



*The green roof at Allegheny College's  
Vukovich Center for Communication.  
Photo: Bill Owen*

## Higher Education's Role in Adapting to a Changing Climate



 a publication of the  
AMERICAN COLLEGE & UNIVERSITY  
PRESIDENTS' CLIMATE COMMITMENT

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# Acknowledgements

This document was made possible thanks to the knowledge and expertise of a broad group of representatives from diverse colleges, universities, and organizations working on issues related to climate change adaptation and sustainability. It was created and refined through the invaluable contributions from the following groups and individuals:

Georges Dyer of Second Nature and Jennifer Andrews of Clean Air – Cool Planet are the primary authors. The members of the Higher Education Climate Adaptation Committee provided direction, resources, expertise, feedback and review:

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- John M. Anderson, President, Alfred State College
- Peter Bardaglio, Director, Tompkins County Climate Protection Initiative, former Provost, Ithaca College
- Sylvia Carey-Butler, Director, UNCF Enrollment Management Program
- Lynne Carter, Associate Director, Southern Climate Impacts Planning Program and Coastal Sustainability Studio, Louisiana State University; Director, Adaptation Network
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- Jonathan Overpeck, Co-Director, Institute of the Environment, University of Arizona
- John J. Sbrega, President, Bristol Community College

# Executive Summary

Climate change poses serious threats to human civilization, yet it offers opportunities to create a better future. Colleges and universities face clear and growing risks from climate disruption, and it is critical that presidents, trustees and those with fiduciary responsibility for these institutions be aware of these risks. Addressing these risks can provide the opportunity to recreate institutions of higher education for the 21<sup>st</sup> century, equipping them to be safe and secure in the face of change, more actively engaged in solving real-world problems, and reorganized to better provide the education and research needed to create and maintain a sustainable society.

This report, prepared by the *Higher Education Climate Adaptation Committee* — a group of experts and institutional leaders convened and coordinated by Second Nature in support of the American College & University Presidents' Climate Commitment (ACUPCC) — finds that higher education institutions:

1. Have a critical role to play in preparing society to adapt to the impacts of climate disruption by providing research and education around adaptation strategies and science.
2. Need to increase their curricular offerings on climate adaptation, both through mainstreaming the information in core courses and offering electives that specialize in the topic.
3. Face direct risks to their operations and infrastructure from the impacts of climate disruption.
4. Have the unique opportunity to role-model solutions in their own operations.
5. Can serve as 'hubs' in their local communities for creating, testing, and disseminating knowledge about regional climate projections and adaptation strategies, and should work directly with their local communities to explain the science and implement solutions.
6. Should acknowledge the inequitable distribution of climate impacts across populations, with low income and communities of color being in most need.
7. Should aim to identify adaptation strategies that also contribute to mitigation efforts.
8. As a whole, have not focused on adaptation sufficiently to date.

Higher education has taken a leadership role in climate *mitigation* — that is, *preventing* climate change by reducing greenhouse gas emissions. It now must take the lead in climate *adaptation* — that is, *preparing for and responding to* impacts of climate change.

Updates to **curricula** across a diverse range of disciplines will be key to addressing climate adaptation to ensure professionals understand the impacts of climate change and the best practices for responding to them.

By providing cutting-edge scientific and social scientific **research**, higher education has already made fundamental contributions to climate adaptation efforts by identifying the most pressing climate impacts — but there is still a large, and growing, need for additional research, especially related to (a) very localized questions regarding specific ecosystems and (b) specific communities, especially in relation to the most vulnerable populations in our society.

Campus **operations and infrastructure** are vulnerable to climate disruption and senior administrators, trustees, planners, and facilities professionals need to be familiar with the financial and safety risks posed. Institutions have opportunities for experimenting and role-modeling adaptation solutions for the rest of society in campus operations.

Colleges and universities have begun collaborating with **local communities** on climate adaptation efforts providing expertise and additional capacity. They have the opportunity to serve as “hubs” in their communities on adaptation issues and help their regions prepare for the impacts brought on by climate disruption.

Examples of how institutions are approaching climate adaptation in each of these four areas — curriculum, research, operations and risk management, and community engagement — are provided below.

The report recommends that college and university presidents, trustees and other senior administrators, particularly business officers, take a proactive approach to climate change adaptation, including the following actions:

1. Understand the expected impacts of climate disruption in their region.
2. Conduct an analysis of what financial and human health and safety risks these impacts pose to the institution.
3. Identify and prioritize strategies for reducing these risks that whenever possible also contribute to mitigating greenhouse gas emissions, and integrate those strategies and actions into the institution’s climate action plans and campus master plan.
4. Evaluate academic offerings on climate adaptation and expand as needed to ensure all graduates have a sufficient understanding of the risks and how to address them in their personal and professional lives.
5. If applicable, evaluate research activities and pursue opportunities for generating new knowledge that will help society adapt to climate disruption.
6. Engage leaders in local communities in a dialogue to identify opportunities for the institution to provide education, research, and pilot projects on adaptation; and for larger projects that can be pursued in collaboration to improve the resiliency of the region’s infrastructure, energy systems, water system, food systems, and transportation systems.
7. Take leadership in assuring that communities in the institution’s region have access to credible, informative science, and that access is extended particularly to communities that are likely to be most impacted by the effective of climate change.

Given the scale and urgency of the threats posed by climate change to every aspect of our society we issue a call to action for all colleges and universities in the country to address the challenges of climate adaptation by explicitly recognizing the need to adapt to the changing climate and taking steps to prepare society to do so through education, research, operations, and community engagement efforts.



# Introduction

Advanced human societies and the institutions that comprise them have emerged during a period of relatively stable climate over the past 12,000 years, making agriculture and settled civilizations possible. As we observe more widespread and drastic changes in climate across the globe, it is clear that this stability, and all it affords human civilization is being threatened. This threat is serious; yet it offers exciting opportunities to make our communities more dynamic and resilient, able to provide energy, water, food, shelter, and mobility, with redesigned systems equipped to thrive in a changing climate.

Leading organizations are beginning to embrace these opportunities, recognizing the risks, while working to create more effective systems. As one corporate executive noted in a recent Carbon Disclosure Project report, “More than simply managing risk, this is an opportunity for us to be more competitive than our peers who often operate in the same region and face the same risks” (CDP, 2010, p.20).

In May 2010, upon release of the NY Academy of Sciences report *Climate Change Adaptation in New York City: Building a Risk Management Response*, Mayor Michael Bloomberg observed: “We are re-imagining what New York City can be – and must be – in the year 2030 if we are to maintain and improve our quality of life as our population continues to grow.... Addressing the challenges posed by climate change is central to this mission and critical to our City’s future” (Bloomberg, 2010). Dr. Cynthia Rosenzweig, who headed up the research effort, added, “Planning for climate change and taking action now will help limit damages and costs in the coming decades and, in many cases, can provide near-term benefits including operational savings and job creation” (Bloomberg, 2010). This is the kind of win-win opportunity that a proactive approach to climate disruption can create.

Like local governments and businesses, higher education institutions face clear and growing risks from climate disruption. But the risks are not evenly distributed (Adger et al 2006; Roberts and Parks 2007). There is now abundant evidence that the first and worst affected by climate disruption are, and will increasingly be, low income communities and communities of color despite the fact that they have the lowest carbon footprints in the USA (Congressional Black Caucus Foundation 2004). This raises huge moral and ethical questions (Gardiner et al 2010) and is the spark behind the growing movement for ‘climate justice’ (Agyeman et al 2007).

