Project Drawdown - The 100 Things We Need to Do to Reverse Global Warming

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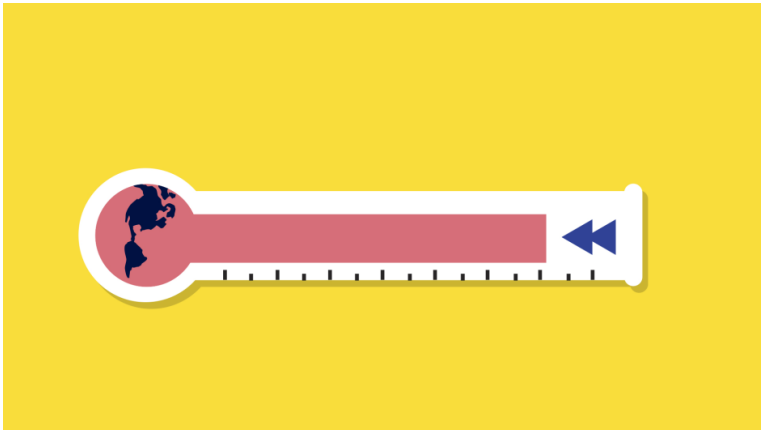

Illustration: Oliver Munday

Paul Hawken's new book *Drawdown* claims to have made a definitive list of the most effective global strategies for lowering our emissions. Don't despair: they're all totally achievable.

BY ADELE PETERS

If you read anything about climate change, it's not hard to become convinced that we're screwed.

For instance, here are just a few notable recent apocalyptic warnings: In January, a chunk of ice roughly twice the size of Central Park split off a glacier in Antarctica; within months, another chunk larger than Rhode Island is likely to follow. By 2100, sea levels could rise eight feet. Much earlier–perhaps as soon as in 15 years–drought and disease linked to climate change could begin to kill more than a quarter of a million people each year.

"If you give someone a piece of paper, and said 'Put the top ten solutions down, in any order,' no one would get it right."

The scale of the problem is familiar, but the specifics of the solution aren't. Even the pledges made for the Paris agreement, the world's first comprehensive climate deal, don't go far enough to keep warming in check. Some climate activists are beginning to organize support groups to deal with their own anxiety. For the public, a sense of helplessness begets avoidance and

sometimes denial. Especially with a climate-denying party controlling the government, it can seem that there's no hope.

But a new book might change that–and serve as a blueprint for what comes next if the U.S. government (and the global community) begins to aggressively focus on altering the climate future. *Drawdown: The Most Comprehensive Plan Ever Proposed To Reverse Global Warming*, analyzes the details of what it might actually take not only to stop global warming, but potentially begin to reverse it. To create it, a team of researchers spent two years examining data on the 100 most substantive ways to reduce or sequester emissions, and doing the math on how much those solutions could achieve over the next three decades.

If the top 80 solutions are deployed in combination, aggressively, between 2020 and 2050, they could lead to what the book calls drawdown: the point at which the concentration of greenhouse gases in the atmosphere begins to decline year by year and we avoid the worst (but certainly not all) of the damage that climate change could do to the environment, food system, and human civilization.

TWO DECADES LEFT

"It's really pretty straightforward questions that I had a writer, and a journalist, and as a person: Do we know what to do? How much does it cost?" says Paul Hawken, the environmentalist, entrepreneur, and author, known for influential books about business and sustainability such as *Natural Capitalism* and *The Ecology of Commerce*.

Hawken first began asking experts for a similarly comprehensive list of solutions, along with their potential for impact and their cost, in 2001. It didn't exist. By 2013, after reading an increasing number of articles that suggested it might be too late to avoid catastrophe (see, for instance, James Hansen's *New York Times* op-ed "Game Over For the Climate"), he decided to build a team to create the list himself.

If we want to keep global average temperatures from rising two degree Celsius, a target to avoid many of the worst impacts of climate change, the world has a finite budget for emissions of heat-trapping gasses. At current rates–around 40 gigatons of carbon dioxide emissions a year–we have less than two decades left, by some estimates, before we deplete that budget.

"Once we reach that budget, that's it, forever," Katharine Mach, a senior research scientist at Stanford University who was not involved with the book, tells *Co.Exist*. "We need to be at zero emissions at the global scale… That is a massive reworking of how our economy works at the global scale, recognizing that, to date, fossil fuels have actually been phenomenally important for global development."

