Breaking Through

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Confronting climate change confounds many people, whether as individuals or joined together in schools and businesses. How can one person or entity cope, making a meaningful difference in the face of a global problem of such an enormous and complex nature? To address that paralysis and empower students across Harvard University to take action, I created the Climate Solutions Living Lab. The Lab is housed at Harvard Law School's Emmett Environmental Law & Policy Clinic, which I direct, but students from all of the university's graduate schools, as well as a few Harvard undergrads and MIT students, work together in the Lab on multidisciplinary teams to design practical projects to address climate change.

From years spent in the private sector, I know the importance of being able to communicate with and learn from professionals across disciplines; from my years at Harvard, I know there are too few opportunities for advanced students to learn and work across disciplines during the course of their studies.

I provide each team specific project ideas before the semester begins. Then, for 12 weeks, we work together intensively to analyze the feasibility of the ideas from each discipline represented on the team: business, law, public health, engineering, design, and public policy. Advanced students in education, biology, data analysis, and forestry have also joined the Lab, bringing in their expertise.

The projects have proved to be educational, as designed, but also fascinating and feasible. Students in the Lab have created a program aimed at reducing emissions from the agricultural sector in the Midwest using chestnut trees for alley cropping and paying farmers to use less nitrogen-based fertilizers. Others designed a community cooperative for a remote area of Puerto Rico to produce renewable energy and safe drinking water from existing but neglected hydroelectric facilities. And yet another team analyzed district energy systems using heat pumps that extract thermal energy from river water (a renewable resource) to replace natural gas-powered heating systems in low-income neighborhoods. There are a dozen similar examples.

I begin the course by helping the students ponder how they may use the same word to mean very different things depending on their professional (and personal) perspectives. It's a fun and eye-opening exercise. Examples are risk management, load, and leakage. The students are fascinated by the different twists and often laugh listening to each other's definitions.

Midway through the semester, the students produce a fairly robust feasibility assessment. There are several requirements. The project must achieve quantifiable greenhouse gas emission reductions. It must produce quantifiable public health and other social benefits (e.g., jobs, education, reduction of other pollutants, improved water or soil quality). Projects must be realistically fundable and have a coherent legal strategy for obtaining permits and other regulatory approvals and for contracting. Finally projects must be replicable and scalable.

The course design enables students to experience the iterative nature of project development as they discover how to tweak a project to respond to each other's analyses. For example, the design may require modification to avoid triggering a costly legal permitting or review process. Or, a grant may only be available if the project meets certain conditions that the engineering or design students did not anticipate until the policy student raised the issue. Each team produces a detailed implementation plan providing preliminary engineering and design sketches, a budget, funding sources, and a list of the needed contracts and permits. The plan also provides calculations of the greenhouse gas reductions and public health benefits that the project will achieve and an estimated cost per ton of the cuts.

In lieu of an exam, I convene a group of experts, including academic specialists, business leaders, municipal and university sustainability officers, and government representatives. Over the course of two evenings, each team presents its project and plan, taking questions and feedback from the experts. We engage in a fantastic exchange of ideas. Two students received job offers as a result of their final presentations. Some of the teams remain friends well after the course ends; at least one team convenes a periodic reunion. Several students so enjoyed the experience, they formed the Harvard Climate Leaders Program to engage more students in interdisciplinary climate conversations.

After the semester ends, implementation begins. Some of the projects can be advanced by students. Others are being advanced by partnerships formed with people inside and outside of Harvard. For example, six former Lab students are continuing their work — as volunteers — on several of the projects. They are applying for grants, continuing to gather data and undertake analyses, presenting the projects at workshops and conferences around the country, and drafting manuals to guide implementation.

The projects are varied. Some aim at low-income, underserved populations. Others target universities and other institutions that have made voluntary commitments to reduce their greenhouse gas emissions but cannot efficiently achieve additional reductions on their own properties — paying for or implementing these projects would generate off-site reductions for which these entities could legitimately claim credit. Some would generate marketable emission reduction offsets. Others would pilot novel solutions. To date, 14 teams have produced implementation plans, including the three mentioned at the top of the article. Each of their projects is feasible, replicable, and scalable. I offer two in detail below as examples of how a project can move from concept to implementation.

Improved management of forests in Alaska (and elsewhere across the U.S. and the globe) is important for mitigating climate change. While a lot of money has been paid for offset credits associated with forest management, there is a lot of skepticism about whether these projects are actually sequestering carbon. The skepticism derives in large part from the difficulties of monitoring the projects and measuring their benefits. The same problem is presented by projects to sequester carbon in the soils of farms or reduce emissions by restricting the types and amount of fertilizer. Measurement, monitoring, and verification have been dauntingly labor intensive and expensive. Hence, the voluntary offset market for these projects is limited. I asked a recent team of Lab students to address this problem by identifying cheaper but more reliable measuring, monitoring, and verification techniques.