It is especially important that college and university presidents, trustees and those with fiduciary responsibility for these institutions be aware of these risks. Preparing for these risks using principles of resilience can open up new opportunities for campuses — to re-vision themselves as 21<sup>st</sup> century community hubs with even closer ties to their places, and as models for leading society into a new era of creativity, cooperation and vibrancy in the face of unprecedented change.

# What is Climate Adaptation?

The current concentration of carbon dioxide in the atmosphere is more than 390 parts per million (ppm) – well over the previous peaks of about 280ppm over the past 800,000 years. To preserve relatively stable climatic conditions, we need to keep the concentration of CO<sub>2</sub> below 350ppm. While efforts are underway to return to those levels, it is clear that we will inevitably experience the impacts of climate change within our lifetimes — indeed, we already are.

The federal Interagency Climate Change Adaptation Task Force noted in its interim progress report to the White House in 2010 that “Climate change impacts pose significant social, economic, and environmental risks to the United States and the global community. As documented in the latest U.S. National Climate Assessment (NCA) report, *Global Climate Change Impacts in the United States*, and the National Research Council’s report series on *America’s Climate Choices*, communities across the Nation are already experiencing a range of climatic changes, including more frequent and extreme precipitation events, longer wildfire seasons, reduced snowpack, extreme heat events, increasing ocean temperatures, and rising sea levels. The impacts from these changes are affecting livelihoods, infrastructure, ecosystems, food production, energy supply, national security, and the cultural heritage of populations and communities. Certain communities and ecological systems are particularly vulnerable to these impacts. We know enough about climate risks to take actions now that ensure a safer, more resilient and prosperous future.” (CEQ, 2011, p.2).

The term climate adaptation refers to the need for society to prepare for these “core system” climate impacts that have become unavoidable. A technical definition of adaptation is “adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects” (NRC, 2010, p.19).

Also referred to as ‘climate preparedness’ or ‘climate resilience,’ in practice, climate adaptation means preparing for and responding to increased infrastructure vulnerability, public health

## Spotlight 1: Adapting “Core Systems” for Climate Resilience

The following are some ways that governments and organizations are adapting core systems

- **Transportation:** Raising roads and runways; increasing culvert sizes; strengthening bridges
- **Agriculture:** Shifting to drought resistant crop varieties; re-training farmers; emphasizing local agriculture
- **Business:** Examining and altering supply chains; increasing transparency and disclosure regarding climate risk
- **Infrastructure:** Ensuring current public investments are informed by climate change trends and projections
- **Water:** Increasing protection for wetlands; installing permeable pavement, green roofs, and rain and water gardens
- **Energy:** Protecting or moving production and distribution facilities/equipment vulnerable to flooding, extreme heat, drought or weather events
- **Public Health:** Identifying ways to reduce urban heat island effect; assessing vulnerabilities to emergency response systems in the face of extreme weather
- **Ecosystems:** Planning for movement of habitat, changes in local plants and animals, sea level rise
- **Land Use:** Changing building codes; planning “retreat” from sea level rise

## Spotlight 2: What “Adaptation” Means in the Nisqually River Basin

Washington State’s Nisqually River is fed by mountain snowpack, and empties into Puget Sound. It has long been a spawning ground for economically and culturally important fish species like Chinook, and depended upon by the Nisqually Indian tribe; it is also a key feature in local economic re-development efforts focused on eco-tourism. An increase in the number of severe storms and a decrease in snowpack will make the water warmer, shallower, and more polluted by 2060—threatening its ability to serve these functions.

A Council made up of representatives from the Nisqually tribe, local nonprofits, adjacent county governments, Washington state agencies and the University of Washington was formed 20 years ago to manage and improve conditions of the river and the watershed. That council is now engaging a coalition of community partners to initiate climate adaptation measures, including:

- Reserving land farther in from wetlands so when the sea rises, the marsh will have room to move as well;
- Promoting rain gardens on private commercial and residential property to absorb runoff warmed from paved spaces, and keep it out of the river;
- Installing logjams to cause the river to hollow out its bottom and create cooler pools for fish.

These efforts involve coordination and active participation of more than three-dozen stakeholder organizations representing tens of thousands of local citizens.

threats, constrained or compromised public water supplies, droughts and floods, and impacts on regional economies that have ‘already been bought’ by increased concentrations of greenhouse gases in the atmosphere.

Climate adaptation is distinct from, though related to, the need to shift society away from fossil fuels and toward climate neutrality in order to halt further, catastrophic climate disruption. Such efforts to avoid additional climate change by reducing greenhouse gas emissions are referred to as “climate change mitigation.” In other words, “mitigation” is about *preventing* climate change; “adaptation” is about *preparing for and responding to* impacts of the climate change that is and will continue to occur.

While climate adaptation and climate mitigation are distinct endeavors, the strategies that fuel them can be complementary. One example is that of planting urban trees, which from a *mitigation* perspective absorb carbon dioxide, reducing atmospheric greenhouse gas concentrations. From an *adaptation* perspective they provide shade and improve soil drainage to prevent run-off, tempering the effects of increased temperatures and run-off from extreme weather events, which can lead to poor water quality. Of course, climate mitigation and adaptation strategies can also conflict or undermine each other: installing air conditioning in buildings that previously did not have it would be an example of an action which might help an organization *adapt* to rising temperatures from climate change, while unfortunately consuming more electricity that, if produced from fossil fuels, will hinder efforts to *mitigate* climate change. Such conflicts are not inevitable—but these and other examples do highlight the importance of being mindful of both imperatives.



# Climate Adaptation Efforts Across Sectors

Leaders across society are now recognizing the need for climate adaptation efforts parallel to and integrated with climate mitigation strategies. The *America's Climate Choices* report from the National Academy of Sciences concludes that components of an effective national response to climate change include substantially reducing greenhouse gas emissions *and* beginning to prepare now for adaptation (NRC, 2011).

The scientific community has done extensive work to document and project exactly what types of disruptions different regions face. In 2009, the US Global Change Research Program published its latest report, titled *Global Climate Change Impacts in the United States*, that lays out specific anticipated impacts by region, such as flooding and sea-level rise in the Northeast, water shortages in the Southeast and Southwest, impacts to agriculture in the Midwest, and so on (USGCRP, 2009).

Similarly, social science research has contributed to the as yet relatively unexplored psychological (Swim et al. 2010; Agyeman et al. 2009), communication related (Moser and Dilling 2007), sociological and equity (Adger et al 2006; Roberts and Parks 2007) implications of climate change and adaptation.

Public-private partnerships between property owners, nonprofit groups and others have undertaken projects to preserve vital natural and economic resources (see “Spotlight 2”).

Leaders in the private sector have begun exploring climate adaptation options as they recognize the risks climate change poses to their bottom-lines, as well as the opportunities to increase their competitiveness. The Carbon Disclosure Project's 2010 report notes: “Businesses that can adapt best to the challenge of climate change will be best placed to continue providing reliable and relevant services in an environment of physical, regulatory, and commercial change” (CDP, 2010).

