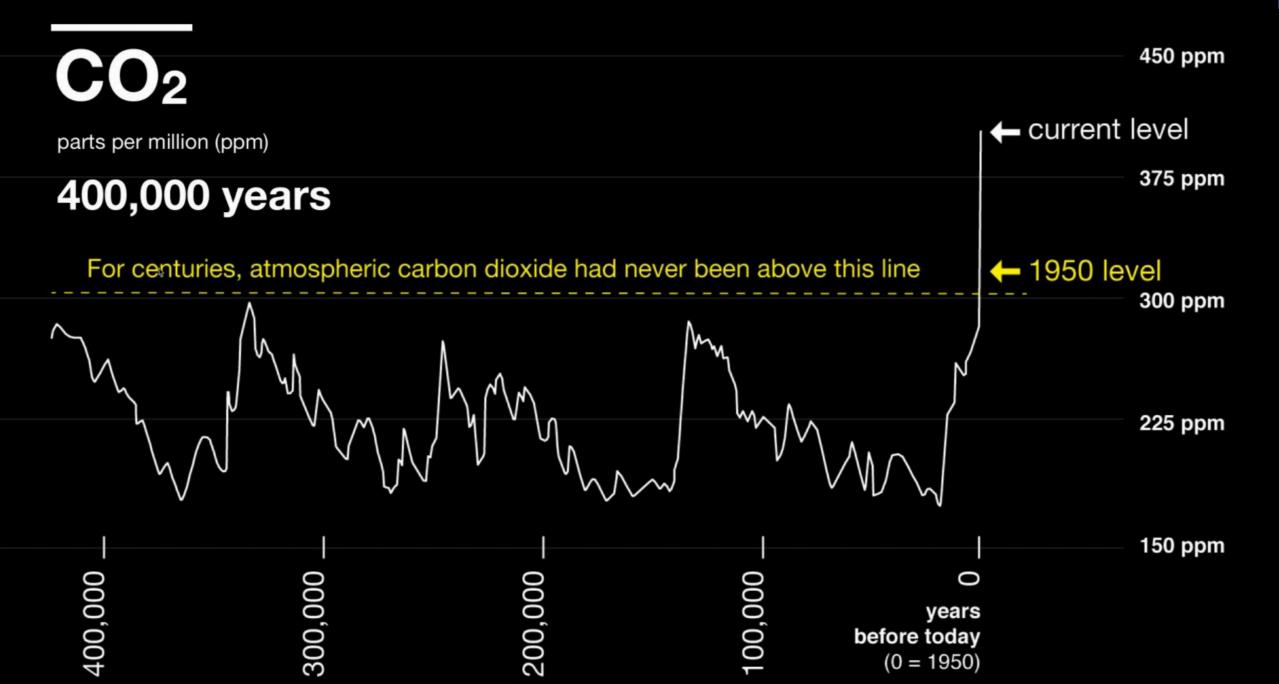
THE MOST COMPREHENSIVE PLAN EVER PROPOSED TO REVERSE GLOBAL WARMING EDITED BY PAUL HAWKEN

#drawdown

@drawdown



Scientific American

Union of Concerned Scientists

- 1. Forego Fossil Fuels
- 2. Move Closer to Work
- 3. Consume Less
- 4. Be Efficient
- 5. Eat Smart

