[34] Colleges on the Atlantic or Gulf Coast need to prepare for stronger hurricanes. Midwest colleges and universities need to prepare for more dangerous floods and tornadoes. Higher education institutions must begin preparing now for predictable threats to institutional operations.

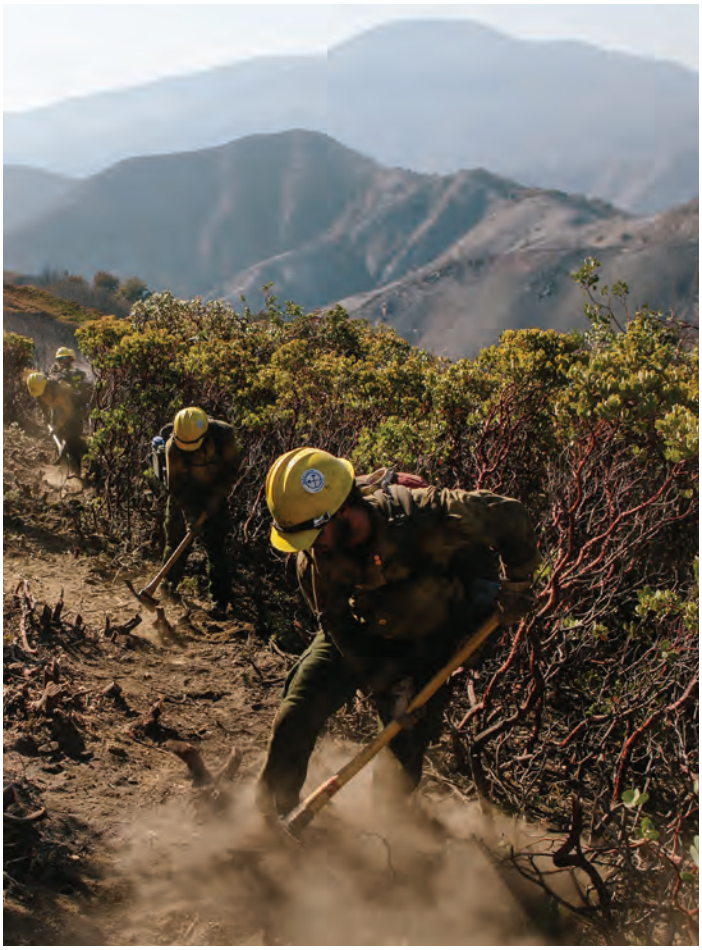


Photo courtesy of California State University

ASSESSING CLIMATE RISK

Higher education, as well as our society as a whole, exists in a changing climate. As a result, leaders in higher education must grapple with questions about how a changing climate will impact their ability to fulfill their mission. For instance, how will a changing climate impact the ability to recruit and retain a diverse student body? How will a changing climate impact the ability to serve students on campus? How will it impact costs of operations or relevance of existing programs? How will it impact the broader communities served? The answers to these questions will be different for different institutions based on their institution type, the students served, and the geographic locality.

Thoughtful planning that brings together administration, faculty, staff, students, and community members can help higher education institutions determine climate risk and build more resilient institutions. Second Nature's resilience toolkit encourages colleges and universities to conduct thorough self-assessments on topics ranging from infrastructure and finances to ecosystem health and community well-being.[35] Resources from Probable Futures can help institutions consider how different warming scenarios are likely to impact heat, precipitation, and drought in the community. Once institutions determine their likely climate risks, they can make informed decisions about programmatic, health, and comprehensive support for students, campus master planning, partnerships with communities, and resource investments.

RESILIENT OPERATIONS AND INFRASTRUCTURE

After assessing climate risks, institutions must take bold steps to address them. Needs will vary widely by where a college is located and the student population that it serves. A university facing potential power shortages might consider installing solar micro-grids and battery storage to prepare for anticipated outages. A college anticipating major flooding events can invest in a variety of storm drainage infrastructure from natural landscaping to larger sewers. As more students took a portion or all of their classes online after the COVID-19 pandemic, remote dynamics offer both challenges and opportunities to colleges. Supporting students through a changing climate now requires institutions with large online populations to think well beyond their physical location to provide services to students facing extreme weather. On the other hand, the increased use of remote learning may also provide additional tools for colleges and universities to employ in response to climate disruptions.

Bright Spot: Arizona State University

Arizona State University (ASU), located in Tempe—outside Phoenix—has responded to its changing environment with several ambitious steps. It invested in a series of initiatives from energy efficiency to water conservation to keep its desert campus sustainable in the face of extreme heat. The university provides public access to a Campus Metabolism dashboard, allowing all community members to track and take responsibility for resource use.36 Duke Reiter, Senior Advisor to the President of Arizona State University and the Executive Director of the University City Exchange explained, “We are actively participating in what it means to live in an environment which unfortunately will never become cooler in our lifetime.” ASU also serves a significant population of students virtually, meaning these students may face climate risks that ASU is not experiencing directly on-site, and ASU is considering how to best support students who are not on-site. Reiter noted, “This is a new way of thinking about what your campus is, what your student body is, and what your obligations are to those people who are degree seekers even if they are not on campus.”

CONTINUING BASIC RESEARCH

Although higher education must take a more expansive approach to tackling climate change, it should also continue core strengths in basic research. Academic researchers deserve tremendous credit for alerting the world to the dangers of climate change and tracking its progress. Extensive modeling of climate risks large and small will continue to form the foundation to the global response to climate change. For instance, research and analysis of what works to respond to anticipated risk will have implications far beyond colleges and universities, reaching into all aspects of society—from personal health decisions to global treaties—to build resilience in our chaning climate.