The report notes an uptick in the number of firms that are acknowledging climate risks and opportunities, and undertaking comprehensive strategy development, overseen at the board level, to address both. The risks for different industries vary in detail, but in general they fall into major categories like supply chain disruptions, raw

## Spotlight 3: Climate Risk Management in the Private Sector

- **Glaxo-Smith Kline:** Developing strategies to deal with water shortages they face in US and Australia
- **Entergy Corporation:** Mapping the risks of sea-level rise to their coastal facilities and energy infrastructure, and implementing plans to re-site or protect those properties
- **Partners HealthCare:** While designing Spaulding Rehabilitation Hospital, raised base elevation by two feet and sited all “critical facilities” on the second floor or above to protect from potential flooding due to sea level rise (City of Boston, 2011)
- **Nestle:** Encouraging their suppliers to diversify the crops they grow or switch to drought-resistant varieties (CDP, 2011)
- **Napa Valley vintners:** Developing new planting and pruning techniques to help vines handle rapid temperature increases (CBS News, 2011)
- **Starbucks:** Supporting coffee farmers in Mexico and Indonesia in adoption of resiliency strategies; for example, more shade-growing to protect plants from extreme weather events like hurricanes

material shortages, and rising energy costs (for a more complete list of challenges faced by various industries, see Appendix 2). Many firms are planning now to protect vital infrastructure from sea-level rise and extreme weather, and re-insurance companies have begun factoring climate impacts into their models, making insurance for coastal property increasingly expensive or even unavailable (LOE, 2006).

#### Spotlight 4: Municipal Climate Action

The C40 is a group of major cities across the globe tackling climate change mitigation and, increasingly, adaptation. In the U.S., the Mayor's Climate Agreement similarly promotes climate leadership from local governments. Both groups work closely with organizations like the Clinton Climate Initiative and ICLEI – Local Governments for Sustainability. All of these groups are helping U.S. cities prepare for new climatic norms: developing and implementing recommendations to change zoning, transportation planning, building codes, storm water management, economic development plans, emergency service operations, and many other facets of their operations.

- **Boston, MA:** One of eight US cities to participate in ICLEI's "Climate Resilient Communities" pilot program (kicked off in 2010), the City is especially focused on preparing for sea level rise-induced flooding and threats to public health from an increase in extreme heat (City of Boston, 2011).
- **New York, NY:** New York has built climate adaptation into its high-profile long-term PlanNYC effort. Among many other initiatives, the City has plans to invest \$1.5 million in "green infrastructure"—green roofs, permeable pavement, tree plantings, rain gardens, etc.—to alleviate problems with excessive storm-water runoff from more extreme weather events (Koch, 2011).
- **Norfolk, VA:** With a growing amount of annual infrastructure spending related to sea level rise, the city is now doing a feasibility study on measures such as dam structures, to deal more holistically with 14.5-inch sea level rise they've witnessed since 1930—and the possibility of more to come (Koch 2011).
- **Chicago, IL:** In 2006, Mayor Daley launched a study on climate impacts to Chicago; the results are being used to guide a comprehensive, citywide strategy. Initiatives include adding green roofs, more and different tree species, permeable pavement, rain gardens, and air-conditioning for public schools (Kaufman, 2011).
- **Denver, CO:** Denver's public water utility, Denver Water, is one of 10 members of the Water Utilities Climate Alliance (WUCA), which works to "promote and collaborate in the development of adaptation strategies and tools to reduce the impacts of [climate disruption] on ... water supplies" (WUCA website).
- **Chula Vista, CA:** In 2010, the city released a list of 11 recommended adaptation strategies developed with public input over 10 months, targeting storm-water management, water supply and reuse, extreme heat plans, zoning changes in response to sea level rise, wetlands preservation, etc.; these were approved by City Council in May 2011 and will be phased in over 3 years at a cost of around \$554,000 (CAKE, 2011).
- **San Francisco, CA:** Over the next 5 years, San Francisco's Public Utilities Commission will install equipment to prevent rising sea levels from pushing seawater back into the city's wastewater treatment facility. The projected cost will be covered by ratepayers and is expected to be \$20-40 million.
- **Seattle, WA:** Seattle has been on the forefront of climate action, playing a pivotal role in the launch of the US Mayors Climate Commitment. As part of Seattle's commitment to carbon neutrality, they are assessing and addressing their vulnerabilities to climate risk; in the meantime, their adaptation efforts also include a Green Stormwater Infrastructure program, increased transportation options, limits on coastal development, and a number of other related policies (Conlin, 2011).

Professional associations of architects and planners like AIA and the US Green Building Council have featured the issue of climate risk and the need for climate adaptation at their conferences and in their journals, helping to draw attention to the opportunities to better site, design and construct buildings. And a small but growing number of companies are beginning to disclose their climate risks to their investors (Mou, 2010).

Much work is also underway in the public sector, as government policies will play a vital role in facilitating effective climate preparedness. Every executive branch agency of the federal government has been directed to take climate adaptation needs into account in its planning processes henceforth (CEQ, 2011). Fifteen states have climate adaptation plans completed or in progress and there is an acknowledgement that “communities will be affected differently and experience differing degrees of change, so action to address these changes must take place at the local level” (Pew, 2011).

Officials at the local level are reviewing and changing policies governing zoning, building codes, emergency service provisions and many other issues to better prepare communities for climate impacts. For example, the city of Boston’s Redevelopment Authority has begun asking developers of projects that will likely be subject to more frequent coastal flooding due to sea-level rise to analyze the effects of climate change as part of the project review (City of Boston, 2011).

Currently, the National Climate Assessment (NCA) is being conducted under the auspices of the Global Change Research Act of 1990. Due to be released in 2013, “The NCA will help evaluate the effectiveness of our mitigation and adaptation activities and identify economic opportunities that arise as the climate changes” (USGCRP, 2011).

## Background on Higher Education’s Climate Leadership

Colleges and universities have taken a leadership role in climate mitigation. Through the American College & University Presidents’ Climate Commitment (ACUPCC), over 665 institutions have pledged to pursue climate neutrality in their operations and provide the education, research, and community engagement needed for the rest of society to do the same. To date, over 600 ACUPCC institutions have publicly reported their greenhouse gas (GHG) emissions inventories and over 400 have published climate action plans, available at [www.acupcc.org/reportingsystem](http://www.acupcc.org/reportingsystem). Over the past 5-10 years, there has been a clear trend in the higher education sector of sustainability moving from the realm of discrete, isolated programs to that of a core, strategic imperative for colleges and universities with regard to (1) education and training; (2) research; (3) community engagement; and (4) campus operations. While mitigation efforts should and will remain a major focus, it is clear that colleges and universities also need to address climate adaptation. Their social mandate to provide the education and research to ensure a thriving civil society demands that they take a leadership role in developing, testing and modeling solutions for meeting human needs in the face of rapid global change that threatens the viability of current systems.

# Opportunities for Leadership on Climate Adaptation

Some colleges and universities have already begun to contribute to climate preparedness efforts, in ways that cross the spectrum of their research, education, operational and community engagement activities. However, it is clear based on existing literature and direct feedback from campus leaders that there is relatively low awareness of what climate adaptation entails for institutions of higher education and relatively little action being taken on adaptation, particularly in terms of education and operations. While there is more research and community engagement activity around adaptation, it is insufficient in light of the magnitude of the challenge of creating a resilient society that is able to handle dramatic changes in climate.

Colleges and universities should provide leadership in communicating anticipated local and regional climate changes, articulating what these changes mean for regional residents, businesses, and governments. In other words, higher education should be translating the science into information that policymakers can apply to their work. Given insufficient support from the federal government in this regard, colleges and universities need to be centers of leadership on adaptation, not only in terms of conducting research but also in explaining its significance and steps necessary to deal with it effectively.