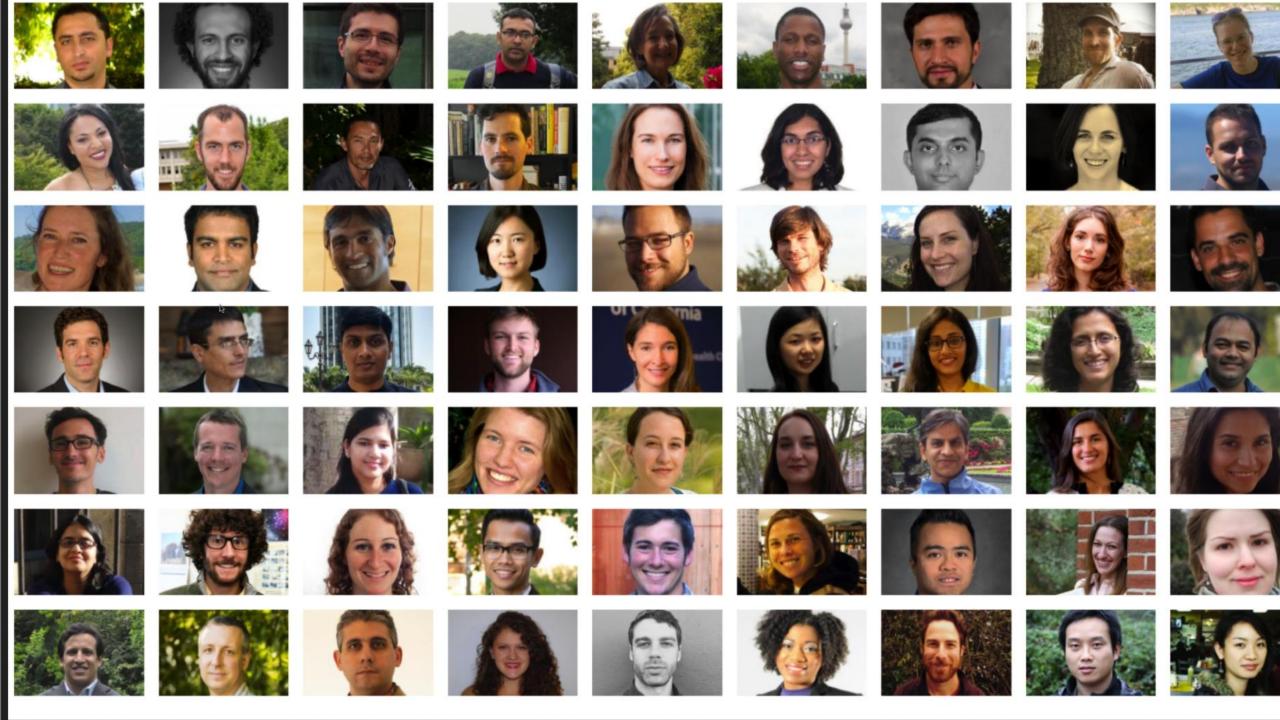
- 1. Change the car you drive
- 2. Make your house air tight
- 3. Use power strips in home entertainment ctr
- 4. Wash clothes in cold water
- 5. Buy less stuff

DRAWDOWN

In atmospheric terms drawdown is that point in time at which greenhouse gases peak and begin to decline on a year-to-year basis.

DRAWDOWN

In conducting our research, we found a plan, a blueprint that already exists in the world in the form of humanity's collective wisdom, made manifest in applied, hands-on practices and technologies that are commonly available, economically viable, and scientifically valid. Individual farmers, communities, cities, companies, and governments have shown that they care about this planet, its people, and its places. Engaged citizens the world over are doing something extraordinary. This is their story.



Leo Burke

University of Notre Dame

Mary Evelyn Tucker, PhD

Yale

Andy Revkin

The New York Times

Molly Jahn, PhD

University of Wisconsin

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Virgin Earth Challenge

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Brazil Green Bldg Council

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Idle no More

Mehjabeen Abidi-Habib, PhD

Government College University

in Lahore

Bill McKibben

350.org

Chris Pyke, PhD

IPCC

Brendan Mackey, PhD

Griffith University, Australia

We do the math.

TOTAL NET COST AND OPERATIONAL SAVINGS The total cost of each solution in this book is the amount needed to purchase, install, and operate it over thirty years. By comparing this to what we typically would spend on food, fuel for cars, heating and cooling for our homes, etc., we determined the net costs or savings from investing in a given solution.







MATERIALS REFRIGERANT **MANAGEMENT**

Downtown Singapore, showing the ubiquity of air-conditioning units on Asian streets.

Every refrigerator and air conditioner contains chemical refrigerants that absorb and release heat to enable chilling. Refrigerants, specifically CFCs and HCFCs, were once culprits in depleting the ozone layer. Thanks to the 1987 Montreal Protocol, they have been phased out. HFCs, the primary replacement, spare the ozone layer, but have 1,000 to 9,000 times greater capacity to warm the atmosphere than carbon dioxide.

RANK AND RESULTS BY 2050

89.74 GIGATONS REDUCED CO2

DATA TOO VARIABLE TO BE DETERMINED

\$-902.77 BILLION NET OPERATIONAL SAVINGS

IMPACT: Our analysis includes emissions reductions that can be



WIND TURBINES (ONSHORE)

Wind turbine under construction

Wind energy is at the crest of initiatives to address global warming in the coming three decades. Today, 314,000 wind turbines supply nearly 4 percent of global electricity, and it will soon be much more. In 2015, a record 63 gigawatts of wind power were installed around the world.