For most of human history, the concentration of carbon dioxide in the atmosphere hovered around 280 parts per million, rising and falling small amounts each year as plants absorbed carbon and released it. Over the last few years, centuries of human climate pollution have caused carbon dioxide levels to occasionally rise above 400 parts per million, and as of 2016, it seems to be a permanent condition (in April 2016, the Mauna Loa Observatory also set a new record daily

reading, of 409.44 parts per million). The last time levels were this high was the Pliocene Epoch, roughly 3 million years ago.

ACHIEVING DRAWDOWN

The new book considers two types of solutions that could potentially bring that atmospheric concentration down: technologies and practices that can avoid emissions compared to business as usual, and those–like planting trees, or managed grazing, which uses cattle to bring back native grasses–that can help absorb more CO2. Using the best available data, each solution was modeled in three scenarios, each with an increasingly aggressive scale of adoption.

The "plausible" scenario looks at an optimistic but somewhat conservative path for adoption of each solution (trips by bike, for example, are assumed to rise from the current global rate of 5.5% of urban trips to 7.5% by 2050). The "drawdown" scenario scales those solutions up. The final scenario, called "optimum," looks at the maximum potential of the solutions, such as the adoption of 100% clean, renewable energy. Each scenario ranks the solutions by potential impact.

"We need to be at zero emissions at the global scale."

The most effective solutions aren't necessarily easy to predict because this type of comprehensive comparison is new. "If you give someone a piece of paper, and said 'Put the top ten solutions down, in any order,' no one would get it right," says Hawken. "No one."

The scale-up of large solar farms, at number eight on the list in one scenario the researchers considered, could be less impactful than educating girls in the developing world, which is at number six. Women with more education have fewer children, which directly translates into reduced emissions. For the same reason, family planning ranks high on the list.

Both solutions are cost-effective, but haven't gotten as much attention as sexier technology. "People early on recognized [climate change] as the ultimate super-wicked problem, like humankind has never encountered," says Hawken. "I think the science at the time–largely men–the feeling was that we need a super-wicked solution, a solution as wicked as the problem. So they just went right to renewables, boom, and efficiency."

LESS MEAT, FEWER EMISSIONS

Of the solutions modeled in the book, the food sector has more impact than energy. Reducing food waste ranks third or fourth on the list of solutions, depending on the scenario. Globally, around a third of food is thrown out before it's eaten (in developing countries, this often happens because food can't be refrigerated before it gets to consumers; in the U.S., much of the waste happens after it gets to consumers). In the most conservative scenario modeled in the book, reducing food waste could avoid 70 gigatons of emissions.

If half of the world's population can eat less meat–a challenge as the global population grows, and more people in lower-income countries can afford to buy it–that would also have a significant impact; the book ranks a plant-based diet fourth in one scenario and fifth in another.

(In the unlikely event that everyone becomes vegan, the world could reduce food-related climate emissions by 70%, according to a 2016 Oxford University study.)

A variety of different farming practices make the list, and one makes the top ten: silvopasture, or deliberately growing trees on pasture where cows graze. The trees, and the soil beneath them, can sequester five to ten times as much carbon as a treeless pasture. Growth of the practice has been limited so far because the up-front costs are higher, and many farmers still believe that treeless pastures will grow more fodder for their cattle. But silvopasture actually helps support more livestock, partly because the trees give cattle shade and protection from wind. If farmers adopt it, they may also be able to avoid deforestation.

That's particularly important in places like the Amazon, where beef production is a major driver of deforestation. The book ranks the protection and restoration of tropical forests as another of the most impactful solutions. On its own, tropical forest loss is responsible for as much as 19% of human-caused greenhouse gas emissions.

IT'S TIME TO TALK ABOUT REFRIGERANT MANAGEMENT

Wind power ranks first or second as a solution, depending on the scenario. (In the "plausible" scenario, which is optimistic but conservative about the adoption of each solution, wind power reaches 16.7% of global electricity use by 2050; the Global Wind Energy Council predicts that number could be as high as 41%).

Maybe most surprising is what ranks first in the "plausible" scenario–refrigerant management. The chemicals used in refrigerators and air conditioners for cooling can have a global warming potential thousands of times greater than carbon dioxide. In a deal struck in 2016, the world agreed to phase those chemicals out; over the next 30 years, if the deal is enacted, that can avoid 89.74 gigatons of carbon dioxide equivalent emissions.

The list follows the 80/20 rule: the top 20 solutions are responsible for 80% of the impact. "The next 80 are 20%," says Hawken. "But that 20% of the impact is what puts you from going over the top." In other words, the full list of solutions is necessary; there are no silver bullets here.