The following sections provide a high-level overview of what colleges and universities can and should be doing with regard to adaptation in terms of curriculum, research, operations and risk management, and community engagement, and highlight some examples of early efforts on campuses in each of these areas.

## Curriculum Overview

Updates to curricula across a diverse range of disciplines will be key to addressing climate adaptation. From business practices to ecosystem management, from community planning to law, from architecture to health care, trained professionals who understand the impacts of climate change and the best practices for responding to them will be vitally needed as communities and citizens face the realities of a changing climate.

At a basic level, building environmental and climate literacy in all graduates is helping to prepare the citizens and community members of tomorrow by helping them to understand climate change impacts and systems thinking. Many fields of study have begun incorporating climate adaptation education more specifically into their curricula; many planning departments are now routinely including lessons in some required courses on weighing climate impact risks when undertaking community master plans, zoning ordinances, and the like. Climate adaptation education cannot be limited to the STEM disciplines (science, technology, engineering, and math). There is a need to bring discussions about climate adaptation into core courses so all students have at least a basic understanding of the issues, in addition to offering specialized courses in many disciplines to train experts on the topic. It will be critical to capacity building to focus on social and behavioral disciplines, including emerging inter-disciplinary

fields, such as ecological psychology and ecological economics. Incorporating new learning objectives into a variety of programs will be necessary to ensure that tomorrow's professionals and workforce have an understanding of the new climate reality that will impact their work.

A great strength of teaching colleges is their faculty's ability to get information to a wide audience, providing teaching and training on new topics. As communities face increased stresses from climate impacts, local colleges can deliver the relevant information needed to prepare for and deal with such impacts, both to relevant professionals and the general public. A top priority should be translating scientific information to make it accessible to many types of audiences.

Community colleges also have opportunities to teach members of the local community about adaptation, and train the technicians and professionals with the specific skills needed to implement adaptation solutions. For example, a growing number of institutions offer courses on weatherization — a professional skill set that will play a role in ameliorating the impacts of rising temperatures (while also helping to mitigate climate change by reducing energy consumption).

## Curriculum Examples

**Antioch University New England:** The MS in Environmental Studies with a concentration in Sustainable Development and Climate Change integrates courses in climate change adaptation and resiliency, environmental site assessment, sustainable community planning, and building sustainable organizations, plus applied internships and projects. Graduates are prepared for a variety of environmental careers in the public and private sector including environmental regulation, environmental consulting, local and regional planning, and environmental non-profit leadership.

<http://www.antiochne.edu/es/sdcc/>

**Arizona State University:** The BA in Sustainability degree at ASU's School of Sustainability includes a track on society and sustainability that "addresses vulnerability and adaptation to risks, environmental justice and intergenerational equity, sustainability values and normative views, collaborative decision-making, and social structures and governmental institutions."

<http://schoolofsustainability.asu.edu/future-students/undergraduate/bachelor-arts.php>

**Bristol Community College:** The MassGREEN Weatherization Installer Course prepares students to work as professional air sealing technicians and insulation installers. Successful graduates of the course will be prepared to take the BPI Installer exams for Air Sealing and Densepacking. Improving the insulation of homes is an excellent example of actions that contribute to both adaptation and mitigation – in that it better protects residents from extreme heat events (adaptation), and also reduces energy demand (and associated emissions) for heating and cooling (mitigation).

[http://bristolcc.edu/community\\_education/center/greencenter/massgreen.cfm](http://bristolcc.edu/community_education/center/greencenter/massgreen.cfm)



**Columbia University:** Recognizing that decision makers need clear and reliable guidance on impending climate shocks, as well as practical information and tools to deal with their consequences, the Climate and Society program at Columbia covers dynamics of climate variability and change, regional climate and climate impacts, managing climate variability and adapting to climate change.

<http://www.columbia.edu/cu/climatesociety>

**Harvard University:** Several courses covering climate adaptation are offered at Harvard including *Creating Resilient Cities: Climate Adaptive and Anticipatory Practices* at the Harvard Graduate School of Design and *Urban Response to Sea Level Rise* at the Harvard Law School.

<http://ow.ly/65NgQ>

**Tufts University:** In 1998 Tufts pledged to meet or beat the emission reductions in the Kyoto Protocol. Over 25 graduate and undergraduate courses offered in the last 18 months have climate change in the course title or description. Today, Tufts faculty and students undertake a wide range of climate-related research including performance assessments of green buildings, planning for increased pedestrian and bicycle access, and implementing renewable energy and efficiency programs. A Climate Change and Climate Justice (CCCJ) group offers programming for students and faculty (<http://environment.tufts.edu/?pid=15>) and Tufts has an interdisciplinary program on Water: Systems, Science and Society (WSSS), in which climate change is a central theme.

<http://www.tufts.edu/water/>

**University of Massachusetts Amherst:** UMass Amherst is beginning to address adaptation in a variety of courses. One example is *Planning for Climate Change and Energy Uncertainty* course in the Landscape Architecture & Regional Planning department, which focuses on implications of these coming conditions for the built environment and municipal governments. Associate Professor Elisabeth Hamin's forthcoming paper *Changing Climates, Changing Pedagogies: Teaching Climate Change Planning* examines the incorporation of climate issues in planning programs, explores the range of courses and approaches that faculty have adopted on this topic, and presents preliminary principles that faculty can use to include climate considerations into seminars, studios and planning practice.

**University of Washington:** The School of Law at UW offers a Climate Justice Seminar that includes students and faculty working for communities impacted by the climate crisis to create climate adaptation assessments and apply corresponding legal and policy tools to further climate justice goals.

<http://www.law.washington.edu/CourseCatalog/Course.aspx?ID=B576>

## Research Overview

By providing cutting-edge scientific and social scientific research, higher education has already made fundamental contributions to climate adaptation efforts by identifying the most pressing climate impacts—globally, nationally, and from region to region.

As both the public and private sectors move forward in weighing adaptation needs, priorities, strategies and timetables at the local or organizational level, they will continue to rely upon new and increasingly, inter-disciplinary research from scientists and economists, behavioral and communications experts, and scholars from many other disciplines as the increasingly complex nature of adaptation becomes better understood.

Research universities have the opportunity to provide much needed research on adaptation challenges and solutions. A recent assessment by Clean Air-Cool Planet found that there is still a large and growing need for additional research, especially related to very localized questions regarding specific ecosystems and impacts (CA-CP, 2011).

While many of these research questions will focus on scientific, engineering and economic decisions, good decision-making will require involving researchers from diverse disciplines. For example, research from faculty working with business (particularly the insurance industry) will be needed to evaluate risk management practices. Planning, landscape, architectural and design faculty, together with public policy researchers can assess the implications of the design of the built environment on adaptation. Also, behavioral scientists and communications experts can contribute vitally useful new knowledge regarding how to effectively implement adaptation solutions.

Adaptation research will often require collaboration across these diverse disciplines. This can be challenging within the current structure of most institutions. Different departments often operate autonomously and in isolation. Tenure and promotion policies tend to reward a specialized focus. Most research is published through discipline-specific journals. To effectively address the adaptation challenge — which will require integrating many disciplines such as climate science, economics, public policy, psychology, engineering, and more — research institutions will need to identify and reduce the structural barriers to cross-disciplinary research, revising policies to incentivize and reward collaboration across disciplines. In addition, they will need to examine the challenges faced by interdisciplinary teams working across multiple universities, which recent research indicates is much more problematic than collaboration that does not cross-university boundaries (Cummings and Kiessler, 2005). Increasingly, funding agencies such as NSF and NOAA are supporting the kind of collaborative efforts that are necessary in climate adaptation research, such as the CCRUN program described below.

