THE PLUS SIDE

BY LYDIA LEE

When designers need to calculate the environmental cost of projects, a new tech tool crunches the numbers.

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For the new Frederick Douglass Memorial Bridge project in Washington, D.C., landscape architects at AECOM made sure that the bridge’s adjacent 80-acre waterfront park would provide many environmental benefits: bioswales and rain gardens for treating stormwater, pollinator meadows, and extensive tree cover to reduce the urban heat island effect. But when they did a rough estimate of how long it would take for the carbon dioxide absorbed by the plantings to cancel out the carbon dioxide emitted from producing asphalt and concrete paving and from maintenance, they got a surprisingly high number: 39 years. Two other completed projects they investigated took even longer to become carbon neutral: 346 and 154 years. “It was pretty interesting—we had no idea we were that far off,” says Ignacio Bunster-Ossa, FASLA, the vice president of landscape architecture and urbanism for the Americas at AECOM.

These calculations can be done painstakingly by hand, but Bunster-Ossa’s group was able to get these results by using Pathfinder, a new carbon calculator and design tool designed specifically for landscape architects. The app’s developer, Pamela Conrad, ASLA, a principal at San Francisco-based CMG Landscape Architecture, has spent the past four years thinking about the carbon footprint of landscape projects. “A landscape looks green, so we assume that it’s good and that we do good things,” says Conrad. “But it has a unique carbon impact that is hidden to the eye—it’s only when we measure that we can fully understand this complex formula.”
Pathfinder is available for free at climatepositivedesign.com, and it has the potential to galvanize the profession to lead design for climate change. The overarching goal of Pathfinder is to help landscape architects design landscapes that will become carbon neutral by 2030—and thus do their part to keep the global temperature gain under the critical threshold of 1.5 degrees Celsius, per the claxon sounded by the Intergovernmental Panel on Climate Change (IPCC) in 2018. “This tool is transformational for our practice,” says Barbara Deutsch, FASLA, the CEO of the Landscape Architecture Foundation (LAF), which funded some of Conrad’s foundational work on Pathfinder through the LAF Fellowship for Innovation and Leadership. “The carbon footprint of our proposed works becomes tangible, so we can make the case for reducing it.”

Once the data is input, the app calculates the number of years for the project to become carbon positive. Image courtesy CMG Landscape Architecture/Climate Positive Design.

How much landscape projects actually contribute to global carbon emissions has not been fully calculated, but at least one designer has attempted to figure out his individual impact. In 2006, Craig Pocock, a landscape architect in New Zealand, estimated the carbon emissions of the projects he’d designed over the past 14 years and came up with a conservative number of nearly 16,000 tons of carbon dioxide. In a 2017 presentation to the International Federation of Landscape Architects, he talked about how he hoped the “one ace up my sleeve—a lot of trees” would make a difference, but they made only a tiny dent. “The fundamental problem is that we tend to specify more carbon in the form of materials within our work than the planting of our work could possibly ever offset,” he added.

The Pathfinder app tackles this problem by breaking down a project into its individual components and quantifying the carbon cost for each. It has about 100 potential inputs for materials, plants, and ongoing maintenance. The app calculates the carbon emissions from materials and maintenance and subtracts the amount of carbon sequestered by the plantings over time. When the latter number exceeds the former, the project becomes “climate positive,” a term that Conrad picked over “carbon neutral” or “net zero” because it sounded optimistic and less potentially confusing than “carbon positive.” Released as part of a Climate Positive Design Challenge, the app sets targets for designed landscapes, including parks, gardens, and mixed-use or campus developments, to become climate positive in five years and for hardscapes such as plazas and streets in 20 years.
Developing an app would be a daunting task for most, but Conrad is used to the long, iterative process of big projects. On a Zoom call at the start of May, she spoke from her partially renovated house in San Francisco’s Castro neighborhood, which she and her husband have been slowly working on since they moved in three years ago. Wearing a gray hoodie, with her hair in a ponytail, she seemed perfectly cast as a young app developer poised to disrupt an industry. The first of her family to go to college, she describes herself as a one-time “farm girl from Missouri,” growing up in a landscape of creeks, fields, and animals. She helped out on her family’s 100-acre corn, wheat, and soybean farm and had a side gig maintaining people’s yards. She contemplated becoming a landscape architect, but had second thoughts after a visit to the HOK office in Kansas City, Missouri: “I saw a whole bunch of people sitting in front of screens, which looked terrible—I loved working outside and being hands-on,” she says.