By modeling everything from the adoption of high-speed rail and more bicycling to biochar, the models also account for system dynamics. If the researchers assumed that people ate less meat, for example, that also impacted the numbers they arrived at for deforestation and food waste. Net-zero buildings are listed as a solution, but not given a number for impact, since the impact is measured in the technologies each building uses, such as heat pumps or LED lights. (Twenty other solutions, such as direct air capture of emissions and the hyperloop, are discussed in the book but not modeled, since the technology is so nascent.)

It's likely the most comprehensive model of climate solutions ever made. "Nothing that shows up in *Drawdown* is unique to *Drawdown*, but it's the compilation, the extremely comprehensive scope, I think, that's new," says Anna Goldstein, who served as a research fellow on the project and is now a postdoctoral research fellow in the science, technology, and public policy program at the Harvard Kennedy School's Belfer Center for Science and International Affairs.

As countries studied potential solutions to make pledges to reduce emissions for the Paris Agreement, they focused on solutions that made the most sense within their own context. In the U.S., for example, the Pathways to Deep Decarbonization report, which studied the details of a national transition to a low-carbon economy, focused on energy, and what it would take to change American infrastructure to avoid tipping over two degrees of warming. *Drawdown* looks implementation of solutions for the whole world, and also aims for a different goal: instead of stopping warming at two degrees, it wants to try to reverse warming entirely.

In the book's "plausible" scenario, the goal of "drawdown" isn't met. 1,051 gigatons of emissions are avoided or sequestered, but the concentration in the atmosphere would still increase. In the "drawdown" scenario, with a shift to 100% renewable energy (which, in this scenario includes biomass and nuclear), the model estimates that, in the year 2050, there would be a net reduction of carbon dioxide in the atmosphere. In the "optimum" scenario, with 100% renewable energy that is clean (no biomass or nuclear, etc.), drawdown could happen as early as 2045.

CURRENTS IN THE RIGHT DIRECTION

There are caveats: the models don't account for how much carbon dioxide or methane the ocean and land can absorb; increased warming may make both less possible. The CO2 that the ocean has already absorbed is also causing acidification, affecting everything that lives in the water, and further impairing absorption. As ice melts at the Arctic, warming is likely to increase much faster even if emissions drop.

And, of course, all of these solutions would also need to grow as much as the models predict. Some of this is well underway; the economics of wind and solar energy, as well as electric cars, are likely to speed adoption even if countries like the U.S. don't provide strong policy support.

"It's hard to not ride the waves of politics, but I think that there are strong currents in the right direction, and in critical areas we've seen astronomical technology improvement in the last few years that really changes the equation in terms of whether it's a cost at all to transition to these types of decarbonized energy systems," says Ben Haley, co-founder at Evolved Energy Research and one of the researchers on the United States Pathways To Deep Decarbonization team.

"The role of individual citizens in policymaking is to show our policymakers that you care, and not just that you care a little bit, or that you're worried a little bit, but that it's a strong motivator."

But growth of all of the solutions is far from guaranteed. "Baked into this is optimism, not fact," says Goldstein. "It's not taken by anybody as a given. This is doable, it's within reach, but you still have to strive."

That means political support; while individual actions like driving less or eating less meat can help a little, they can't make the larger systems changes that are necessary.

"Beyond everyday actions, I think the role of individual citizens in policymaking is to show our policymakers that you care, and not just that you care a little bit, or that you're worried a little

bit, but that it's a strong motivator," says Goldstein. "Basically, we have to have a climate voting bloc. I think a lot of leaders today would perceive from their constituents that it's way down on a list of priorities…If we can gather the momentum, keep people politically active, and move climate up the priority list, that will be key."

It's not possible to stop all of the negative effects of climate change; many species may face extinction before solutions to reach "drawdown" can be fully implemented. Climate change already has contributed to deaths in heat waves and from droughts. But the list of ideas outlined here could avoid the worst impacts.

Emerging solutions, from microbial farming to nuclear fusion, could help more–and those solutions aren't modeled in the book, though some are outlined in a section of "coming attractions."

"The ingenuity, and the brilliance, and the inventiveness that's going on right now is extraordinary," says Hawken. "When you start to approximate some of the 'coming attractions' in terms of when they will be available and how they will scale, and the impact they will have, and you start to layer that on top of what we are doing and know how to do and measure very well, it gets really very interesting. The question is whether we will do what we can do. That's a question I don't have an answer to."