UNIVERSITIES ON FIRE

Higher Education in the Climate Crisis

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CHAPTER 7

What Is to Be Done

Perhaps the great awakening on warming has already happened—or keeps happening and keeps being forgotten, among other reasons so that we can continue to believe we stand just at the threshold of climate suffering rather than well beyond it. But the great awakening on adaptation probably still lies ahead of us. Or maybe that "permanent emergency" is beginning right now.

—DAVID WALLACE-WELLS

Achieving global net zero CO_2 emissions is a requirement for stabilizing CO_2-induced global surface temperature increase, with anthropogenic CO_2 emissions balanced by anthropogenic removals of CO_2.

—IPCC 2021 REPORT

Time is no longer on our side. Let's use what time we have more wisely.

—MICHAEL MANN AND TOM TOLES

At this point in the book, the reader might experience a powerful sense of gloom, even despair. The preceding chapters present a picture of a vast, persistent, and brutally destructive threat already starting to hit academia around the world. The two great tasks the climate crisis presents humanity—to reduce greenhouse gas emissions to zero and to adapt civilization to a new world—are enormous, historically unprecedented, astonishing in scope and complexity. Confronted with them, some may experience decision paralysis. The idea of attempting to preserve academia for another century could overwhelm us. Others may cede the struggle completely, as does the Dark Mountain group, or to view climate change, as writer Jonathan Franzen recently put it, as "a lost cause."[1]

Academia is also not so fortunate as to confront the climate crisis as its sole challenge. Higher education worldwide confronts a swarm of additional pressures. The world we inhabit presents us with the demographic transition, changes to the labor market for graduates, inequalities and violence by multiple categories (class, race, gender, sexuality, religion, geography, ethnicity), changes to public attitudes toward higher education, political directives, warfare, and, of course, disease. Academic institutions struggle internally with their own economic sustainability, curricular and pedagogical development, supporting research, integrating technology, hiring and supporting faculty and staff, supporting students, and many more issues besides. To an extent, each of these challenges appears independent of the climate crisis and must absorb some of our resources. At the same time, each can connect with global warming and make the picture more complex still. Each institution's experience will vary, of course, but colleges and universities worldwide will have to grapple with the climate emergency, perhaps in escalating intensity over the next eight decades—in addition to all of those other problems. Academics as individuals and as participants within institutions will have to determine priorities and apply resources accordingly, which is something we have always done. Yet the Anthropocene appears in addition to our past efforts, and in some crucial ways at a far greater scale.

In the face of all of this, colleges and universities can appear to be small and fragile entities, massively out of their depth in the crisis. To consider academia as a human institution from which humanity in general might draw strength may seem starkly unjust, especially for an academic sector often reeling from financial, political, and epidemiological pressures. Viewing higher education as a space from which to mount a positive response to the unfolding catastrophe may seem woefully inappropriate. Individual academics can feel especially minute, dwarfed by the challenge, overwhelmed by its enormity. These are deeply human and valid responses, and we will require time to work through them. Yet

we must also react practically and strategically if academic institutions are to survive, much less thrive, for the rest of our century. Further, colleges and universities *can* play a decisive role in humanity's response. As we've seen in this book, higher education can contribute so much, from our research mission to our teaching, from our local community service to our engagement with the world.

Where to begin?

We can start with the question of motivation. Which academics would be interested in climate action? It should be clear by now that some number of people within and adjacent to higher education—faculty members, staff, students, government officials, nonprofit officers, business employees, journalists—will view the climate crisis as a gigantic or existential threat and want to take steps accordingly. A good number already do so. It seems likely that their numbers will grow in the years and decades to come, as the crisis deepens and expands. There will also be people who see the university's Anthropocenic response as an opportunity for them to pursue unrelated goals: to boost their own reputation, settle personal scores, build empires, make more money, enable a career shift, and so on. It would be naïve to imagine otherwise. As academia's climate response grows, both of these populations (and there is overlap, of course) may well expand. Climate crisis activism can become its own movement, lobby, or constituency on and between campuses.

We should also add to our answer a kind of personal-institutional attitude. The climate emergency presents to colleges and universities a way of rethinking, reimagining, and redesigning the entire academic enterprise. It opens up a possibility space perhaps larger and more ambitious than we have seen in some time, since so much of our institutions are in play, as I hope this book has demonstrated. There is a defamiliarization at work, in literary critical terms, as global warming causes us to rethink and resee much of the academy, often in new ways and in different combinations. The same is true for the academy's role in the world, both locally and globally, as we saw in chapters 4 and 5.

I do not want the reader to think that I am cheering on the Anthropocene as a delightful opportunity for individual and institutional growth, although the latter will occur. This is a dire threat with terrible human costs in the wings; readers unconvinced of this should reread chapter 6. Institutions and individuals may seize the opportunity to do foolish or cruel things, as we learned from recent crises, such as the COVID pandemic or 2008's financial crash, and as even a casual glance at history will demonstrate. Academia's response to the crisis over the next eighty years will likely include many missteps and heinous acts. It would be naïve to imagine otherwise.

Yet for all of that, the climate threat remains, and it will worsen. Academia should not look away from it. We should reimagine and redesign our institutions, not only in response, but proactively. We can play a larger role in the crisis in our communities and in the world. We have a vast capacity for thoughtful, creative, and humane institutional and personal imagination. As Georgetown University's Red House initiative declares, "A university can reinvent itself."[2]

Let me now bring into our discussion two very different views. They aren't mine, but ones I can ventriloquize based on conversations I've participated in over the past decade with academics around the world. The first voice is that of a professor or senior administrator who has considered some of the evidence, then concluded: "I can see how global warming will endanger certain universities—but not ours. We are protected by our geographical location, far from deserts and oceans. Our government/donors/church will assist us with what we need, should anything bad occur over the next eighty years. The broader civilizational issues you describe are, of course, important, but we are only one academic institution, and we're also addressing other major issues at the same time. The faculty we have can research and teach enough climate change to satisfy students and accreditors. There's really nothing else we need to do."

The second voice I'd like to represent belongs to another senior campus leader, who asks: "What if we're already doing enough? We have faculty researching climate change and have done so for years, so we are strong on that front. We also teach the subject, both in the form of majors and graduate programs as well as a campuswide commitment to sustainability. Our campus architecture? Well, some of it is dated, but the

key buildings are LEED certified and we have capital plans for improvement. We purchased insurance policies that are strong enough to take care of challenges. The experience of surviving COVID-19 taught us well to be resilient in an emergency. What else must we do?"

Those are good questions from a thoughtful and active president, professor, chancellor, board chair, or other senior leader. They describe progress that we should recognize and appreciate. Yet there is still more to be done, depending on an individual institution's situation and how the next generations of climate crisis pan out. Recall the three-part model of threats introduced in the introduction to this book. Primary stresses can strike campuses away from seas and deserts, and that have purchased insurance—strike with some unpredictability, and perhaps more often than in the past. Secondary stresses can be hard to anticipate, as they work through complex systems: ecologies, economics, geopolitics. And the tertiary stresses can approach in any number of forms, based on the sheer variety of human sociopolitical imagination. Consult chapter 5 for a sketch of the ways the world might impinge on a college or university. In other words, a given academic entity can make progress and avoid some leading dangers, while still being subjected to dangers.

Even more remains to be done if an academic institution wants to not only survive reactively but proactively participate in the global movement to mitigate and adapt to the heated world. Colleges, universities, systems, alliances, and other organizations can play a leading role in this ultimate crisis. We can serve as exemplars and inspiration, demonstrating practical ways to mitigate and adapt, even at the small scale of a single school. Higher education can advocate for global transformation through many different mechanisms, from faculty and staff acting as public intellectuals to lobbying businesses and governments with which we work. We can contribute capacity to mitigation and adaptation efforts, such as assisting civil engineering projects with our knowledge and labor. As we reinvent higher education, we can help civilization reinvent itself.

Given these questions, answers, and possibilities, let us outline steps to consider, starting with the short term.

What to Do in the Short Term?

Colleges and universities should consider their organizational stance toward the unfolding Anthropocene. What attitude would best mobilize their resources for survival and development? I have previously argued that a futures orientation best positions an institution for uncertain years and likely challenges in general and think that advice holds in this context. This should include an attitude favoring experiments and explorations, which is not necessarily as easy to adopt when a campus sees itself as under threat or being charged with guaranteeing a heritage. A posture dedicated to resilience should be essential, even if the term is overused.

Internally, campuses may consider forming or dedicating a unit to the climate crisis. The recent COVID experience can be useful here, in that institutions had to assemble groups who gathered intelligence, used it to shape policies often on the fly, communicated policies with clarity and transparency, and were ready to shift operations at a moment's notice. Such groups may begin on an informal basis but may develop into permanent bodies. They should inform strategic planning over time. Governance implications may also follow the coronavirus pattern, depending on the institution. That is, some campuses formed an emergency management leadership group, while others partnered closely (voluntarily or otherwise) with local or national public health authorities. In some situations, senior administration expanded their internal governance role at the cost of faculty's; this dynamic will doubtless occur again and form the ground of political contestation.