However, studying plant science at the University of Missouri as an undergraduate gave Conrad an environmental perspective and a sense of the impact she could have. She did an internship with the U.S. Army Corps of Engineers, working on large-scale ecosystem restoration projects in and around Los Angeles, and got a master’s in landscape architecture at California State Polytechnic University, Pomona. After completing her professional training, she worked for SWA and the Office of Cheryl Barton, designing large public parks including the Fields Park in Portland, Oregon, and the Youth Olympic Park in Nanjing, China. Soon after she joined CMG in 2013, she began working on the parks and open space for Treasure Island, a low-lying artificial island being redeveloped as a San Francisco neighborhood for 19,000 residents. “We were starting to think about how landscape architects can be part of climate change adaptation and resilience,” Conrad says. “It was easy to see then that we clearly have a role. We don’t have a choice—we’re too far down the road; we’re going to have to adapt. Sea-level rise is already occurring.”

On Treasure Island, CMG’s strategy was to create wide setbacks with waterfront parks that would evolve into wetlands. “I started to ask myself if there was anything else we could do as landscape architects,” Conrad says. “My plant-nerd brain was super curious about remediation and carbon sequestration. There are two sides to the conversation: How are we going to protect people and adapt to climate change—and the flip side, mitigation—how do we reduce greenhouse gases and protect sea-level rise from happening?”
The app’s design tool kit includes quick cheat sheets on low-carbon alternatives. Image courtesy CMG Landscape Architecture/Climate Positive Design.

Attempting a calculation similar to what Pocock had done about a decade ago, Conrad was frustrated by how difficult it was. It was possible to ascertain the carbon sequestration of trees, but the U.S. Forest Service data was in its own silo. Meanwhile, calculating the carbon emissions from producing industrial building materials like concrete and steel could be done through tools such as the Athena Impact Estimator for Buildings; Tally, a Revit plug-in; and One Click LCA, but they were all designed for architectural projects. For more than a decade, architects have chased the goal of designing buildings that used net-zero energy or offset as much greenhouse gas as they produced. But after the IPCC report highlighted the need to immediately cut carbon emissions, reducing embodied carbon—which is released into the atmosphere as soon as materials are produced—became a priority. (Cement and steel production are extremely energy-intensive, and by one tally, the building materials industry alone accounts for 11 percent of global carbon emissions.)
Unlike buildings, landscapes can actively take carbon out of the system. “Carbon neutrality isn’t really a good goal for landscape architects—it’s too low of a bar,” Conrad says. “Landscapes can capture and sequester carbon through trees, plants, and soil, and that ability has been completely excluded from the conversation.”

To provide a holistic picture of a landscape’s carbon footprint, Conrad developed Pathfinder, using a $25,000 fellowship grant from LAF to turn it from a complex spreadsheet into an app. Environmental consultants Atelier Ten vetted the app’s various sources of peer-reviewed data. “The most challenging piece was figuring out how to represent the dynamic nature of landscape projects,” says Kristen DiStefano, an associate director at Atelier Ten. “When you do an LCA [life cycle assessment] of a building, you can evaluate the initial carbon impact and make assumptions about materials that need to be replaced. But trees increase their rate of carbon sequestration over time and partially rerelease carbon when they decompose. Getting the tool to reflect this carbon cycle while determining the level of data granularity that would be useful to designers was tricky.”

A key benefit of the app is that it allows you to see what happens when you make changes to the design, and you can compare different versions. “The closest we’ve come before is to look at the carbon sequestration of trees,” says AECOM’s Bunster-Ossa. “But that doesn’t compare to the value of what [Conrad] is doing, where you can find out what happens if you reduce the sidewalk [by] one foot to nine feet, and the whole play between hard materials and soft materials.”

To the degree that landscape architects have thought about sustainable material choices, they’ve tended to focus on recycled and local materials. But in Atelier Ten’s analysis, 85 percent of the embodied carbon emissions from a landscape architecture project come from the materials, while transporting materials, site work, and construction account for 5 percent each. (Pathfinder tacks on an automatic 20 percent to the carbon emissions total to cover these aspects.) The app brings into sharp resolution how much embodied carbon results from specifying building materials. “The biggest takeaway for us is that the more you can recycle materials from the existing site and use cement substitutes in concrete, the more you can lower the footprint,” says José Almiñana, FASLA, a principal at Philadelphia-based Andropogon, which recently completed the first project to be certified Platinum under the Sustainable SITES Initiative v2 Rating System at the Phipps Conservatory in Pittsburgh.