## Research Examples

**City College of the City University of New York, Columbia University, Drexel University, Stevens Institute of Technology, and the University of Massachusetts-Amherst:** The Consortium for Climate Risk in the Urban Northeast (CCRUN) funded under NOAA's Regional Integrated Sciences and Assessments (RISA) program, serves stakeholder needs in assessing and managing risks from climate variability and change. It is currently also the only RISA team with a principal focus on climate change adaptation in urban settings. CCRUN's initial projects are focused in three broad sectors: Water, Coasts, and Health. Research in each of these sectors is linked through the cross-cutting themes of climate change and community vulnerability, the latter of which is especially important in considerations of environmental justice and equity.  
<http://www.ccrun.org/>

**Cornell University:** The College of Agriculture and Life Sciences conducts research focused on climate science, mitigation and adaptation. Adaptation research focuses on understanding how the world will respond to a warmer future, moderating the damage, and exploring opportunities. Specific topics have included crops, pests, birds, corral, and human health.  
<http://www.climatechange.cornell.edu>

**Louisiana State University and University of Oklahoma:** The Southern Climate Impacts Planning Program (SCIPP) is a climate research initiative with the goal of helping communities better plan for weather and climate-related disasters in the southern United States, particularly in the face of changing climate. Focusing on the six-state study region of Oklahoma, Texas, Louisiana, Arkansas, Tennessee, and Mississippi, SCIPP concentrates on the high frequency of hazardous climatological events that plague the region, including extremes in precipitation (droughts and floods) as well as other hazards such as severe storms and hurricanes.  
<http://www.southernclimate.org>

**University of Notre Dame:** Notre Dame's Environmental Change Initiative has a program devoted to climate adaptation that focuses on how humans might help reduce the consequences of climate change not only for specific animals, but for entire ecological communities as well. Notre Dame scientists plan to create an online research community or "collaboratory" that engages researchers, students and policymakers in a nationwide science-based conversation about climate change adaptation.  
<http://environmentalchange.nd.edu/programs/climate-change-adaptation>

**University of Wisconsin:** The Wisconsin Initiative on Climate Change Impacts (WICCI) assesses and anticipates climate change impacts on specific Wisconsin natural resources, ecosystems and regions; evaluates potential effects on industry, agriculture, tourism and other human activities; and develops and recommends adaptation strategies that can be implemented by businesses, farmers, public health officials, municipalities, resource managers and other stakeholders. WICCI represents a partnership between the University of Wisconsin; the Wisconsin Depart-

ment of Natural Resources (DNR); and other state agencies and institutions. It combines cutting-edge climate modeling capabilities with field expertise to assess impacts at focused and relevant measures of time and space. It fosters collaboration among units across the UW System. Unlike the Governor’s Global Warming Task Force, which targets mitigation of greenhouse gases - how we affect the climate - WICCI focuses solely on the impacts of climate change - how the climate affects us.

<http://www.wicci.wisc.edu>

**University of Arizona:** The University of Arizona conducts varied and extensive research in adaptation to climate change and related research to support adaptation planning and capacity building. Projects include developing adaptation-planning frameworks, understanding consumer choices and their collective impact on the adaptive capacities of communities, and conducting experiments on the resilience of forest and rangeland ecosystems to climate changes to help inform adaptive management of natural resources. A website on “Adaptation at the University of Arizona” provides a compilation of research projects, events and organizations across campus and beyond that are working on adaptation issues.

<http://www.adaptation.arizona.edu>

## Operations and Risk Management Overview

Many campuses operate like small cities with complex physical plant and infrastructure systems that often include buildings, transportation, forests, agriculture, power generation, heating and cooling systems, storm water management, and so forth. As such, they are vulnerable to the risks posed by the new climate reality and its impacts.

In some ways, these impacts are not new; institutions have always faced various risks from weather events like storms, flooding, and drought. However, the severity and frequency of such weather events are creating new challenges for institutions, and will continue to do so. Furthermore, other impacts, such as sea level rise, represent new threats.

The 2009 national assessment, *Global Climate Change Impacts in the United States*, describes the changes in climate by region of the US, and identifies some of the key risks that accompany these changes. For example, in the Northeast extreme heat and declining air quality pose threats to human health; climate shifts adversely affect agriculture operations; and sea-level rise and increased rainfall cause severe flooding that threatens human safety and damages property. The report states: “Each of these observed changes is consistent with the changes expected

### Spotlight 5: Learning from Disaster – Hurricane Katrina and Gulf Coast Colleges and Universities

The devastation that Hurricane Katrina brought on New Orleans provides a stark example of these types of risks. A recent report from the United Negro College Fund (UNCF) — *Learning from Disaster: Gulf Coast Colleges and Universities, the Lessons of Hurricane Katrina* — focuses on the actions of Xavier University, Dillard University, and Delgado Community College surrounding this disaster and provides guidance on how institutions can prepare for and react to future threats (Gravenberg, 2011). In the wake of the hurricane, officials at Dillard estimated financial damages from the storm of \$400 million; Southern University at New Orleans estimated \$500 million (Powell, 2007).

in this region from global warming. The Northeast is projected to face continued warming and more extensive climate-related changes, some of which could dramatically alter the region's economy, landscape, character, and quality of life" (USGCRP, 2009, p.107). Pages 107-152 of the report provide similar overviews for the Southeast, Midwest, Great Plains, Southwest, Northwest, Alaska, Islands, and Coasts of the US.

At the ACUPCC Climate Leadership Summit hosted by George Washington University in June 2011, nearly every campus representative in the working session on adaptation reported that changing climate conditions are already impacting their campus infrastructure. There were reports of flooding in upstate New York and Vermont; roof collapses from record-breaking snow in Washington, DC; droughts in Atlanta; and concerns about erosion and sea level rise in California. Extreme events like these represent significant financial and safety risks for colleges and universities across the country.

Senior administrators and trustees thus need to be familiar with the financial and safety risks posed by climate change impacts. Institutional leadership must be proactive about ensuring their campus physical plant and infrastructure are as resilient as possible in the face of these new threats. Presidents should provide trustees with the

#### **Spotlight 6: Anticipating Sea Level Rise in Designing a Boston Sewage Treatment Plant**

"Boston's Deer Island sewage treatment plant was designed and built taking future sea-level rise into consideration. Because the level of the plant relative to the level of the ocean at the outfall is critical to the amount of rainwater and sewage that can be treated, the plant was built 1.9 feet higher than it would otherwise have been to accommodate the amount of sea-level rise projected to occur by 2050, the planned life of the facility.

"The planners recognized that the future would be different from the past and they decided to plan for the future based on the best available information. They assessed what could be easily and inexpensively changed at a later date versus those things that would be more difficult and expensive to change later. For example, increasing the plant's height would be less costly to incorporate in the original design, while protective barriers could be added at a later date, as needed, at a relatively small cost" (USGCRP, 2009, p. 109).

latest reports on expected climate risks for their region, and have frank conversations about how the campus can prepare to minimize potential damage, and react in the wake of potential disasters. Business officers cannot ignore the implications of severe floods, prolonged drought, or sea level rise for an institution's operating and capital budgets (see "Spotlight 5").