We can find early examples of this kind of organization already in use. Eckerd College's president organized a resilience plan in combination with senior staff, some faculty, and external consultants. That became a group, a "task force of executive college staff and faculty . . . includ[ing] President Eastman, Sparkman and several other administrative staff and faculty members." The University of California, San Diego set up a Climate Action Planning Group with many campus offices and stakeholders to create a plan. Members represented facilities, engineering,

sustainability, and other units. The plan the group developed addressed current campus GHG emissions, future scenarios, and mitigation strategies. However, the UCSD plan also had minimal faculty involvement.[3]

Such a campus group may also rely on external support. This can entail working informally with peers and networks, as well as utilizing formal relationships with associations and governments. External design groups may prove useful, as Eckerd College found. Such work can involve a participatory, iterative process with many institutional populations.[4]

External relations include government relations, of course. On the local level, individual campuses may conduct more work with their immediate communities. As we saw in chapter 4, this could take the form of increasing collaboration between members of the academic institution and local groups and institutions. It can also appear as friction or hostility. Negative and positive town-gown interactions can occur simultaneously or in close sequence, especially over years and decades. Doing so well may entail assigning community relations functions to administrators and/or faculty, or the creation of detailed positions or offices. At a broader scale, we might anticipate government relations officers devoting more time to climate change issues. This could involve taking up GHG reporting roles or establishing positions focused on that function, as we saw in chapter 5. Of course, governments of all levels may proactively work with colleges and universities for their own purposes. As we also saw in chapter 5, we can envision regulations and policies that include or specifically target academic institutions. A government might require postsecondary institutions to teach victims of climate disasters or migrants. It could nationalize some research it deems relevant or prohibit certain teaching. A campus leadership group will have to be very attuned to government attitudes and actions, seeking to protect its institution while maximizing benefits and opportunities from the relationship.

Colleges and universities should also consider meaningful work on the representational or symbolic layer. I do not mean this in a cynical or shallow way, but instead to draw attention to linking actual climate work with how the world perceives an institution. It is quite possible for a postsecondary institution to conduct research on climate change, transform its pedagogy, and mount all kinds of public work without making a dent in its reputation. Further, since so much social interaction and political transformation takes place at the symbolic level, for better or for worse, interacting at that level can be productive for helping us grapple with the climate disaster. To this end, colleges and universities may change their physical appearance to look greener or more climate committed. Huge wind turbines, roads replaced with bike paths or lined with solar cells, new buildings that are net negative emissions and look very different from the rest, and so on can make a clear statement of an institution's priorities. A more literal statement can come in the form of an institution's mission statement. These can easily be general boilerplate with little practical application, yet perhaps language about grappling with the Anthropocene will signal that a campus has some resourced intention along that line.[5] Universities or their executives could also issue public statements to influence public opinion and decision-making about climate issues, drawing on their institutional reputation and analytical powers. They can come together to encourage each other in taking concrete steps toward decarbonization. For example, the Race to Zero declaration bound signatories to these actions:

- Pledge: Pledge at the head-of-organization level to reach (net) zero GHGs as soon as possible, and by mid-century at the latest, in line with global efforts to limit warming to 1.5C. Set an interim target to achieve in the next decade, which reflects maximum effort toward or beyond a fair share of the 50% global reduction in CO_2 by 2030 identified in the IPCC Special Report on Global Warming of 1.5C.
- Plan: Within 12 months of joining, explain what actions will be taken toward achieving both interim and longer-term pledges, especially in the short- to medium-term.
- Proceed: Take immediate action toward achieving (net) zero, consistent with delivering interim targets specified.
- Publish: Commit to report publicly both progress against interim and long-term targets, as well as the actions being taken, at least annually.[6]

It's important to remember that much depends on the specific nature of a given postsecondary institution. Its geographical location radically situates it within the climate crisis itself. Its institutional nature—research university, technical institute, military academy, religious college—fundamentally shapes an institution's choices and parameters. Public colleges and universities are intertwined with governmental policy to varying degrees, while private campuses are more closely tied to private funding and governance sources.

We now turn from questions of institutional leadership to matters involving the physical campus, and in this area, many options and challenges loom ahead. We can start with a university's computing environment. How can that infrastructure survive climate change–driven dangers, both on- and off-site? One option is to build redundancy by hosting and backing up data and applications to off-site (i.e., cloud) hosting. Another is to participate in intercampus collaborative hosting projects like LOCKSS (Lots of Copies Keep Stuff Safe) or CLOCKSS (Controlled LOCKSS), where members agree to host other campuses' data, creating a resilience backup network in case of disasters.[7]

At the same time, campuses will most likely rethink their IT strategy and operations in terms of their carbon footprint. For example, does an institution reduce or directly block the use of some technologies? It would be unsurprising to see a university ban bitcoin mining, given the enormous (and growing) carbon emissions involved in that process. Perhaps campus policies will restrict some AI research and usage, such as training software on huge datasets, because the cumulative computation involved means generating a large amount of carbon emissions throughout the process. Alternatively, an institution might want to restrict such computational intensity because campus leaders see it drawing green energy that others could use to purposes the institution would prefer. Hardware provisioning may shift to easily upgradeable devices, rather than replacing them entirely. Campuses may encourage—or mandate—green computing practices in general. Governments, local or national, could well encourage or require the same, and nonstate partners (companies, nonprofits, civil society organizations) follow suit. To determine

such policies, academic institutions must measure computing's impact, which requires research and the creation of metrics with new techniques. Conversely, some institutions should prepare to defend the carbon costs of conducting computationally intensive research; in certain contexts, climate research may be the easiest to protect. Using a mixture of distributed sensors with analytical software to understand campus building performance may be another justifiable use of computer resources, even to the point of creating a "digital twin" that simulates the academic space. Beyond immediate computational use of energy, how will a college or university account for the social costs attending on environmental stresses?[8]

Computing is just one part of a physical campus's energy needs. There are many other steps an institution can take to reduce its carbon footprint. On a small scale, switching lights to LED is an established practice, already seen in related cultural institutions, like opera houses. Replacing appliances that use chlorofluorocarbons and hydrochlorofluorocarbons, notably refrigerators and air conditioners, is quite feasible. Replacing static windows with electrochromic smart glass, which changes the amount of heat and light it allows through based on computer instructions, is an emerging technology worth exploring. Improving overall energy efficiency through insulation, replacing some materials, and more closely aligning energy consumption with actual use is a relatively easy win.[9]

At a broader level, we may rethink, redesign, and even overhaul the built environment of a physical campus, as we saw in chapter 1. Some buildings may be fortified against storms, fire, and particles. Others could be renovated to reduce greenhouse gas emissions. Still others could be relocated, either to a more favorable site on campus or to another spot in the community. Consider the case of Washington College, as described in Lee Gardner's groundbreaking 2019 reporting:

> The student union, which was inundated in 2008, now sits behind a 360-degree flood wall, more than 10 feet high on the river side. The university also invested in nine miles' worth of large-scale interlocking prefabricated barriers that can be quickly moved into place and filled with sand by bulk loaders to protect other sites.

Some sites can be protected only so much. The building that houses the theater-arts department at Iowa sits right on the river bank, and the 2008 flood deposited about six inches of river-bottom sludge on every horizontal surface on the first floor. Iowa has since prepared the building for deluges to come. All of the mechanical systems were moved up from ground level. The university redid the ground floor with durable triple-layer plaster, raised electrical outlets, and minimized the activities held on that floor.

Campuses in vulnerable areas also need to design against fire. Those in arid areas as well as regions where droughts are increasing, such as the Universidad de San Carlos de Guatemala, should plan for the likelihood of advancing flames. Some have already done so and can be learned from. The University of California, Los Angeles, is changing the mix of trees on its grounds for this reason:

> The drier weather has begun killing off some species of trees planted around the campus, such as non-native Canary Island pines. As part of a master landscape plan, the university is now looking at replacing some trees with better-adapted native species—and getting rid of its eucalyptus trees altogether. The aromatic oil that suffuses them means "eucalyptuses are quite flammable," says Nurit Katz, chief sustainability officer. "The large number of eucalyptus [*sic*] is part of why the Oakland Fire in the '90s was so severe."

Near to UCLA, Pepperdine University has a very extensive fire prevention plan:

> Only about 300 acres of the 800-acre site have been developed—the rest stand as a buffer. Closer to the developed core, the university maintains a 200-foot zone cleared of flammable brush around all structures. Phil Phillips, vice president for administration, has watched fire race toward the campus five times, but "when it hit that brush-clearance line, it would just kind of fade out, peter out, over and over and over."
>
> The Mediterranean-style buildings themselves are faced with stucco and roofed with terra-cotta tiles, both fire-resistant surfaces. They have no eaves, which are among the easiest entry points for a floating ember or stray flame. The buildings are arranged in clusters, but even as the campus has expanded, they have been spaced widely enough that fire couldn't easily leap from one to the next, and firefighting equipment could be maneuvered between them.
>
> Pereira even built in a campus water-reclamation system that the university uses to feed its two-piece fleet of firefighting equipment—and its public-safety officers are cross-trained in wildland firefighting.[10]

Renovating old buildings and rethinking new ones will bring to mind the options discussed in chapter 1. Redesigning structures to be carbon neutral is one large step, involving careful building siting, improved insulation, changes to windows, overhauled appliances, and new materials. On the construction side, we may make more use of recycled materials, as well as tending to refurbish present buildings instead of replacing them totally.