Others familiar with Pathfinder include Martin O’Dea, an associate director at Clouston Associates in Sydney, who has started to redesign a new landscape for a hospital even before plugging the project data into the app. “I’m expanding the amount of green space to reduce both the budget and the carbon footprint,” he says. “I’m looking at where I can squeeze in more planting and remove a bit of carbon, and increasing planting depths and soil volumes so we can maximize large trees and the amount of green you can see from a hospital bed.”

When I logged my imaginary 5,000-square-foot park into Pathfinder, it was tempting to become an instant environmental hero by removing all the paving, but ultimately something else must be specified in its place. At CMG, which is using the app on its current projects, the landscape architects have designed a tech campus in Silicon Valley to meet the five-year target by using wood and stabilized crushed stone paving for pathways, and integrating tiny forests—densely planted areas with understory and overstory layers. “It’s important to start the process early on, so the whole team is rooting for the goal,” Conrad says.
If all new landscapes are designed to meet the Climate Positive Design Challenge and become carbon neutral within five years (or 20 years, in the case of hardscapes), they will pull a net one gigaton of carbon dioxide from the atmosphere by 2050—a calculation that is based on the numbers from projects handled by CMG. Since the app’s launch in September 2019, nearly 600 firms and organizations have used it to evaluate more than 1,200 projects, and most projects are not far from the goal—the median is 12 years to become carbon positive. As more designers use the app and provide data about their projects, the goalpost may change from “years to become carbon positive” to a percentage of improvement against a baseline. For example, the Architecture 2030 Challenge calls for new buildings to cut down their fossil fuel use by 90 percent compared to the regional average by 2025.

Those who have given the app a whirl are excited by its potential to facilitate conversations with clients. “We can use this tool to learn how to make better choices and what gaps of information we have in our practice. But it’s also a way to communicate about a project with the design team and with the client that there are some choices they need to make and what the implications are,” says Andropogon’s Almiñana, who has used Pathfinder to analyze a project that is currently at the end of design development, when budgetary concerns come to the forefront. “I can imagine having a conversation along these lines: ‘We have 20 trees; if you put in 50 trees, then this is the impact.’ We can justify the cost and the design to the client as we gain more understanding of the complexity of the systems.” AECOM’s Bunster-Ossa imagines that even streetscapes, like the one that will take an estimated 346 years to become carbon neutral, could pare down their carbon debt. “Wood pavers are prohibitively expensive. But if it’s a private client and they can brand the project as carbon neutral, that could be a really good value for them,” he says. “Or you could translate the carbon footprint into a woodland that you could plant somewhere else and do a carbon offset for the project.”
Data and resources are housed on the website, such as this case study for a seawall that shows low-carbon alternatives and their impact on the length of time needed to become carbon positive. *Image courtesy CMG Landscape Architecture/Climate Positive Design.*

Whether it leads to a side gig in carbon trading or not, the tool can clearly help in a broader effort to quantify the ecosystem services, the tangible benefits that landscapes provide. “If you combine carbon sequestration with all the other benefits—stormwater retention, shade, habitat creation, public health benefits—you can really begin to put a big value on landscape,” Bunster-Ossa says. “Obviously for us, it’s worth figuring this out and putting it all together.” Carbon reduction calculators are also a natural fit for sustainability certification programs, and Conrad is in talks with the administrators of the Sustainable SITES Initiative and the U.S. Green Building Council’s Leadership in Energy and Environmental Design (LEED) program about including credits for reducing carbon emissions in landscapes.

And the climate-positive app is already serving as a significant educational tool. “It makes the projects less arbitrary. The shapes drawn on the page have meaning,” says Ellen Burke, ASLA, an assistant professor of landscape architecture at California State Polytechnic University, San Luis Obispo, who has tried it out with her fourth-year design studio. “My hope is that by teaching students how to use it, it might be similar to how digital tools for drafting have spread. People coming out of school are able to bring it into firms, and it empowers them to find an important place in the practice.”

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**Project Credits**

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i think the real benefit of this tool is showing people in general how much we've already harmed our environment with these destructive construction practices, as well as how long it takes to mitigate current effects. it is truly astounding what Our Earth has had to endure from us.

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