Climate preparedness should not be viewed as yet another "add-on" consideration that campus administrators need to take, but instead should be integrated into the normal course of business with regard to strategic planning and budgeting. While the purpose of climate preparedness is to manage risk and avoid large future costs, campus leaders will need to balance the costs of upfront investment in climate preparedness with the realities of current fiscal constraints. By integrating climate adaptation planning into the normal course of business, administrators can identify opportunities to implement adaptation solutions at little to no additional upfront cost (see "Spotlight 6").



As new “norms” for climatic realities evolve, some campuses have already begun integrating adaptive strategies into their campus master plans and operational processes. These strategies will need to be designed around the local and regional climate conditions, and also take into account other unique circumstances such as the institutional culture, political environment, and financial realities.

Each region in the US can expect and should prepare for some combination of the following direct impacts of climate disruption:

- Drought
- Floods
- Extreme heat
- Wild fires
- Severe storms
- Sea level rise

These direct impacts can lead to indirect impacts and risks for institutions in all regions, including:

- Disruption to food systems
- Disruption to transportation systems
- Disruption to energy systems (fuel and electricity)
- Disruption to water systems

## Operations and Risk Management Examples

**North Carolina State University:** Increased temperatures and longer periods of time between rains driven by climate change are expected to continue to exacerbate water scarcity issues in the Southeast (USGCRP, 2009, p. 116). To adapt to this new trend in the region’s climate — and specifically in reaction to severe droughts in 2007 — NCSU implemented a water restriction and drought action plan, which includes: water catchment systems, high efficiency washing machines, low-flow shower heads and toilets, limiting water usage, and an emergency action plan.

[http://www.ncsu.edu/energy/2008/docs/Stage\\_I\\_NCSU\\_WaterRestrictions\\_021108.pdf](http://www.ncsu.edu/energy/2008/docs/Stage_I_NCSU_WaterRestrictions_021108.pdf)

**University of Montana:** Forests in western Montana are becoming more susceptible to insect and disease outbreaks as well as more extreme fire events due, in part, to climate change. UM is planning a woody-biomass fueled boiler to replace about 70% of the natural gas consumed by its central steam plant. Not only will this reduce UM’s carbon footprint, but in using an estimated 15,624 bone dry tons per year of forest based slash (tops, limbs, stumpage) and low-market value in-field grindings, commonly known as ‘hog fuel’, it will help improve forest health and reduce the risk of wildfires.

<http://umt.edu/biomassplant/default.aspx>

**University of British Columbia:** A climate adaptation task force, chaired by Stewart Cohen, is studying the projected climate-related impacts on the Vancouver campus and infrastructure as part of the university's climate action planning process. This committee includes student, staff and faculty representation.

<http://climateaction.ubc.ca/climate-action-plan/process>

## Community Engagement Overview

Colleges and universities have always played substantial roles in shaping their communities: as economic development drivers and infrastructure developers; as resources of expertise, student capacity and of leadership; and as advocates for specific policies at the local, state and national levels. All of these roles are relevant in the effort to prepare communities and make them more resilient in the face of growing climate change impacts.

Scholars at colleges and universities have already begun partnering directly with “client” community members to explore climate adaptation opportunities. College presidents and administrators are raising the need for climate adaptation planning and resources with elected officials at all levels. Facilities directors and campus planners are working with local officials to shape their physical campuses with climate impacts in mind. Program heads and faculty across the country are shaping their courses to involve their students in local climate adaptation projects, from vulnerability assessments to weatherization to community outreach.

Colleges and universities are sources of expertise with significant convening ability and multi-faceted connections within their local communities. As such, they can serve as “hubs” in their communities on adaptation issues and help their regions prepare for the impacts brought on by climate disruption, providing vision and coordination. For example, through The Oberlin Project, Oberlin College and Oberlin, OH are working together to construct a downtown green arts district, achieving climate neutrality for both city and College, and build an educational alliance between the College and other local schools. Higher education can also participate in more discrete community engagement activities, such as:

- *Providing expertise:* Institutions can provide incentives for faculty and graduate students to lend their expertise to projects with specific research needs.
- *Providing capacity:* Local governments and agencies are chronically strapped for resources, and colleges and universities can engage students to provide crucial “person-power” for projects at the local level, through internship or practicum programs, community service requirements, and partnerships with nonprofits. This could serve an extremely valuable educational function while significantly advancing local efforts (CA-CP, 2011).
- *Collaborating with local leaders:* Use on-campus building and operational efforts as an opportunity to engage local officials regarding the possibilities for broad community incentives or regulations aimed at climate adaptation; participate in local working groups or committees aimed at improving community climate resilience.

## Community Engagement Examples

**Washington State University:** The Climate Friendly Farming project at WSU's Center for Sustaining Agriculture and Natural Resources seeks to understand the interconnections between climate change, greenhouse gas emissions and agriculture. Modern production systems have evolved and are managed in response to local and regional climatic conditions (averages and variability) and are vulnerable to changes in local and regional climates. The CFF project seeks to better understand the potential impacts of climate change on regional agricultural production to inform investment and management decisions to ensure the sustainability of agriculture through the 21st Century.

<http://csanr.wsu.edu/CFF>

**University of Alaska:** The Scenarios Network for Alaska Planning (SNAP) is a collaborative organization linking the University of Alaska, state, federal, and local agencies, and NGOs with a mission to provide timely access to management-relevant scenarios of future conditions in Alaska. Alaska is undergoing rapid changes in climate, human population and demands on natural resources. Future planning that accounts for these changes can reduce costs and liabilities. The primary products of the network are (1) datasets and maps projecting future conditions for selected variables, and (2) rules and models that develop these projections, based on historical conditions and trends.

<http://www.snap.uaf.edu/>

**University of Southern California:** The USC Sea Grant Urban Ocean Program works with local communities to help them wherever they are in the process of climate change adaptation planning. Decision-makers in Southern California's coastal cities and counties generally recognize that climate change will impact their communities and coastline. Sea level rise threatens coastal infrastructure and wetlands; increased storminess could lead to damaging floods and mudslides. California's coastal communities are at different stages in developing and/or implementing climate change adaptation plans. USC Sea Grant provides educational tools, workshops, and funding opportunities to assist communities.

[http://www.usc.edu/org/seagrant/research/climatechange\\_adaptation.html](http://www.usc.edu/org/seagrant/research/climatechange_adaptation.html)

**University of Hawai'i – Manoa:** The Center for Island Climate Adaptation and Policy (ICAP) facilitates a sustainable, climate-conscious future for Hawai'i, the Pacific, and global island communities. The Center produces innovative, interdisciplinary research and real-world solutions to island decision-makers in the public and private sectors. As a focal point for University of Hawai'i climate expertise, the Center serves as a two-way conduit between the university and island communities to catalyze climate change adaptation and resiliency.

<http://www.law.hawaii.edu/icap>

# Conclusions and Recommendations for Action

Higher education institutions:

1. Have a critical role to play in preparing society to adapt to the impacts of climate disruption by providing research and education around adaptation strategies and science.
2. Need to increase their curricular offerings on climate adaptation, both through mainstreaming the information in core courses and offering electives that specialize in the topic.
3. Face direct risks to their operations and infrastructure from the impacts of climate disruption.
4. Have the unique opportunity to role-model solutions in their own operations.
5. Can serve as ‘hubs’ in their local communities for creating, testing, and disseminating knowledge about regional climate projections and adaptation strategies, and should work directly with their local communities to explain the science and implement solutions.
6. Should acknowledge the inequitable distribution of climate impacts across populations, with low income and communities of color being in most need.
7. Should aim to identify adaptation strategies that also contribute to mitigation efforts.
8. As a whole, have not focused on adaptation sufficiently to date.