There are many opportunities for innovation on this score. For institutions located on bodies of water, elevating entire grounds may be the best option. Bringing together sufficient dirt or landfill to the sea might reduce mountains or create vast new pits inland. Building massive seawalls is another possibility, one already established around the world, from Holland to Guyana and Puducherry (formerly Pondicherry). These, of course, run the obvious risk of being leaky, overtopped, or broken. They run the less obvious but no less threatening risk of trapping flood waters on campus, if the walls survive a flood, as we have seen with Hurricane Katrina in New Orleans. Another option might be floating buildings, which have already been deployed in São Vicente and parts of Lagos.[11] Campuses may loft buildings and walkways on pillars or stilts in order to let waters pass harmlessly beneath them. In any event, what is to be done with landfills an institution uses, either those located on campus or elsewhere? To what extent is a college or university willing to expand its sense of recycling and waste cleanup?

There are still more options when it comes to building design. To pick one source of inspiration, the Living Building standard, currently in version 4.0, offers a very challenging yet inspiring set of requirements. They include growing food on-site, protecting land for animals on- or off-site, offering support for bicycle and electric vehicle transportation,

embracing biophilic design, and enabling access to outside air and light. Materials must be locally sourced to certain degrees and avoid containing any "Red List" chemicals. A building created and maintained to this standard must also "supply one hundred percent of the project's water needs through captured precipitation or other natural closed-loop water systems, and/or through recycling used project water, and all water must be purified as needed without the use of chemicals."[12]

The COVID-19 experience may yield further ideas for academic building design in the Anthropocene. The importance of safe and healthy ventilation is encouraging schools to improve filtration and circulation systems. Larger and a greater number of doors and windows may fulfill that purpose as well. We may see a move toward more spaces with direct outside exposure. The pandemic may literally change the face of higher education, a change climate planners may continue. At the same time, we must remember that every institution occupies a different ecological niche with its own constellation of threats. Different types of institutions have varying capacities and responsibilities. A religious university, for example, may be bound to its faith's climate strategy, while a public campus has to navigate state politics. (See, for example, a call for Catholic institutions to use their land for power from Dan DiLeo, faculty member and director of Creighton University's Justice and Peace Studies Program.) It may be that small pilot projects are the safest way for an institution to advance. In 2005, a group of Leuphana University Lüneburg students and staff set up a pilot solar project. In so doing, they navigated university power structures, financing, and maintenance: "The initiative's members . . . had to acquire knowledge and skills to build up and run a private initiative. They also had to obtain and coordinate internal and external knowledge on photovoltaic technologies." By 2009, Lüneburg embraced the installation for future maintenance, and it sounds like a successful pilot that suited its situation well. Ultimately, each campus has its own distinct nature and has to assess its individual risk exposure:

> The myriad effects of climate change can be very localized. A university in Manhattan, for example, might have to deal with rising sea levels. A college in Denver may be faced with colder winters. A warmer planet generally means more flooding, wildfires and extreme heat. Colleges at this stage often also assess the politics and infrastructure of their home location. Is public transit robust? What are the bonds like between the college and the county? In some cases, administrations may choose not to release assessments that expose the vulnerabilities of their institution, [Alex Maxwell, senior manager of climate programs at Second Nature] said.[13]

Higher education institutions should also reconsider their inherited sources of electrical power. Campuses may increasingly install solar panels for their own use and in different forms. Alberta's Red Deer Polytechnic now generates 16 percent of its electrical needs through thousands of solar panels distributed across its campus. That includes a new residence hall that integrates hundreds of panels into its structure, not just on top of its roof, but on walls and other surfaces, "form[ing] part of the building or the building envelope." In 2021, Grinnell College broke ground on a standing solar farm installation designed to provide one-third of campus power needs. Some academic solar projects may involve collaboration with the local community, as with Vermont's White River Community Solar project driven by a graduate school (Vermont Law School) and a nonprofit (Building a Local Economy). In addition to different economic and format structures, different types of solar cells are becoming available. Besides different ways of siting panels, there are also varying materials, such as crystalline silicon and cadmium telluride. Beyond solar, larger institutions may consider hosting wind turbines, depending on local meteorological and political conditions, while smaller ones may site microturbines.[14]

Other power sources may become available over the rest of this century, depending on technological development, finances, and an individual institution's situation. Geothermal power is, for now, more affordable in certain areas that have underground hot water close to the surface (for example, in Iceland). We may have campuses decide to take advantage of this power generation method as carbon costs rise and as—and if—geothermal becomes more flexible and affordable. For colleges

and universities near substantial bodies of water, hydropower may become attractive as current and tidal technologies improve. "Low-head" hydropower could work for those campuses located next to fast-moving rivers. One instance of this approach appeared in 2021, when Berea College successfully installed a hydroelectric plant on the Kentucky River, which should provide 50 percent of that institution's power needs. Perhaps some institutions will deploy or outsource anaerobic digesters to turn food and agricultural waste into natural gas as a transition fuel, as Middlebury College has done. Concentrated solar power, whereby many mirrors focus sunlight on a fluid container to heat the contents to turbine-driving steam, may become more efficient and therefore attractive, especially in regions with the highest amounts of sunlight. Biomass can provide heat as well as electricity, as a University of British Columbia project has demonstrated. Nuclear power may appeal, either in the form of very small reactors on site or, more likely, as an off-campus outsourcing strategy, especially as the climate crisis deepens. Naturally, each of these power sources has its own issues, from competing with other needs for certain sites to political opposition, noise pollution, and significant maintenance or decommissioning costs. Each may appear on campus (or be outsourced), serve for years to generate power, then give way to successor power generation systems. Each can figure into campus emission audits as well.[15]

When Universities Draw Down Carbon from the Skies

All of these physical campus measures involve academic institutions fulfilling one of humanity's great Anthropocenic tasks, cutting down our GHG emissions. Campuses may also decide to participate in a second such task, drawing down previously emitted GHG from the atmosphere. The most popular forms of this are afforestation and reforestation. La Universidad Autónoma de Madrid planted trees in a carefully selected local area, collaborating with another university and the city government in choosing a tree species, developing a road, determining tree density, and paying bills. These plantings can be done badly (trees planted in bad soil, too closely together, or in the wrong climate for a given species) and their benefits overestimated (it takes years, often decades from planting to realizing results), but done properly, this is a strategy with positive long-term results. There are as many ways to expand tree count as there are microbiomes and forms of human ingenuity. Mangroves might be a good choice for campus grounds experiencing saltwater intrusions. A campus might select or genetically modify trees to have lighter colors in order to not only gather carbon dioxide but also to reflect back more sunlight. Adding trees and other plants to campus grounds often suits popular and historical impressions of academic styles, such as the cliche of "ivy-mantled tow'r[s]" in Thomas Gray's famous line. More foliage has the additional benefit of improving mental health, according to biophilic design thinking.[16]

A second strategy involves installing DAC devices on campus. We could imagine seeing such machinery in small numbers and at likely locations to start with, such as near engineering or environmental studies offices. DAC numbers and scale may well increase as the century progresses, growing in quantity to banks and installations, each device improving in efficiency as the technology improves. Perhaps climate-minded colleges and universities will compete with one another on their carbon sequestration capacity; perhaps institutional ranking schemes will account for this metric. Anand Kulkarni of Victoria University has suggested the creation of a resilience ranking to be hosted either by a published, third-party entity or by campuses themselves. How to set this up can involve many specifics—Kulkarni recommends considering faculty research output, student value, risk management, consistently following published values, diverse revenue sources, and demonstrated flexibility—and it is easy to find many critiques of ranking systems. The key point is opening up climate operations as a domain for institutional competition, with DAC as a measurable, contestable metric.[17]

A third carbon sequestration approach involves agriculture and campus grounds. "Enhanced weathering" works by amending soil with materials like basalt, wollastonite, or olivine, which, ground up to a very fine powder, can be distributed over certain areas to reproduce the

carbon-gathering capacity we see in rock weathering. Other materials could be used for this purpose. Academic researchers from Sheffield to the University of Guelph have been experimenting with enhanced weathering: "While . . . researchers apply basalt to hemp in New York and to alfalfa and olive trees in California, scientists working with the University of Sheffield's Leverhulme Centre for Climate Change Mitigation in the U.K. are spreading basalt on cornfields in Illinois and on sugarcane in Australia. In Ontario, Canada, researchers are applying wollastonite from a nearby mine on soybean and alfalfa fields." As Elizabeth Kolbert recommends, "Basalt could be mined, crushed, and then spread over croplands in hot, humid parts of the world. The crushed stone would react with carbon dioxide, drawing it out of the air."[18]

As with any technology, these three carbon-capture techniques bring with them ramifications, side effects, and knock-on consequences. Banks of trees or DACs will change a campus's physical profile. Each may require significant amounts of water to function, which could necessitate expanding institutional water supply, which may in turn stress local hydrological systems. Enhanced weathering may require setting up ground rock stockpiles or conducting the grinding on site. Campuses might build or expand greenhouses using drawn-down carbon dioxide to aid plants in growing food. Storing sequestered carbon might take place on campus, underground, or at an off-site location, each of which will require monitoring.[19]