I chose Alaska as the focus for the student team for several important reasons. It has more forests than any other state. It is suffering the effects of climate change faster than any other state. Healthy forests are crucial for the subsistence lifestyle of many communities. By implementing better forest management practices and less logging, Alaska Native communities could generate a significant revenue stream from the sale of carbon offsets, thereby relieving economic pressure to log their forests to generate income. Meanwhile, the project would produce a number of valuable social and climate outcomes. Current methods of measuring sequestration in these vast forests are likely overestimating the amount of stored carbon. Moreover, current measurement methods are very labor and time intensive. For example, a primary indicator of carbon sequestration in forests is biomass measurement. To date, this has been done by ground-based measurements of tree height, tree diameter, tree volume, and wood density. This manual process is time-consuming, expensive, and particularly challenging in remote areas.

The Lab team assigned to this topic proposed a collaboration. The team would include an Alaska Native corporation that owns a significant amount of forested acreage, forestry experts and researchers at one or more of the University of Alaska campuses, a local high school, the Lab itself, and a future Lab (or Clinic) team. The collaboration would build upon several existing pilot projects to test combinations of on-ground and in-air technologies for measuring the growth of forests and the amount of carbon sequestered. In addition to cheaper and better measurements, the goals include training youth in the community to collect and help interpret data, advancing research, and producing verifiable marketable carbon offsets for the benefit of an Alaska Native community that would enable it to curtail logging, improve public health, create jobs, improve water quality, weatherize homes, and the like.

NASA and the Department of Agriculture have already begun to supplement field observations with remote sensing observations from satellites and aircraft-based sensors. The Lab team’s project envisions harnessing these technological advances. Due to the lack of transportation infrastructure, only a small percentage of Alaska’s vast forests have been assessed by USDA’s Forest Inventory and Analysis project. While no single technique can capture the entire spatial and temporal scales necessary for accurate forest carbon measurement in Alaska, combining field observations and remote sensing offers a promising avenue for improving forest biomass estimates and providing the frequent, large-scale data needed for the success of forest carbon offset projects. Additional benefits of the project include faster detection of forest changes, monitoring of surrounding regions to prevent leakage (e.g., the forest owner shifting logging practices to other locations not covered in the forest sequestration project), and more timely alerts about wildfires, natural disasters, and other climatic disturbances.

The Trump administration’s rollback of regulations that govern the use of refrigerants inspired another Lab project. In the absence of regulation, I saw an opportunity for universities, other schools, and large enterprises with cooling and refrigeration systems to voluntarily reduce their use and emission of halocarbons such as HFCs. These commonly used refrigerants are very potent greenhouse gases, which led to global agreement to phase out their production and use through the Kigali Amendment to the Montreal Protocol. The United States has not ratified the amendment. However, if done correctly and properly quantified and verified, institutions can reduce their own carbon footprints by voluntarily reducing their use and emissions of HFCs and legitimately take credit for doing so. Reducing the use and emission of these gases is critical because they contribute much more significantly to climate change in the near term than does carbon dioxide; there is an immediate benefit from reducing halocarbon emissions. Moreover, as air temperatures continue to rise, people demand and need ever more air conditioning, which typically uses these refrigerants.

I assigned a team to figure out how our university could tackle this problem. After meeting with staff responsible for facilities management, utilities, and environmental health and safety here at Harvard, the Lab team developed a plan for raising awareness, taking refrigerants into account in equipment purchasing and maintenance decisions, and phasing out use of the most harmful halocarbons altogether.

The students discovered that reckoning with the cost and intricacies of capital planning for a large institution that operates 24/7 and 365 days/year is daunting. For example, hospitals and laboratories cannot readily take equipment out of operation; building codes do not allow for some of the substitute refrigerants; some equipment is buried in the ground and can’t easily be excavated for replacement. On the other hand, in some cases equipment could be operated more efficiently (thereby using less electricity) by replacing halocarbons with less potent refrigerants. The students rose to the challenge. They identified several pilot projects that could be implemented in the near term and prepared a planning guide for decisionmakers to prioritize actions to replace refrigerants and equipment.

The Lab and the Clinic are unquestionably the high points of my career as an environmental lawyer. Helping students find a starting point for tackling climate change, creating meaningful, practical projects, and watching them learn from and bond with each other, have been incredibly rewarding. TEF