RANK AND RESULTS BY 2050

84.6 GIGATONS REDUCED CO2

\$1.23 TRILLION NET IMPLEMENTATION COST

\$7.43 TRILLION NET OPERATIONAL SAVINGS



FOOD REDUCED FOOD WASTE

This is the back end of a processing plant for vegetables in Burscough, Lancashire, UK. If you wonder why you have never seen a crooked carrot in your local market, commercial or natural, this is why. Vegetables are ruthlessly sorted to conform to "quality standards" set by the food chain, and this is the result. Some is carted off to piggeries, some as you can see is already rotting in the water.



RANK AND RESULTS BY 2050

70.53 GIGATONS REDUCED CO2

GLOBAL COST AND SAVINGS DATA TOO VARIABLE TO BE DETERMINED







TOP 20

Food is 8 of top 20

RANK	SOLUTION	SECTOR	REDUCED CO2
	Refrigerant Management		
	Wind Turbines (Onshore)		
3	Reduced Food Waste	Food	70.53 GT
4	Plant-Rich Diet	Food	66.11 GT
	Tropical Forests		
	Educating Girls		
	Family Planning		
	Solar Farms		36.90 GT
9	Silvopasture	Food	31.19 GT
	Rooftop Solar		
11	Regenerative Agriculture	Food	23.15 GT
	Temperate Forest		
	Peatlands		
14	Tropical Staple Tree Crops	Food	20.19 GT
	Afforestation		
16	Conservation Agriculture	Food	17.35 GT
17	Tree Intercropping	Food	17.20 GT
	Geothermal		
19	Managed Grazing	Food	16.34 GT
	Nuclear		

Food 321.93 GT	Land Use 149.6 GT	Materials 111.78 GT	Trans port 45.7	
Reduced Food Waste 70.53 GT			GT	
Plant-Rich Diet 66.11 GT	Tropical Forests 61.23 GT		Electric Vehicles 10.8 GT	
Silvopasture 31.19 GT	Temperate Forest 22.61 GT			
Regenerative Agriculture 23.15 GT				
Tropical Staple Tree Crops 20.19 GT	Pastlanda at 57 OT		Ohion	
Conservation Agriculture 17.35 GT	Peatlands 21.57 GT	-	Ships 7.87 GT	
Tree Intercropping 17.2 GT				
Managed Grazing 16.34 GT	Afforestation 18.06 GT	-		
Clean Cookstoves 15.81 GT	Bamboo 7.22 GT Forest Protection 6.2 GT	-		
Farmland Restoration 14.08 GT Improved Rice Production 11.34 GT	Indigenous Peoples' Land Management 6.19 GT Perennial Biomass 3.33 GT Coastal Wetlands 3.19 GT	Refrigerant Management 89.74 GT	Mass Transit	
		Alternative Cements 6.69 GT	6.57 GT	
Electricity Generation 246.14 GT	Women and Girls 121.26 GT	Water Saving - Household 4.61 GT		
		Bioplastics 4.3 GT Household Recycling 2.77 GT Industrial Recyling 2.77 GT	Т	
		Buildings and Cities	6.18GT	
Wind Turbines (Onshore) 84.6 GT		District Heating 9.38 GT 54.5 GT		
Solar Farms 36.9 GT	Educating Girls 59.6 GT	Insulation 8 27 GT	Airplanes	
Rooftop Solar 24.6 GT		LED Lighting (Household) 7.81 GT	5.05 GT	
Geothermal 16.6 GT		Heat Pumps 5.2 GT	Cars	
Nuclear 16.09 GT		LED Lighting (Commercial) 5.04 GT	(Hybrid) 4 GT	
Wind Turbines (Offshore) 14.1 GT Concentrated Solar 10.9 GT Wave and Tidal 9.2 GT Wathana Directors (Jarrel) 9.4 GT		Building Automation 4.62 GT Walkable Cities 2.92 GT Smart Thermostats 2.62 GT		
Wave and Tidal 9.2 GT Methane Digesters (large) 8.4 GT Biomass 7.5 GT Solar Water 6.08 GT		Landfill Methane 2.5 GT Bike Infrastructure 2.31 GT		
	Family Planning 59 6 GT			

Impacts of U.S. Buildings on Resources

- Buildings are responsible for...
 - 40% primary energy use*
 - 72% electricity consumption*
 - 39% CO₂ emissions*
 - 13.6% potable water consumption**

Source: http://www.usgbc.org/DisplayPage.aspx?CMSPageID=1720

^{*} Environmental Information Administration (2008) EIA Annual Energy Outlook ** U.S. Geological Survey (2000). 2000 data.