Besides carbon dioxide, campuses are also likely to pay increasing attention to their role in controlling methane, currently the second most damaging greenhouse gas. This can involve rethinking landfill use, such as by more extensive recycling, repurposing, and reuse. It may involve adding new sewage treatment methods. As with carbon dioxide, this means rethinking human diets as they appear on campus—that is, food service plus public health communication. Taking steps to control food waste can slow methane creation. A methane strategy should involve changes to the way any animals are raised on campus grounds, if there are any. A methane plan also overlaps with a carbon reduction effort, since fossil fuel production also emits methane—35 percent of the human total, according to a United Nations report.[20]

Many of these plans and alterations are costly, of course, and campus finances may have to change in other ways. For some institutional leadership, redoing their physical structure appears to be too expensive, which leads them to purchase carbon offsets instead. This may be a short-term solution, one that divides faculty, students, and staff into supporters and opponents. That latter population may also press on institutional stewards to divest endowment holdings in GHG-intensive businesses. Student activism may play a key role here, drawing on previous divestment campaigns, as Naomi Klein has argued. Institutions could take a similar stance with regards to charitable gifts from certain entities, in the form of refusing carbon-burning money. For example, Britain's Russell Group universities received "more than £60m in research and teaching funding from companies in the coal, oil and gas sector" during the 2015–2020 period. Will activism—either within academic institutions or beyond—call for that practice to end? How will those charged with fiduciary responsibility respond, especially given rising demands on their budgets? Several American universities, including Harvard and Boston, recently divested from fossil fuel industries. Additionally, colleges and universities will likely revise their insurance policies. As climate pressures rise—again, unevenly, depending on a given institution—negotiations over pricing and coverage will likely heighten.[21]

Overall, we might expect to see colleges and universities set decarbonization targets using various metrics and timelines. At this point, there are many options, including the question of whether to aim for net zero or negative carbon emissions. Academic leadership can also alter targets, much as their governmental, business, and nonprofit peers have done. For example, Southern New Hampshire University recently advanced its target date from 2030 to 2025. Those peer organizations may also seek to influence or compel campus decarbonization and methane reduction plans. Scoping out just what constitutes a carbon or GHG footprint requires a major decision at three and more levels and striving to

be carbon negative across all of them. The nonprofit Carbon Disclosure Project (CDP) offers three options for defining an organization's footprint, in Solitaire Townsend's summary:

> Scope 1—Direct emissions (from a company's own vehicles and facilities)
> Scope 2—Indirect emissions (from the electricity that a company purchases)
> Scope 3—All other indirect emissions (from supply and even in consumer use)

We can see a college or university choosing one of these and defending that choice. Townsend actually thinks these are too limiting, and calls for a new level, "Scope X," or "work that restores and regenerates, that rebuilds the foundations of healthy ecosystems and thriving communities, that takes responsibility for system level emissions . . . A Scope X company would act on carbon far beyond their direct or even indirect impacts, and instead accept the challenge of system change." Townsend is referring to corporations, especially the largest ones, but we can imagine some academic populations seeing Scope X as fitting their sense of mission in the community and world.[22]

The Question of Academic Travel

A key source of those Scope 1–2 and also 3 emissions in that academic setting is transportation, of course. As noted in chapter 1, that is one area colleges and universities seem likely to rethink and redesign. We have already seen some institutions replacing the fossil fuel–burning campus shuttles, carts, cars, and other vehicles that they own and operate with electrically powered ones. La Universidad Autónoma de Madrid took steps to expand its accessibility to bicycling, adding secure storage centers, making bike rentals available, and adding bike paths and lanes totaling "almost 100 km." Australian National University created the "Timely Treadlies departmental bike fleet," which has "reduce[d] motor vehicle use." UCLA recently vowed "to run a completely carbon neutral fleet by 2025." This parallels similar moves in primary and secondary schools.[23]

Beyond the makeup of vehicles campuses own is the more complex question of academic travel in general. We may face this issue for a generation, as at least one major airplane manufacturer states it will be using conventional fuels, which emit a great deal of carbon dioxide, through 2050. Student travel raises its own set of questions. First, will we come to view remote learning at an institution located in another country to be on par with physically traveling there? Or will students turn to low- or no-carbon transportation for international study, such as trains, ships, or mechanisms to come? Second, how will an aggressive decarbonization agenda impact study abroad? One can imagine a college buying carbon offsets for the next few years, arguing that the personal and social benefits of that course of learning justify the action. Or will students and/or program leaders prefer study that requires shorter travel distances, or perhaps aim for a combination of fewer trips with deeper cultural dives, as Hans de Wit and Philip G. Altbach have called for? For example, their take on Europe's Erasmus+ program:

> More than 10% of European students participate in the flagship Erasmus+ programme, moving around the continent and beyond for periods between two months and one academic year. This is the most extensive mobility scheme in the world. The European Union, which advocates a more aggressive policy on climate change, should also take measures to reduce the environmental impact of this programme, only allowing more climate-neutral forms of mobility and exchange of students, teachers and administrators.

Alternatively, will study abroad anchor itself on what Jenny J. Lee and Ola A. Lundemo refer to as "regenerative partnerships"? These voyages would focus on improving a community's sustainability and resilience in the face of the climate crisis and doing so with preexisting study abroad benefits: learning another language, exploring a culture, and practicing mobility, independence, and interdependence. This might have curricular impacts at sending institutions: "A regenerative approach to international education also involves eco-consciousness raising, such as incorporating environmental education and research into other disciplines. Infusing environmental topics into and across the curricula, sponsoring interdisciplinary meetings to address climate change and supporting nature conservation research are obvious places to start."

Third, will campuses with significant residential student populations revise their academic calendars to reduce the frequency of holidays and vacations and thereby cut down student travel? It is not difficult to imagine new academic calendars in the climate emergency. We potentially saw academic institutions' ability to make such changes when colleges and universities altered their calendars in reaction to COVID-19's successive waves.[24]

Faculty and staff travel may fall under similar scrutiny. Given the environmental costs of professors and staff flying, especially longer distances, we might expect charges of flight-shaming and calls to simply cut back such trips. Those calls may come from within the academic world as well as from the outside. They can easily be politicized, as when (for example) right-wing politicians criticize environmentally minded politicians for extensive jet travel. Rather than reducing such professional activity outright, we can attempt to replace some or all of it with digital means. The COVID-19 pandemic taught us many ways this can be done, both badly and well. Yet flipping a conference, meeting, or on-site research experience online may not be sufficient. We can also seek to reduce the GHG footprint of virtual experiences. Grant Faber published a framework within which virtual event participants can cut back their emissions, from use of electric lighting to server traffic. Reducing emissions may also entail new arrangements with on-site hosts, including hostels, local transportation, food service, and other parts of local society.[25]

Academic travel may learn from some of the thinking around green religious pilgrimages, which seek to preserve the spiritual experience while reducing the overall GHG footprint. James Mills offers suggestions that might inspire non-pilgrimage-based academic applications: "Pilgrimages could be local and based on walking, therefore limiting the use of fossil fuels for mobility. Pathways could simultaneously serve as wildlife corridors, connecting fragmented habitats and making movement safer for birds, mammals and amphibians. Green cemeteries could be integrated into the pathways further increasing natural habitats while serving a human purpose."

Mills goes on to find an additional benefit to these new practices, one that resonates with some climate pedagogies discussed in chapter 3: "Intimate contact with local landscapes while on a pilgrimage can help develop a stronger sense of place, which often leads to greater concern and stewardship of the environment." Perhaps a reduction in physical travel will enhance academics' sense of their campus and its immediate community. Perhaps that local community might seek to encourage this new mode of academic work: Juliet Osborne, chair in applied ecology and leader of the environment and climate emergency working group at the University of Exeter, said that "academics could be better at sharing the outcomes of conferences to reduce the number of scholars attending each event and universities could highlight the health and equality benefits to reducing travel."[26]

We must also keep in mind that travel technology will surely change as the twenty-first century progresses. Recall that the first heavier-than-air flight was just over one century ago (1903) and consider just how much innovation, expansion, and development occurred in that span. Looking ahead, academics might anticipate revised designs for jet aircraft. Less GHG-intensive fuels may appear, including some that include biofuels or synthetic aviation fuels (SAFs). More efficiently burning fuels would help, as would improvements to aerodynamic design. Planes may eventually fly powered partially (as hybrids) or entirely by hydrogen or batteries, the latter considered to be functioning electrical aircraft, at least for short distances, where smaller craft and slower speeds are accepted, since batteries are heavy (for now). We may also see airships and blimps return to play a key role in travel. Their motors run by electricity, rather than by burning fuel, and can be powered by solar or batteries.[27]