## Recommendations for Action on Individual Campuses

College and university presidents, trustees and other senior administrators, particularly business officers, should take a proactive approach to climate change adaptation.

1. Explicitly acknowledge the risks and build an understanding of the expected impacts of climate disruption in their region.
2. Conduct an analysis of what financial and human health and safety risks these impacts pose to the institution.
3. Identify and prioritize strategies for reducing these risks that whenever possible also contribute to mitigating greenhouse gas emissions, and integrate those strategies and actions into the institution’s climate action plans and campus master plan.
4. Evaluate academic offerings on climate adaptation and expand as needed to ensure all graduates have a sufficient understanding of the risks and how to address them in their personal and professional lives.
5. If applicable, evaluate research activities and pursue opportunities for generating new knowledge that will help society adapt to climate disruption.
6. Engage leaders in local communities in a dialogue to identify opportunities for the institution to provide education, research, and pilot projects on adaptation; and for larger projects that can be pursued in collaboration to improve the resiliency of the region’s infrastructure, energy systems, water system, food systems, and transportation systems.
7. Take leadership in assuring that communities in the institution’s region have access to credible, informative science, and that access is extended particularly to communities that are likely to be most impacted by the effective of climate change.

## A Call to Action for the Higher Education Sector

A critical mass of the higher education sector has assumed a leadership position in *climate mitigation* in terms of providing education and research on the topic, and in terms of seeking and role-modeling solutions in campus operations and the local community. This is evidenced through the nearly seven hundred institutions that have signed the ACUPCC, and hundreds more that are pursuing climate mitigation strategies in other ways.

Given the scale and urgency of the threats posed by climate change to every aspect of our society, all colleges and universities in the country should provide similar leadership in addressing the challenges of *climate adaptation* as well, by explicitly recognizing the need to adapt to the changing climate and taking steps to prepare society to do so through education, research, operations, and community engagement efforts.



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## Appendix 1 — Definitions for Key Terms

**Adaptation:** Adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects.

**Resilience:** A capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy, and the environment.

**Vulnerability:** The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes.

**Mitigation:** An intervention to reduce the causes of changes in climate, such as through reducing emissions of greenhouse gases to the atmosphere.

*Source: (NRC, 2010)*

## Appendix 2 – Climate Risks by Industry

Sector	Example Risks Resulting from Physical Effects on Climate Change
Electric Utilities	<ul style="list-style-type: none"> <li>• Peak electricity demand due to warmer and more frequent hot days could in some regions exceed the maximum capacity of current transmission systems and will be combined with system stresses due to heat</li> <li>• Increased risk of damage to facilities and infrastructure from extreme and unpredictable weather conditions</li> <li>• Uncertainty over energy output from hydroelectric plants due to potential water shortages</li> <li>• Uncertainty over water supplies for cooling power plants</li> </ul>
Mining	<ul style="list-style-type: none"> <li>• Extreme weather events increase physical risk to business operations, for example due to flooding</li> </ul>
Integrated Oil & Gas	<ul style="list-style-type: none"> <li>• Negative business impacts due to weather changes and natural disasters</li> </ul>
Food, Tobacco, & Beverages	<ul style="list-style-type: none"> <li>• Risk of food supply and operations interruptions due to extreme weather events</li> <li>• Longer term weather trends may affect reliability (and quality) of supply of fresh produce</li> <li>• Physical risk to water supply and raw materials</li> <li>• Greater risk of animal infections (e.g., avian flu), insect infestation, plant disease, wildlife damage, etc.</li> </ul>
Building Design and Construction	<ul style="list-style-type: none"> <li>• Extreme weather events may disrupt transport for site deliveries and affect site work (e.g., muddy site conditions), restricting work-days</li> <li>• Infrastructure (e.g., drainage) affected by extreme weather events</li> <li>• Excessive heat in summer will affect some construction processes and onsite workforce</li> <li>• Design standards may need to be clarified or upgraded in response to changing climate</li> <li>• Insurance may be more expensive or difficult to obtain for existing buildings, new buildings, and during the construction process</li> </ul>
Insurance	<ul style="list-style-type: none"> <li>• Increased need to develop catastrophe models to evaluate capital adequacy and overall natural catastrophe exposure</li> <li>• Disruptions to business operations become unpredictable and more financially relevant</li> <li>• Competition for water resources between agricultural and urban developments increases commercial risks with impacts on crop insurers</li> <li>• Increased risks to human health (thermal stress, vector-borne diseases, natural disasters)</li> <li>• Prolonged periods of poor weather or extreme events increase costs of claims and make it more difficult to deal with high volumes of claims</li> </ul>

Sector	Example Risks Resulting from Physical Effects on Climate Change
Agriculture	<ul style="list-style-type: none"> <li>• More refrigerated distribution and storage required and problems with livestock transportation in summer heat</li> <li>• Damage to transportation infrastructure or disruptions in services due to floods, etc. creating problems with transporting raw materials</li> <li>• Limited availability of water and potential interruption of supply to irrigation systems</li> <li>• Equipment and other investments, as well as expertise of farmers and workforce, are linked to specific crops, which may become unprofitable or may no longer be viable</li> <li>• Quality issues: overheating of grain, or availability of water for pre-washed products</li> <li>• Access to land during flood or extreme rain conditions</li> <li>• Less frequent frosts will affect quality of certain crops and reduce kill-off of pests/disease</li> <li>• Exposure of workforce to increased heat</li> <li>• Farm buildings affected by extremes of wind, heat, rain (animal welfare issue)</li> </ul>
Motor Manufacturing	<ul style="list-style-type: none"> <li>• Supply chain interruptions and vulnerable transport systems carrying high value products around the world (e.g., one ship carries over \$60 million of product)</li> <li>• May need vehicles that tolerate new extremes of climate, including greater intensity of rainfall (affecting seals, wipers, tires) and increased need for cooling</li> <li>• Process environment will become hotter with increased need for cooling—particularly important for comfort/health of workforce and performance of production processes</li> <li>• Increased drying time for painted products as a result of increased humidity</li> </ul>

Source: (Sussman and Freed, 2008)