Ton=
Weight
Volume
Thermal

But what is a gigaton? To appreciate its magnitude, imagine 400,000 Olympic-sized pools. That is about a billion metric tons of water, or 1 gigaton. Now multiply that by 36, yielding 14,400,000 pools. Thirty-six billion tons is the amount of carbon dioxide emitted in 2016.

The quantitative results shown in the pages of Drawdown represent the total impact of each solution modeled over a thirty-year period using a reasonable yet optimistic forecast for their global rate of growth. We call this the Plausible Scenario. If we apply this method, the total amount of carbon dioxide avoided and sequestered is 1,051 gigatons by 2050.

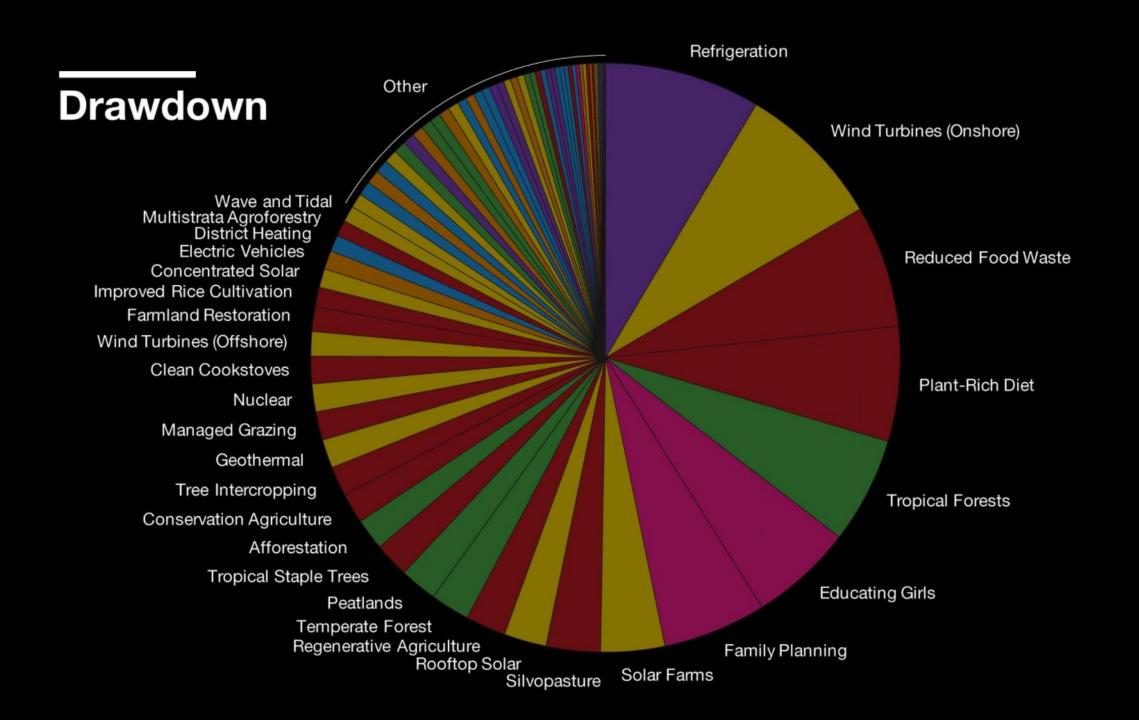
OUR 'CARBON BUDGET'