The New Research Mission of Universities

Some of that research and development will come from the academy, and here we return to the research enterprise, how it might be transformed by the next several generations, and how we can best anticipate and plan now. To begin with, it seems likely that many universities will increase

their support for research into climate change with professional development, hiring faculty and staff, and creating new academic units. As we saw in chapter 2, many academic fields can research aspects of the climate crisis. Such scholarship can contribute to our common understanding of the crisis, which is a clear case of academia serving the public good. This research can play out across the full breadth of the Anthropocene as a topic, from analyzing changes to ocean currents to modeling how societies may respond to increased temperature. In order to support this research agenda, some institutions will be faced with the additional cost of some physical research that runs into climate obstacles, like gathering ice cores from decaying glacier fields or conducting fieldwork amid advancing prairies. This could involve temporarily hardening certain sites under extreme conditions or building very high-fidelity digital twins of the source material.[28]

Academics may also carry out not only research but also combined research and development of new technologies, services, and more. Purdue University faculty have developed a complex new paint that helps materials cool off more rapidly, based on barium sulphate, nanoparticle films, and nanocomposite paint. Other researchers have developed new structures and designs for floating buildings. Still others continue developing alternatives to meat, such as vat-grown food built up from the cellular level. Some explore alternatives to oil-based plastics, like mycelium. Oceanic power, both tidal and current based, calls out for rapid R&D, as it has fallen behind solar and wind in terms of efficiency and price. Faculty, staff, and students might work on improving the efficiency and price of devices that obtain water from the air, which could be vital hardware for drought-afflicted areas. The most ambitious universities might aim for the carbon removal XPRIZE. Others might support restorative research, which enters the field to build back damaged or transformed ecosystems, like a University of Virginia effort to restore and expand seagrass on the Atlantic coast.[29] Higher education is already playing a research (and sometimes development) role for the climate crisis in the broader world. Universities could become the leading laboratories for humanity's Anthropocene transformation.

A slice of academic research turns its gaze inward to examine how academia responds to the climate crisis. We cited some examples in chapter 2, such as a political economy analysis of university endowment divestment campaigns. Elsewhere, there are philosophers who examine scholars in other disciplines, analyzing how they think through the crisis.

A Royal Melbourne Institute of Technology engineering team is studying colleges and universities as they plan for the climate crisis. Walter Leal, chair of Climate Change Management at the Hamburg University of Applied Sciences, has done tremendous work organizing conferences and scholarly collections on this topic.[30]

Institutional support for academic climate crisis research of all sorts may take various forms. We could see climate research centers appear, like Tsinghua University's Carbon Neutrality Research Institute, Oxford University's Environmental Change Institute, Johns Hopkins University's Ralph S. O'Connor Sustainable Energy Institute, or Rutgers University's Geoengineering Model Intercomparison Project. Some academic centers may consist of partnerships with local communities, such as the Centre for Climate Repair at Cambridge. Partnering with think tanks, like the Potsdam Institute for Climate Impact Research (*Potsdam-Institut für Klimafolgenforschung*) might be another way forward. Libraries can continue their historic and present role in supporting scholarly inquiry. A drive toward open access publications can make that role even more important. Libraries could also support the growing sharing and use of datasets, which might lead to new formats, genres, and publications.[31]

A great deal of this research may proceed through more partnerships with other academics and researchers from other institutions. For example, the World Weather Attribution project mentioned in chapter 5 involves researchers from the Red Cross Red Crescent Climate Centre, the Royal Netherlands Meteorological Institute, and the University of Oxford's Environmental Change Institute. Other research can include governmental scientists, as did a 2021 analysis of models seeking to account for land use in climate mitigation plans. Similarly, NASA's Jet Propulsion Laboratory joined forces with a nonprofit to develop a GHG

identification tool. That nonprofit, Carbon Mapper, features scientists from academia, industry, and government. Four American colleges joined forces to buy electrical power from a distant solar farm. As part of that project, "students will intern with the solar farm developers, access the energy production data for research."[32]

Collaborations between academics and business may proliferate, as we saw in chapter 5 with Aarhus University working on wind turbine blade recycling with a group of collaborators, including turbine manufacturer "Vestas; chemical producer Olin, which produces resin for turbine blades [and] the Danish Technological Institute, an independent research and technology institute." Citizen science may enhance academic climate research, providing additional perspectives on and person-hours for projects. ClimatePrediction.net offers one example, where Oxford University scientists make available software that runs on thousands of other people's computers, distributively crunching data. The relationship between scholars and publishers could change as open access output and the amount of research data both grow, potentially driving new publication formats and genres.[33]

In pursuit of climate research, marginalized faculty will often need extra support. Untenured researchers will face multiple risks from external politics as well as on-campus forces. Faculty marginalized by gender, race, religion, sexuality, class, geography, and other axes of oppression, depending on social context, will need additional help in fending off bigotry and bias as they work. Antidiscrimination efforts that have been established recently may need to expand on this point, drawing on the emerging climate justice movement.[34]

Redesigning Teaching for the Emerging World

Turning from academic research to academic teaching, we can now explore how colleges and universities can prepare for changes to their educational mission, starting with certain fields facing physical challenges due to the crisis. For example, teaching agriculture may require a significant investment in that department's physical resources, which have deteriorated in some nations. We can think as well of classes that use remote sensor data, from engineering to environmental studies and oceanography. They may need backup plans as the environment changes.[35]

We should also prepare for climate change teaching that cuts across disciplinary divides. As noted earlier, the interdisciplinary nature of climate study may require consideration as a new form of the liberal arts. Alternatively, we could see teaching the Anthropocene taking the form of wide-ranging climate literacy, instantiated in many classes and through on-campus events. Such an initiative could link to the decades-long field of information literacy, teaching students how to detect climate disinformation and greenwashing. It can also become an emergent current within general undergraduate education. As University of Vermont engineering professor and university provost David Rosowsky asked his institution in 2016:

> What if we were the first major university to require all of our undergraduate students to have a minor or certificate in Climate? Why not? After all, professionals in every discipline will be required to come together to address the complex issues around climate change, and all of us will live in a world impacted by these changes. And why not UVM? We have nationally recognized faculty and programs in the environment and natural resources, climate studies, energy, water, complex systems, global and population health, policy, sustainability, food systems and agriculture, political science, and more.[36]

Academia may also teach itself, as it were. Our best understanding of the climate crisis may not be well understood by faculty and staff. A form of self-education or professional development may prove essential in order for the entire academic community to participate in thinking and planning for the next generations. Tecnológico de Monterrey calls this out openly in its new strategic plan: "Our commitment is to train the students and professors of Tecnológico de Monterrey to understand the complexity of the climate crisis and transform the world toward sustainable development."[37]

Higher education may also change the schedule of course offerings as the unfolding climate crisis reshapes the academic calendar. The

COVID-19 pandemic might provide one direction, as Beloit College shifted its semester schedule to a shorter one, based on "blocks," in order to provide more scheduling flexibility in case of threats or disasters. Alternatively, postsecondary institutions may reduce or end class offerings during the most dangerous times of the year, such as summers for areas experiencing intensified heat and humidity, or any month when dangerous storms are locally most likely to strike, such as late summer and fall for the Atlantic Ocean's hurricane season. On a shorter time frame, campuses in warmer climates, especially those with high humidity, may consider declaring "heat days" when rising temperatures spike to dangerous levels or shift a day's schedule to avoid holding classes and other meetings during the hottest hours.[38]

How we teach will probably change as much as *what* we teach. We can already identify a set of teaching practices that support climate learning, as we saw in chapter 3. Learning based on projects, student inquiry, and physical places are established pedagogies, practiced and studied, which we may expect to become more popular as the crisis demands more teaching. Service learning and internships are similarly known and may become more climate focused, with students working on storm damage cleanup or afforestation. Other less well-known pedagogies may surface and develop, driven directly or indirectly by the climate crisis. For example, peeragogy, the practice of students teaching one another without a guiding instructor, could grow among learners faced with disinterested or climate denier faculty. The movement to recover and honor Indigenous ways of knowing could inform postsecondary teaching. Given the globally disaggregated nature of higher education pedagogy, perhaps we should expect multiple schools of practice to claim the mantle of "climate teaching." We should also anticipate short, public teach-ins on climate topics, at times driven by current events, such as a disastrous storm or the implementation of a major policy.[39]

Digital learning may also rise, both in the form of wholly online education as well as computational work in face-to-face classes. Encouraging and supporting all of it requires some staff assistance and institutional commitment, ranging from an institutional library making available recording spaces to fully staffing an online teaching center. Off campus, there are many resources, from peers at other institutions to published research, experts on social media, and professional organizations. We should see a body of knowledge grow that describes digital climate teaching. The online community dedicated to helping people tell their climate crisis stories, hosted by StoryCenter, gives us an inkling about that possibility. StoryCenter takes care to support the stories of marginalized populations, offering a good example of a climate justice approach.[40]

The COVID-19 experience gives us further insights into how digital teaching might change. The most evident lesson is that higher education rapidly expanded its ability to teach entirely online. To the extent that weather damage impacts an academic institution and its population, this proven capacity may well be summoned throughout the rest of this century. For nations and regions suffering enrollment drops or financial stress, it seems that online teaching was a way to survive and thrive during the pandemic. On the other hand, the pandemic showed opposition to online learning. Dislike of "Zoom U" from faculty, students, and the popular imagination never fully faded, even as faculty and support staff scrambled to improve at times jury-rigged, emergency remote instruction. Our investment in in-person learning runs very deep, and perhaps not even the Anthropocene will quash it. COVID also coincided with expanding criticisms of Silicon Valley in general and ed tech in particular. The work of skeptics and critics such as Audrey Watters won an audience. Stories about proctoring companies and others violating student privacy and otherwise behaving as bad corporate citizens further tarnished the educational technology field. This animus could combine with concerns about campus technology's GHG footprint to drive some institutions to do less, not more, in digital education.[41]

At another level, we can think (or rethink) of teaching in terms of creative, cross-disciplinary problem study and solving. The climate crisis does not fit neatly into university curricular pigeonholes, nor does it tamely follow our intellectual domains. Instead, it remorselessly attacks our world across those conceptual lines. Teaching our students how to grapple with the crisis on its terms means taking seriously real-world

learning and learning how to learn in a fluid situation, how to innovate in unfriendly environments, and how to communicate in unsupportive situations. Students need to learn adaptation, much as their colleges and universities do.