## Appendix 3 — Sample Frameworks and Guidance for Adaptation Action

Source	Framework
<p>Climate Adaptation Knowledge Exchange (CAKE)</p> <p><a href="http://www.cakex.org/community/don%27t-panic">http://www.cakex.org/community/don%27t-panic</a></p>	<p><i>Step One: Admit you have a problem</i> — Ignoring climate change in informed decision-making does not prevent it from adversely affecting you. Rather it increases your vulnerability and will likely result in missed opportunities to avoid calamity and improve outcomes.</p> <p><i>Step Two: Engage and learn</i> — You are not alone, and you do not have to reinvent the wheel. Engage with others working on these issues and learn from existing resources.</p> <p><i>Step Three: Do something about it</i> — Focus on your goals and what it is you (or your organization) does, and build climate change into that.</p> <ul style="list-style-type: none"> <li>• <i>Question your assumptions.</i> Do a quick assessment of why and how you arrived at your current goals, objectives, and approaches to doing things. Does climate change affect your thinking?</li> <li>• <i>Convene partners.</i> You don't want to do this alone.</li> <li>• <i>Develop a process.</i> Successful adaptation strategies are as much about getting all the relevant parties on board as it is about coming up with good ideas and making the right decisions.</li> <li>• <i>Develop a plan.</i> We must certainly take action to reduce our vulnerability to climate change, but doing so without some thoughtful planning is unlikely to lead to the best results. And if you don't have a plan, it's harder to improve it as you go along.</li> <li>• <i>Implement it!</i> The best plan in the world won't amount to much if you don't put it into action. You won't get everything right, but you'll get more right by acting and adjusting than by sitting around wondering about it.</li> </ul> <p><i>Step Four: Learn while you act</i> — Adaptation is iterative. The climate will keep changing for decades and our understanding of how best to incorporate it into our work at all levels will also evolve and mature over time. Monitoring climate change, its effects, and the efficacy of our actions, and using an adaptive framework to modify actions as necessary, is essential.</p> <p><i>Step Five: Share what you have learned</i> — Talk to your colleagues about what you do and why it's important.</p>

Source	Framework
<p>“Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments”</p> <p>Climate Impacts Group, University of Washington</p> <p><a href="http://cses.washington.edu/cig/fpt/guidebook.shtml">http://cses.washington.edu/cig/fpt/guidebook.shtml</a></p>	<p>Public decision makers have a critical opportunity – and a need – to start preparing today for the impacts of climate change. Preparing for climate change is not a “one size fits all” process, however. Just as the impacts of climate change will vary from place to place, the combination of institutions and legal and political tools available to public decision-makers are unique from region to region. Preparedness actions will need to be tailored to the circumstances of different communities.</p> <p>Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments is designed to help local, regional, and state governments prepare for climate change by recommending a detailed, easy-to-understand process for climate change preparedness based on familiar resources and tools. Questions addressed in the guidebook include the following:</p> <ul style="list-style-type: none"> <li>• How do you scope out the problems of climate change across sectors of your community?</li> <li>• How do you raise and maintain support to prepare for climate change?</li> <li>• Whom should you include on a climate change preparedness team?</li> <li>• What are climate change planning areas, and how do you identify them for your community?</li> <li>• How do you identify your sensitivity, adaptive capacity, and risk to climate change impacts – i.e., conduct a vulnerability assessment and a risk assessment ?</li> <li>• How do identify your climate change priority planning areas?</li> <li>• How do you establish a vision and guiding principles for a climate resilient community in these priority planning areas?</li> <li>• How do you begin to develop climate change preparedness goals and actions in these priority planning areas?</li> <li>• How do you develop a climate change preparedness plan?</li> <li>• How do you ensure that you have the right implementation tools to take your preparedness actions?</li> <li>• How do you develop measures of resilience to track your progress and update your plans over time, to ensure that your efforts are really making your community more resilient to climate change?</li> </ul>

Source	Framework
<p>UK Climate Impacts Programme (UKCIP)</p> <p><a href="http://www.ukcip.org.uk">http://www.ukcip.org.uk</a></p>	<p>The Risk, Uncertainty and Decision-Making Framework is an 8-stage iterative process to help decision-makers identify and manage their climate risks in the face of uncertainty. It is based on standard decision-making and risk principles, and encourages users to consider their climate risks alongside their non-climate risks.</p> <p>The key stages of the process are:</p> <ol style="list-style-type: none"> <li>1. Identify the problem and objectives</li> <li>2. Establish your risk tolerance level and decision-making criteria</li> <li>3. Identify and assess your risks</li> <li>4. Identify a range of adaptation options</li> <li>5. Appraise your adaptation options</li> <li>6. Make a decision</li> <li>7. Implement the decision</li> <li>8. Monitor the decision and for new information</li> </ol>
<p>NOAA Coastal Services Center</p> <p><a href="http://collaborate.csc.noaa.gov/climateadaptation/default.aspx">http://collaborate.csc.noaa.gov/climateadaptation/default.aspx</a></p>	<p>An extensive list of guidebooks and similar resources to assist with climate adaptation planning and action, both general and for specific regions, is available at: <a href="http://collaborate.csc.noaa.gov/climateadaptation/Lists/Resources/GuidanceGuidebooks.aspx">http://collaborate.csc.noaa.gov/climateadaptation/Lists/Resources/GuidanceGuidebooks.aspx</a></p> <p>A shorter list of resources and guides for getting started is available at: <a href="http://collaborate.csc.noaa.gov/climateadaptation/pages/gettingstarted.aspx">http://collaborate.csc.noaa.gov/climateadaptation/pages/gettingstarted.aspx</a></p>
<p>Adaptation Network</p> <p><a href="http://adaptationnetwork.org">http://adaptationnetwork.org</a></p>	<p>Considerations that should be included in any adaptation planning process:</p> <ul style="list-style-type: none"> <li>• After you have decided on the need for an adaptive action, consider the costs (both economic and who is impacted). What are the costs, who should pay them, how should responsibility be shared, who can help? Are there groups missing from the discussion e.g. those likely impacted (vulnerable groups) or those who have expertise to assist in the process (corporations)? Equity issues might need to be included in your calculations as well as the costs of doing nothing.</li> <li>• What might be some of the unintended or unexpected consequences from your adaptive action? Try to think outside of the box and anticipate and address any possible problems.</li> <li>• What is the relationship between adaptations that occur in different sectors? For example, an adaptation that requires a release of water from a reservoir to deal with reduced runoff from lack of rain to support a fishery could cause a water shortage for agriculture or human use.</li> <li>• Any adaptation action needs to consider the relationship between adaptation and mitigation. Is your adaptation making mitigation harder or easier to attain? An adaptation to heat stress could be to provide air conditioners to needy residents. That could be helpful to the health concerns of heatwaves but would lead to problems in the energy sector that is already stressed on hot days and make the overall problem worse by increasing emissions of greenhouse gases.</li> </ul>

Source	Framework
<p>Center for Clean Air Policy (CCAP)</p> <p><a href="http://www.ccap.org">http://www.ccap.org</a></p>	<p>CCAP has an issue focus on Urban Climate Adaptation and has developed the <i>Urban Leaders Adaptation Initiative</i> to help local governments improve their communities' climate resiliency. In 2009, they published a report titled "Ask the Climate Question: Adapting to Climate Change Impacts in Urban Regions."</p> <p>The CCAP Urban Leaders Adaptation Initiative offers the following recommendations for advancing local climate adaptation efforts:</p> <ul style="list-style-type: none"> <li>• Improve <i>climate science and modeling</i>, including regional downscaling;</li> <li>• Support local adaptation by creating <i>climate extension service networks</i> to provide local governments with technical assistance on implementation of adaptation solutions;</li> <li>• Expand programs that <i>encourage proactive, pre-disaster adaptation</i>, such as FEMA's Hazard Mitigation Grant program;</li> <li>• <i>Facilitate dialogue</i> among cities, counties and states to share best practices in adaptation planning and implementation; and</li> <li>• "<i>Ask the Climate Question</i>" by integrating adaptation concerns into local, state and national infrastructure and resource planning, policy and funding decisions.</li> </ul> <p><a href="http://www.ccap.org/index.php?component=news&amp;id=223">http://www.ccap.org/index.php?component=news&amp;id=223</a></p>