8 YEARS
if emissions continue to increase at 2.5% per year

SOLUTIONS

	•	•	TOTAL ATMOSPHERIC CO2-EQ REDUCTION	NET COST	SAVINGS
Rank	Solution	Sector	(GT)	(BILLIONS US \$)	(BILLIONS US \$)
1	Refrigerant Management	Materials	89.74	N/A	\$-902.77
2	Wind Turbines (Onshore)	Electricity Generation	84.60	\$1,225.37	\$7,425.00
3	Reduced Food Waste	Food	70.53	N/A	N/A
4	Plant-Rich Diet	Food	66.11	N/A	N/A
5	Tropical Forests	Land Use	61.23	N/A	N/A
6	Educating Girls	Women and Girls	59.60	N/A	N/A
7	Family Planning	Women and Girls	59.60	N/A	N/A
8	Solar Farms	Electricity Generation	36.90	\$-80.60	\$5,023.84
9	Silvopasture	Food	31.19	\$41.59	\$699.37
10	Rooftop Solar	Electricity Generation	24.60	\$453.14	\$3,457.63
11	Regenerative Agriculture	Food	23.15	\$57.22	\$1,928.10
12	Temperate Forests	Land Use	22.61	N/A	N/A
13	Peatlands	Land Use	21.57	N/A	N/A
14	Tropical Staple Trees	Food	20.19	\$120.07	\$626.97
15	Afforestation	Land Use	18.06	\$29.44	\$392.33
16	Conservation Agriculture	Food	17.35	\$37.53	\$2,119.07
17	Tree Intercropping	Food	17.20	\$146.99	\$22.10
18	Geothermal	Electricity Generation	16.60	\$-155.48	\$1,024.34
19	Managed Grazing	Food	16.34	\$50.48	\$735.27
20	Nuclear	Electricity Generation	16.09	\$0.88	\$1,713.40
21	Clean Cookstoves	Food	15.81	\$72.16	\$166.28
22	Wind Turbines (Offshore)	Electricity Generation	14.10	\$572.40	\$274.57
23	Farmland Restoration	Food	14.08	\$72.24	\$1,342.47
24	Improved Rice Cultivation	Food	11.34	N/A	\$519.06
25	Concentrated Solar	Electricity Generation	10.90	\$1,319.70	\$413.85
26	Electric Vehicles	Transport	10.80	\$14,148.00	\$9,726.40
27	District Heating	Buildings and Cities	9.38	\$457.10	\$3,543.50
28	Multistrata Agroforestry	Food	9.28	\$26.76	\$709.75
29	Wave and Tidal	Electricity Generation	9.20	\$411.84	\$-1,004.70
30	Methane Digesters (Large)	Electricity Generation	8.40	\$201.41	\$148.83
31	Insulation	Buildings and Cities	8.27	\$3,655.92	\$2,513.33
32	Ships	Transport	7.87	\$915.93	\$424.38
33	LED Lighting (Household)	Buildings and Cities	7.81	\$323.52	\$1,729.54
34	Biomass	Electricity Generation	7.50	\$402.31	\$519.35
35	Bamboo	Land Use	7.22	\$23.79	\$264.80
36	Alternative Cement	Materials	6.69	\$-273.90	N/A
37	Mass Transit	Transport	6.57	N/A	\$2,379.73
38	Forest Protection	Land Use	6.20	N/A	N/A
39	Indigenous Peoples' Land Management	Land Use	6.19	N/A	N/A
40	Trucks	Transport	6.18	\$543.54	\$2,781.63