We should anticipate changes to academia's educational mission beyond pedagogy and the curriculum, starting with care for the student population. As demand for psychological counseling services grows in the world at large, counseling may also become more important on campus. We may anticipate increasing interest in providing or referring students to mental health services as eco-anxiety rises and climate-caused traumas burgeon, as noted in chapter 3. This is not just an American phenomenon, despite US colleges' and universities' high standard of student care. A recent *Lancet* article called for a broad investment in psychological support, including for "training for health professionals on climate change and mental health [to] be increased." The global activist group 350.org calls on the world to prepare for climate grief; academia should not be exempt from this. Such preparation could take the form of hosting, or allowing members of the community to host, climate cafes. Modeled on death cafes, these are social spaces for people to safely express their feelings about this fraught topic in a social, facilitated setting. On the biological health side of care, we should plan for changes to what physical health care a campus offers as conditions alter. For example, a campus on the edge of desertification should expect to see worsening cases of asthma. A college susceptible to flooding can plan on more cases of mold allergies. Institutions likely to be hit by weather damage in the short term should expect a wide range of injuries. Institutions should take care to support their students only after learning more about them, without presumption. Population surveys and focus groups may be a good way to start.[42]

Higher education offers other learning services apart from classes, which the climate crisis can alter. "Work colleges," institutions that require students to perform labor with their hands beyond class assignments, may offer manual labor options specifically concerning the climate crisis, such as repairing levees or preparing food for refugees.

Career services will be a focal point for directing students to "green jobs," working in decarbonization enterprises and post–fossil fuel industries. Career services can also guide graduating students to positions that help humanity through the crisis: disaster management, government, certain nonprofits, and the like. Student groups can organize along similar lines, linking students to jobs as well as political action. Student journalists can conduct climate research with strong local resonance. The University of Florida student newspaper offered an interesting foretaste of this during the COVID pandemic, when its rising journalists critically dug into their campus's infection data.[43]

The experience of students living on a campus may change in some ways. Residential universities and colleges may host alternative living spaces with a climate theme, such as the Domes at the University of California, Davis.[44] Residence life can offer climate crisis programming. At the same time, residential institutions may rethink the climate footprint of their activities, such as travel-intensive spring break. They might reduce or remove water-based entertainment (swimming pools, lazy rivers) in arid areas.

Teaching off campus may also rise, and with some urgency if an institution deems the crisis of such importance. As noted in chapter 3, academic libraries and museums can present interactive climate change content and experiences to the community and travelers in a form of public outreach, somewhat like that offered by museums. This can be a way of expanding access to a college's or university's intellectual resources, as well as trying to better inform the public along climate lines. Nonacademic museums are already doing this. For example, the Peabody Essex Museum has recently offered a series of exhibits and programs about the climate crisis. Notably, they are aimed at getting visitors to think productively about climate futures.[45]

Such outreach brings us to the topic of academic-community relations, which we explored in chapter 4. Colleges and universities have an additional strategic path to follow—namely, improving community relations through work on climate issues. There are many projects and avenues to explore, as we have seen. In addition to that discussion, we

could add other examples of potential town-gown collaboration. We could also see students, faculty, and staff working on local biological matters, such as proactively planting species most likely to thrive in the emerging climate while transporting away those that will not succeed, altering landscapes in two or more communities. In countries where police reform has become a vibrant issue, academics could work with local parties on connections between climate justice and police reform. As activist Sam Grant put it, some populations are more at risk than others from both climate *and* police violence. Some police forces politically align with oil companies and their infrastructure, interacting with populations accordingly. Moreover, there's a question of risk in political organization along these lines: "The fight for climate integrity necessitates that all human beings who care about their future are going to be standing up, practicing democracy. And if as we stand up now, we're going to have our lives put at risk by law enforcement who are trained and paid to protect property at all expense at any cost."

What is the responsibility for non-marginalized academics to support the marginalized in climate activism?[46]

The Potential of Interinstitutional Collaboration

So far, we have spoken of individual colleges and universities, yet there is so much potential in collaborations among multiple institutions. As we advance further into the developing climate crisis, campuses can learn from one another's experiments and practice. Campuses can also build shared resources, exchange classes, and mutually support professional development networks. There are already examples of interinstitutional collaboration occurring around climate change. International Universities Climate Alliance is a scholarly information-sharing network of nearly fifty research universities on six continents. The Assessments of Impacts and Adaptations to Climate Change (AIACC) initiative linked a number of sub-Saharan universities to build their teaching capacity. Latvia's Council of Environmental Science and Education (LVZIP) helped organized that nation's universities and external experts in developing on-campus and public education. In 2009, vice chancellors of five universities within the Australian Technology Network (ATN) formed a collaborative Emission Reduction Working Group to lower their collective GHG output. Second Nature works at a presidential level to bring together institutions aiming to reduce carbon emissions, including facilitating offset purchasing. The Cooperative Institute for Climate, Ocean, and Ecosystem Studies (CICOES) links Oregon State University, the University of Washington, and the University of Alaska Fairbanks, as well as the National Oceanic and Atmospheric Administration in collaborative research efforts. The EcoLeague brings together small, liberal arts colleges for a student exchange program.[47]

Some collaborations work through facilitating third parties, like the Sustainable Endowments Institute, which provides tools and competitions for participating institutions, or the Adaptation Learning Network, which provides learning resources to academics in British Columbia. The Virginia Foundation for Independent Colleges helped create the Collaborative Heat Mapping Research Project, wherein students measure temperatures of local urban areas in detail. We may see more of these collaborations, and more ambitious ones, as the climate crisis progresses.[48]

Beyond the academic world, colleges and universities can play a role in the Anthropocenic world, as we saw in chapters 4 and 5. We can see more options as we look ahead. Faculty and staff can enter public debates through various means (old media, social media, campus outreach, personal networks) and seek to inform and influence discussions and decisions. This already occurs, of course, with examples easy to find, like a multilingual, international group of scientists in 2021 publicly urging the world to cut down on methane emissions. A 2021 National Academy of Sciences report authored by nearly one hundred scientists intervened in the geoengineering debate, putting forth a model for broad-based public input. In 2020, another group of scientists called for global action and included academic researchers in their urgency: "As the Alliance of World Scientists, we stand ready to assist decision-makers in a

just transition to a sustainable and equitable future. We urge widespread use of vital signs, which will better allow policymakers, the private sector, and the public to understand the magnitude of this crisis, track progress, and realign priorities for alleviating climate change."[49]

Institutions can support their faculty (and staff, and some students) as they act in such public intellectual roles. Such support can take the form of media outreach, media production, and backing up academic freedom.

In 2019, a world group of universities and colleges signed off on a letter urging world decarbonization, set in the framework of the United Nations' Sustainable Development Goals (SDGs). This suggests one way academics can proceed in their climate actions, by connecting their work to those seventeen goals. Each goal gives a clear way to communicate and connect with global audiences, including governments, NGOs, funders, and civil society, especially when thinking of justice and equity. A university could, for example, cast its effort to source electrical power entirely from local solar and wind in terms of SDG number 7, Affordable and Clean Energy.[50]

Longer Term

> Resilience asks us "how do we keep what we really want to keep?" Relinquishment asks us "what do we need to let go of in order to not make matters worse?" Restoration asks us "what can we bring back to help us with the coming difficulties and tragedies?" Reconciliation asks "with what and whom can we make peace as we face our mutual mortality?"
>
> —JEM BENDELL[51]

The first half of this chapter describes what academia can do now and in the short term. These options are based on realizing effects within short- and medium-term horizons. If we advance those strategic horizons further on, to a much longer term, to the rest of the century, what can colleges and universities start doing or considering now? What can we best contribute to the next two generations? Or do we have the capacity to think, plan, and act along such timelines? If we can speak of students taking a sixty-year curriculum, can academia think, plan, and act on a span of eighty years?

Consider as an example the possibility of long-term biological preservation. Postsecondary institutions could set up refuges for flora and fauna, either protecting them against a changing climate or welcoming them to a new habitat. We could see a campus conducting such efforts as following in the footsteps of the Svalbard Global Seed Vault. As an early example of this idea, one California public university recently started supporting "a menagerie of animals kept at UC Davis until their environments become cool enough to live in again."[52] The quote refers to an unusually high fire and temperature season, but that obviously stems from global warming. Perhaps other universities and colleges around the world will attempt such long-term acts of preservation. Conceptually, such actions would echo literary visions of preserving the present against future catastrophes, à la Isaac Asimov's *Foundation* (1951).

Similarly, institutions can work with long-term climate mitigation or adaptation projects hosted and directed beyond the academy. As of this writing, there are now two massive efforts on two different continents with closely related names and concepts, both aimed at blocking desertification. In China, the Three-North Shelter Forest Program (三北防护林) builds massive forest lines to stop the Gobi Desert from advancing farther into China. Unsurprisingly, "Great Green Wall" is a popular nickname. In sub-Saharan Africa, an African Union project, the Great Green Wall of the Sahara and the Sahel (Grande Muraille Verte pour le Sahara et le Sahel), does the same against that continent's immense desert, as noted in chapter 6. These are not multiyear but multi-decade projects. What role can colleges and universities play with such efforts? Could we consider donating campus-owned land to such efforts, or also to supporting public or private conservancy efforts? Can we contribute our research to refine them while researching their progress? Should we teach them? Should students, along with staff and faculty, contribute labor? How can academic institutions match their planning cycles to projects that plan on generational scales?

Thinking about the climate crisis and academia in the long term also allows us to anticipate fortuitous moments when separate decarbonizing forces reinforce one another. Colleges and universities should

consider benefitting from, and participating in, what Robinson Meyer calls "the green vortex," the process by which many civil society actors cocreate new post-carbon systems and dynamics in a bottom-up fashion: "how policy, technology, business, and politics can all work together, lowering the cost of zero-carbon energy, building pro-climate coalitions, and speeding up humanity's ability to decarbonize."

Scanning for such moments requires studying numerous domains and projects. Few organizations on Earth are as well equipped to perform such analysis as colleges and universities.[53]

If these long-term ideas are daunting, it helps to recall that some of higher education already works on that scale through smaller steps. Some short-term changes accumulate and become more significant in a series over the long term. Small alterations and additions to a campus's built environment gradually build up to a larger transformation. We can stroll through the world's oldest universities and see an architectural history on display, as buildings appear from different eras and styles. Accordingly, we can imagine what a college or university looks like by, say, 2060, once buildings carry gardens, more structures are built from wood and wood-based materials, more solar panels appear, and more DAC machines are present. Perhaps we will be able to identify faculty offices built from wood composites in the Berlin-Kreuzberg "WoHo" style from the early 2030s, while walking on a solar cell–embedded path laid down in the 2020s.[54] Or consider how a college or university would appear after restricting or banning fossil fuel–powered vehicles on campus. That alters the look and feel of an institution, especially as roads and parking spaces change or disappear. Step by step, something perhaps like a solarpunk vision replaces what we now see in our contemporary institutions. Or some new styles will appear. We can envision them now.

Another aspect of modern academia follows this incremental change driving major transformation: the education of women, who now constitute a majority of students in some nations for the first time in history, following decades of steady, gradual enrollment growth. This has had many benefits for those women and their societies in general, and may also have a powerful impact on the climate crisis if postsecondary higher education continues the practice. For those concerned that high population levels worsen global warming by adding to the number of consumers burning carbon, we know that more education correlates with women having fewer children. As projections show more women than men suffering from climate change's stresses, having more education gives women more resources for survival. As a Rapid Transition Alliance report put it:

> Girls who completed their schooling are more likely to be able to use their knowledge and leadership to support their families during climate shocks by finding better-paying jobs. An educated girl is simply better equipped with the skills to withstand and overcome the shocks of extreme weather events and changing weather cycles. A 2017 Brookings [Institution] study suggests that for every additional year of schooling a girl receives on average, her country's resilience to climate disasters can be expected to improve by 3.2 points (as measured by the ND-GAIN Index, which calculates a country's vulnerability to climate change in relation to its resilience).

Drawdown (2017) is a popular and optimistic collection of climate strategies, which we've cited several times so far. It concludes that among all of the strategies it considers, from technologies and policies, the most effective is educating women. Educating more women is one powerful way for colleges and universities to help the human race better respond to the climate crisis along the timeline of multiple human lifespans.[55]

Classically, the role postsecondary institutions play in educating traditional-age (eighteen to twenty-two years old) young people has long had the potential to transform society over the course of generations. Right now, some passionate climate activists seek to set their campus aflame with protests, strikes, and other actions. Their experience in these institutions will help shape where they try to take the world. And nonactivists also pass through academia's gates. For several years, higher education gets to help shape their thinking. When it comes to climate change, these institutions actively form the future of tens of millions of people every few years.[56]

What we teach will vary over time, even through the Anthropocene. Looking ahead over decades, academia should anticipate rising interest in, and support for, curricula people perceive as most directly addressing the climate crisis. As noted in chapter 3, we can view this as a supply and demand problem. Rising student interest in climate classes can cause colleges and universities to supply more of them, depending on an institution's structure, resources, and culture. Faculty members, academic programs, and those publishing content can supply more materials and opportunities for learning. As with any supply and demand model, the amounts of each can fluctuate over time, depending on circumstances. Major climate events, such as disasters occurring or megaprojects in progress, may drive demand up. In contrast, a declining sense of urgency could depress the number of students taking an Advanced Climate Mitigation seminar. Too much supply can also outpace demand. It would be too simple and inaccurate to say, "The Anthropocene will drive up related classes for two generations." It is more accurate and practical to think instead of paying careful attention to signs of interest and to anticipate their next contours.

For example, a consensus is emerging that a clear path lies ahead: switching from fossil fuels to electrical engines powered by renewables. If enough of society accepts this premise and works to realize it practically, then we may see enormous demand for workers who can make that switch in the energy sector—which means growing demand for providing students with those skills, from electrical engineering on. Anticipating this will take some academic foresight. Following up on it with curricular changes, faculty and support staff hires, on-campus infrastructure, and so on will require political and financial capital. How many institutions are thinking along these lines? Yet how many are planning past that point? If the human race successfully switches off carbon and powers civilization by electricity backed by solar, wind, and others, just how badly will demand for those jobs decline? Again, looking ahead for nearly eighty years entails being sensitive to, and anticipating, such changes in demand and supply curves.

Universities in New Economies

Thinking long term necessitates forecasting economic developments and planning strategic responses to them. As we've seen throughout this book, the climate crisis will cause economic damage around the world, albeit in varying ways depending on local circumstances. Colleges and universities would do well to anticipate such hits to their budgets. Further, economic inequality has increased in many nations, and class divides seem likely to widen. The COVID-19 pandemic accentuated this. Such a changing economy gives higher education several challenges, including having to rethink career services and job placement. It may also mean that colleges and universities will find it more practical to approach the very wealthy for assistance along climate change lines than they currently do, especially in nations that have privatized higher education to significant degrees. We have already seen the superrich play roles in trying to mitigate or adapt to global warming. To pick one example, Amazon founder Jeff Bezos launched the Bezos Earth Fund, a "$10 billion commitment to fund scientists, activists, NGOs, and others." Higher education may see fit to work with billionaires like Bezos to support academic work. In addition, given the immensely powerful role capital plays in shaping the world, engaging with the financial industry may be a way to better grasp and influence our collective response to the crisis.[57]

We may also anticipate an economic future that differs from the post–Cold War experience. As noted in chapter 5, some regions and nations may respond to the Anthropocene by planning to halve economic growth or to drive for an economic build-down. As two physicists have argued through modeling, "Degrowth would not be an easy solution, but, as indicated by our results, it would substantially minimise many key risks for feasibility and sustainability compared with established, technology-driven pathways." If the region or nation where a campus is located pursues such a major shift in its economic structure, what does this mean for the institution? Universities depending on financial growth from investments or donors may see those supports flattened. Can academic

economists play a role in no-growth or degrowth planning now? What light can other disciplines, such as sociology or psychology, shed on such an evolving scenario? How would such futures appear in our curricula?[58]

Populations and Some Campuses in Flight

Planning and enacting such economic shifts will become more difficult as climate migration grows. As noted earlier, the number of climate refugees should expand over the next generations as environmental pressures and disasters hit certain areas with increasing frequency and ferocity. Agricultural declines, droughts, spiking wet-bulb temperatures, and storms will drive more people into migration, building up to tens or *hundreds* of millions of refugees by 2100, according to the World Bank. Political responses to these problems—nationalization of resources, militarization, civil unrest, civil war, interstate conflict—can add even more numbers to this rising nomadic tide. Political responses to the burgeoning refugee movement may demonstrate inhumanity, as the twenty-first century has amply demonstrated, which can worsen the problem while also creating additional problems, including more public forms of bigotry and more strident nationalisms.[59]

Let us now number some academic institutions in those danger zones. How will the academy respond to such a threat, looking ahead two generations? To begin with, a substantial number of colleges and universities are presently located in danger zones, notably the warmest areas and those most exposed to violent weather. Campuses near oceans run the risk of flooding or total immersion. Those will have to decide on a survival or adaptation strategy. They may seek shelter behind a seawall, elevate buildings on stilts and piles, raise their grounds above projected oceanic heights, migrate to another location, or simply come to an end. Institutions near growing deserts should pursue other measures, including building defensive forests or erecting anti-sand barriers. Those institutions will face dire problems, such as how to attract people to their grounds when the local community drains away. How can they afford to protect themselves? That is, how much air-conditioning can a campus budget? How often can its financial resources handle repairs from weather damage and rising insurance costs? How many lawsuits over personal injury and death can a school handle? If the local area does not mount general protective measures against floods, what kind of elevation or wall can a university afford? Questions are open as to how much assistance governments, nonprofits, the rich, crowdfunding, and corporations may provide, and with what conditions. It seems that many institutions located in danger areas will be faced with the real choice of closure or relocation. Governing bodies and various stakeholders will have ideas about how this should proceed. Such foundational, radical, and existential questions are what the long view entails.