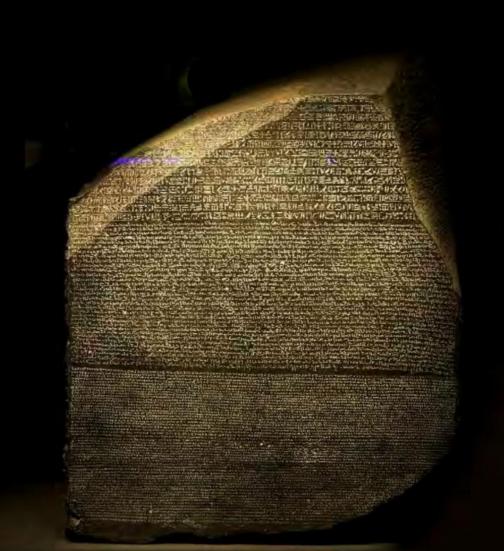
41	Solar Water	Electricity Generation	6.08	\$2.99	\$773.65
42	Heat Pumps	Buildings and Cities	5.20	\$118.71	\$1,546.66
43	Airplanes	Transport	5.05	\$662.42	\$3,187.80
44	LED Lighting (Commercial)	Buildings and Cities	5.04	\$-205.05	\$1,089.63
45	Building Automation	Buildings and Cities	4.62	\$68.12	\$880.55
46	Water Saving - Home	Materials	4.61	\$72.44	\$1,800.12
47	Bioplastic	Materials	4.30	\$19.15	N/A
48	In-Stream Hydro	Electricity Generation	4.00	\$202.53	\$568.36
49	Cars	Transport	4.00	\$-598.69	\$1,761.72
50	Cogeneration	Electricity Generation	3.97	\$279.25	\$566.93
51	Perennial Biomass	Land Use	3.33	\$77.94	\$541.89
52	Coastal Wetlands	Land Use	3.19	N/A	N/A
53	System of Rice Intensification	Food	3.13	N/A	\$677.83
54	Walkable Cities	Buildings and Cities	2.92	N/A	\$3,278.24
55	Household Recycling	Materials	2.77	\$366.92	\$71.13
56	Industrial Recycling	Materials	2.77	\$366.92	\$71.13
57	Smart Thermostats	Buildings and Cities	2.62	\$74.16	\$640.10
58	Landfill Methane	Buildings and Cities	2.50	\$-1.82	\$67.57
59	Bike Infrastructure	Buildings and Cities	2.31	\$-2,026.97	\$400.47
60	Composting	Food	2.28	\$-63.72	\$-60.82
61	Smart Glass	Buildings and Cities	2.19	\$932.30	\$325.10
62	Women Smallholders	Women and Girls	2.06	N/A	\$87.60
63	Telepresence	Transport	1.99	\$127.72	\$1,310.59
64	Methane Digesters (Small)	Electricity Generation	1.90	\$15.50	\$13.90
65	Nutrient Management	Food	1.81	N/A	\$102.32
66	High-speed Rail	Transport	1.52	\$1,038.42	\$368.10
67	Farmland Irrigation	Food	1.33	\$216.16	\$429.67
68	Waste-to-Energy	Electricity Generation	1.10	\$36.00	\$19.82
69	Electric Bikes	Transport	0.96	\$106.75	\$226.07
70	Recycled Paper	Materials	0.90	\$573.48	N/A
71	Water Distribution	Buildings and Cities	0.87	\$137.37	\$903.11
72	Biochar	Food	0.81	N/A	N/A
73	Green Roofs	Buildings and Cities	0.77	\$1,393.29	\$988.46
74	Trains	Transport	0.52	\$808.64	\$313.86
75	Ridesharing	Transport	0.32	N/A	\$185.56
76	Micro Wind	Electricity Generation	0.20	\$36.12	\$19.90
77	Energy Storage (Distributed)	Electricity Generation	N/A	N/A	N/A
77	Energy Storage (Utilities)	Electricity Generation	N/A	N/A	N/A
77	Grid Flexibility	Electricity Generation	N/A	N/A	N/A
78	Microgrids	Electricity Generation	N/A	N/A	N/A
79	Net Zero Buildings	Buildings and Cities	N/A	N/A	N/A
80	Retrofitting	Buildings and Cities	N/A	N/A	N/A
			1050.99	\$29,636.40	\$73,874.44



Language?

Fight climate change
Combat climate change
The climate battle
Climate crusade
Slash emissions
The Carbon War Room
Negative Emissions
Decarbonization

2C



Language

We have sought to make Drawdown understandable to people from all backgrounds and points of view. We endeavored to bridge the climate communication gap by the words we choose, the analogies we avoid, the jargon we stay away from, and the metaphors we employ. As much as possible, we refrain from acronyms and lesser-known climate terminology. We generally spell out carbon dioxide instead of abbreviating it. We write methane, not CH4.

Language

Our goal is to present climate science and solutions in language that is accessible and compelling to the broadest audience, from ninth graders to pipe fitters, from graduate students to farmers. We also avoid using military language. Much of the rhetoric and writing about climate change is violent: the war on carbon, the fight against global warming, and frontline battles against fossil fuels. Articles refer to slashing emissions as if we had machetes.

Unquestionably, distress signals are flashing throughout nature and society, from drought, sea level rise, and unrelenting increases in temperatures to expanded refugee crises, conflict, and dislocation. This is not the whole story. We have endeavored in Drawdown to show that many people are staunchly and unwaveringly on the case. Although carbon emissions from fossil fuel combustion and land use have a two-century head start on these solutions, we will take those odds. The buildup of greenhouse gases we experience today occurred in the absence of human understanding; our ancestors were innocent of the damage they were doing. That can tempt us to believe that global warming is something that is happening to us—that we are victims of a fate that was determined by actions that precede us. If we change the preposition, and consider that global warming is happening for us—an atmospheric transformation that inspires us to change and reimagine everything we make and do—we begin to live in a different world. We take 100 percent responsibility and stop blaming others. We see global warming not as an inevitability but as an invitation to build, innovate, and effect change, a pathway that awakens creativity, compassion, and genius. This is not a liberal agenda, nor is it a conservative one. This is the human agenda.