Campuses located in areas free of such imminent dangers will face other choices as they decide how to respond to destruction suffered elsewhere and refugees therefrom. First, what calculations will go into deciding whether or not to host refugees on site? What pressures will influence those choices, both from within the institution and from beyond? Some universities and nonprofits have urged colleagues and governments to expand their support in 2021. Will this become a mainstream behavior of campuses? Second, what academic support can higher education provide to migrants? We've already discussed some of the issues here, including face-to-face versus online instruction. Campuses could offer scholarships aimed at climate refugees, as Moses Seitler has urged. We could imagine academic programs or entire colleges devoted to educating and supporting climate refugees. Overall, an ambitious or well-resourced campus could position itself as a climate sanctuary. Its communication strategy could celebrate this mission or minimize it, of course, because of an open question that would attend that development: how being an academic climate sanctuary changes an institution's reputation. Departments, programs, colleges, universities, and systems in the global north, and unthreatened with immediate climate disaster, may see supporting refugees from the global south as an act of large-scale climate justice or reparations.[60]

Another question will appear more often: what responsibilities will colleges and universities in safe areas have to those colleagues under

attack? Should academic units take steps to provide resources to their peers, from professional development to scholarly support? How many will offer to help teach out (i.e., offer students from a closing institution classes to finish their degrees) students enrolled in institutions shutting down or suspending operations for a relocation? Will the climate refugee crisis give extra power to calls for open educational resources (OER) and open access (OA) scholarship in order to remove one barrier to learning for those suffering from involuntary migration? We could imagine regional or national shifts as endangered institutions gradually shift people and services toward those in safer areas. This could lead to a reduction in the number of campuses while increasing the size of remaining institutions. Ultimately, the climate crisis could drive the expansion of mega-universities.

The preceding paragraphs distinguished between areas subject to climate devastation and those that are not, but that opposition might become less clear as the decades unroll and the Anthropocene deepens. For example, central Russia or the middle of the United States does not presently enjoy seafronts nor include areas with excessive heat, but both of these regions may gradually lose stocks of potable water as demand for it increases and supplies are drawn off.[61] In addition, I specified "zones" and "regions," rather than nations, because academia within a given country could experience both situations. Multiple schools within a given system, be it a province, church, or state, could receive natural crises in very different ways.

Beyond the direct threats posed by the climate itself are the secondary and tertiary effects discussed in the introduction to this book, those stemming from the natural and human worlds. For the latter, roiled polities and economies present massive challenges to the higher education sector for the rest of the century. How prepared are campuses today for an economic recession or collapse in the next decades? With what foresight is the academic world planning on civil unrest, revolution, or war? How will campuses grapple with cultural ferment, from new religious movements to insurgent groups trying to reshape society during the

worsening Anthropocene? If we can imagine a university as a climate sanctuary, just how far is that institution willing to go during a civil war?

Here I would like to return to chapter 6's worst-case scenario and pick up my earlier reference to Asimov's *Foundation*. One function higher education may see itself performing over the next two to three generations is preserving knowledge and attitudes during a general collapse. If governments are falling amid growing starvation, mass migrations, terrible storms, and social upheaval, a campus may seek to hold candles against that darkness. Preserving knowledge is, after all, a longstanding and core feature of the university. We might see such institutions erect ever higher barriers against those literal and figurative rising tides, protecting their precious intellectual stock. Or we could see multiple institutions collaborating in distributing their academic resources in the internet's original spirit. This may sound hyperbolic or fantastic to some readers, yet the prospects of such a disastrous century are neither.

Perhaps the academy will take more proactive steps over the following decades. There is a tradition of activism starting from within universities and colleges. Student movements stud the historical record, including the modern environmental movement. Campuses may incubate organizers and activists who move on to participate in the great climate struggle. Some academic research will appear within public discourse and play a role in decision-making from local communities to the international community. So much of this will probably occur without academia taking conscious steps to make it so, simply because of our somewhat decentralized nature, when broadly compared to the rest of society, and to the connections with the crisis this book has outlined so far.

Could higher education go further?

We may imagine chancellors and faculty senates declaring institutional commitments to climate mitigation and adaptation, then putting resources behind such strategies. These colleges and universities would cease to position themselves as neutral parties and instead intervene directly in the world, even at a small scale. They could bring to bear their

full gamut of intellectual capability and also run the risk of opposition. They would teach what Peter Sutoris calls "Anthropocene skills," combined scientific and political abilities that give students ways of participating productively in the warming world, then follow those students in intervening within the crisis.[62]

Campuses can also organize together for this purpose and do so generatively. We have already seen institutional leaders agreeing on the importance of lowering carbon emissions. Imagine them forming leagues with specific programs and missions. A group of colleges might agree to end long-haul travel from its members, or collaboratively invest in purchasing DAC hardware. We could see an academic alliance creating an international cadre of students committed to studying and conducting fieldwork to mitigate and adapt to the crisis, a kind of honors society or academic order to which it will be an honor to belong. Obviously, this would take serious work to bring about and support, and just as obviously would run into risks and opposition. How many academics would find the cause worth the effort?

Trent Batson has envisioned something along these lines with the Last Humans Project. This is a call for colleges and universities to align their mission statements and curricula in order to teach a new generation Peter Sutoris's Anthropocene skills through a mix of intellectual and hands-on work, not only for their personal benefit but to try reshaping humanity's climate strategy. The goal would be to influence civilization as a whole, to "lead the world in preserving human society during the current mass extinction caused by climate change." Batson envisions a massive movement or cadre educated and supported by higher education: "If only one tenth of [currently enrolled] students [worldwide] opt for our special "extinction rebellion" curriculum of active learning in real-world extinction projects, The Last Humans Project will have a very large Survival Force (25,000,000) to join the Project and help preserve human society."[63]

How many academics around the world would see this as a powerful and proper use of our position in the world? How many might change their minds over the next several decades as the crisis proceeds? To ask the question another way, how many would see *not doing so* as an act of abdication, of turning away from humanity in the teeth of a global disaster?

In thinking so ambitiously, we can return to a theme we've hit on throughout this book. Will academic institutions take these steps and make these plans inclusively? The history of universities offers an appalling body of evidence demonstrating our ability to exclude people based on nationality, gender, religion, class, geography, and more. Instead, our institutions must advance into the climate crisis by including populations seriously and with care. Rethinking our curricula and research enterprises should not reproduce inherited practices of bias and oppression. Working with the world, from local communities to the international community, must not reprise colonialism.[64]

Within our institutions, will plans and actions engage all people and groups? Once again, the global history of academia gives ample evidence of institutional management practices that involve only segments or even slivers of a university or college community. We also have traditions of community involvement and campus democracy. Will we grapple with the climate crisis in such a participatory fashion, or rerun our bureaucratic and mandarin practices?

I would like to conclude on a note of intense urgency. The climate crisis may be the greatest threat colleges and universities face in this already volatile, uncertain, chaotic, and ambiguous century. Global warming threatens to squeeze, injure, and destroy institutions and the many purposes we invest in them. Yet at the same time as academia faces this challenge, we also have the opportunity to improve humanity's ability to understand, mitigate, and adapt to the emergency. I hope this book has shown that higher education has the capacity to contribute in a major way through research, teaching, community relations, and public activism.

I return to the words of the Bulletin of the Atomic Scientists, which we first considered in the introduction to this book, when that organization surveyed the world's threat landscape in 2021 and determined that humanity was botching the job: "The [COVID-19] pandemic serves

as a historic wake-up call, a vivid illustration that national governments and international organizations are unprepared to manage nuclear weapons and climate change, which currently pose existential threats to humanity."

If we were this unprepared to meet challenges in 2021, our danger will be that much greater as the climate crisis ratchets up remorselessly over the years and decades to come. For those national governments and international organizations, academia could play a vital role in helping them become better informed, wiser, and more resilient. That might not be a gentle process. Higher education may have to coerce, cajole, persuade, and sometimes shock the global system into resilience through our social connections, intellectual firepower, and ability to nurture.

Yet it is too late now for colleges and universities to begin preparations for a far-off danger. The crisis is already upon us. We are advancing ruthlessly into the Anthropocene. Fires now burn on academia's horizon. It is up to us to choose if those will be flames of destruction or the lights of illumination.