

## REACHING NET ZERO: 2023 MID-YEAR UPDATE

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July, 2023

**OUR OUTLOOK** for future efforts to fight global warming is included as the last section of this report. This outlook is based upon our assessment of currently available information.

**IMPORTANT NOTICE:** AT OUR PUBLISHER (ELSEVIER'S) REQUEST, WE ARE PREPARING A TOTALLY UPDATED 2<sup>ND</sup> EDITION OF **REACHING NET ZERO** THAT WILL BE AVAILABLE IN EARLY 2024. IT WILL SUMMARIZE HOW OUR RAPIDLY CHANGING CLIMATE IS AFFECTING THE WORLD, WHAT LIES AHEAD FOR HUMANITY, AND WHAT WE CAN AND NEED TO DO. IF YOU ARE INTERESTED IN RECEIVING AN ADVANCE COPY, PLEASE LET US KNOW. BE AWARE THAT IN THE PAST THE COST HAS BEEN OVER \$100 AND WE ARE URGING THE PUBLISHER TO LOWER THE PRICE.

### EXECUTIVE SUMMARY

Our last report, "Reaching Net Zero: 2022 Year End Update," was published in January 2023 and is available on our website, [www.reachingnetzero.com](http://www.reachingnetzero.com). The following is a brief summary of important developments since our last report. Additional details are found following this summary.

### WHERE ARE WE HEADED—HEADLINES OF THE PERIOD

1. 2023 is breaking temperature records all around the world and will likely be the hottest year ever since records have been kept. A new record was set in June, and this was broken on July 3<sup>rd</sup>, again on July 4<sup>th</sup>, and again on July 6<sup>th</sup>, when the global average temperature reached 17.23°C.<sup>1</sup> As this is only for one month, the yearly average is likely to be less. But 17.23°C is 3.5°C above the IPCC baseline temperature of 13.7°C (average for 1850-1900), which suggests that the IPCC goal of keeping the global average temperature below 1.5°C is now out of reach.<sup>2</sup>
2. There have been more frequent heat waves and "heat domes" that settle in one area and prolong high surface temperatures in North America and the Pacific Northwest.
3. The Intergovernmental Panel on Climate Change (IPCC) and other authorities are now saying that it is **highly unlikely** that the world will keep global warming under 1.5°C or even 2.0°C, and the world **will not** achieve net zero by 2050.
4. Heavy rains have reduced droughts in some areas, but caused flooding and damage in others.
5. A massive wildfire in Canada has caused air pollution across the Northeast U.S. and as far away as Sweden.
6. New data shows that the average ocean surface has increased about 0.8°C compared to pre-industrial times and that the rate of temperature increase is accelerating.
7. Greenhouse gas concentrations in the atmosphere hit a new record in May 2023, when CO<sub>2</sub> levels reached 424 ppm.<sup>3</sup>
8. Sea level rise has already reached 10 inches and is accelerating.
9. Deforestation has slowed but remains a serious problem.
10. Drought and heat are increasing the number and intensity of wildfires.
11. The transition to renewables: there is growing recognition that electrification of the economy for power production and new uses, such as charging electric vehicles and replacing natural gas and oil for building heating and power production, requires investments in electricity storage and in expanding transmission and distribution systems. Faster approval of sites for solar and wind farms and for transmission line projects is required.

### HARD FACTS

### “The Earth is really quite sick now.”

This was the headline on the *Los Angeles Times* front page on June 1, 2023. The byline stated that “climate researchers say seven of eight safety limits have been breached, endangering people’s well-being. What the article was referring to was some of the tipping points that scientists have identified. The specific ones mentioned included climate, (the Earth’s rising temperature); air pollution, phosphorus and nitrogen contamination of water from fertilizer overuse, groundwater supplies, fresh surface water, the unbuilt natural environment, and the overall natural and human built environment. The report stated that were “hot spots” around the world where conditions were worse than at other locations. As an example of a tipping point being reached, a growing world population needs more food, which increases the demand for fertilizer, which leads to more water pollution, when drinking water is becoming scarcer, due to droughts, and so on.<sup>4</sup>

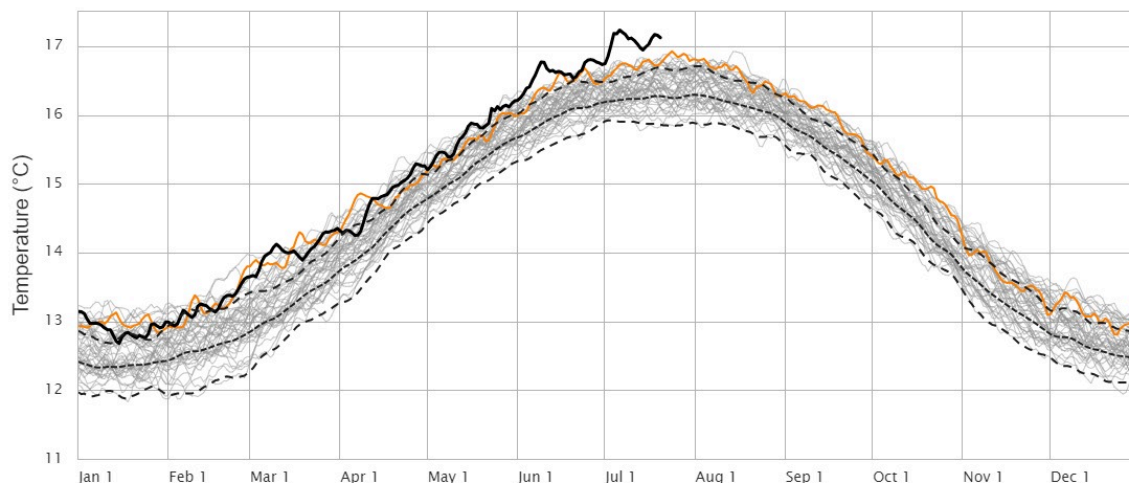
In an editorial on July 7, 2023, the *Los Angeles Times* wrote “Heat records are falling. Can we get serious about climate change?” The editorial goes on to say that “Each record broken and new extreme is a warning that the planet is in distress. We are not doing enough to slow climate change and avoid greater suffering... . The course forward is clear, though not easy or cheap. It requires dismantling the machinery of fossil fuels and replacing it with clean renewable energy.”<sup>5</sup>

#### 1. Greenhouse gas concentration.

In May 2023, the CO<sub>2</sub> concentration in the atmosphere set a new record, reaching 424 parts per million (ppm), an increase of 5 ppm over December 2022. CO<sub>2</sub> accounts for about 75 percent of total greenhouse gas emissions. About 50 percent of greenhouse gases in the atmosphere were put there in only the last 30 years.

#### 2. Earth’s average temperature.

Temperature records continue to be broken. In June, 2023, record highs were recorded in the U.S., Northern Africa, and many European countries. The U.K., at 15.8°C, saw the highest



ever since records were kept.<sup>6</sup> These records were short-lived, being broken a few days later by new global highs: July 4<sup>th</sup>, 17.01°C and then again, July 5<sup>th</sup>, 17.18°C, and July 6<sup>th</sup>, 17.23°C.

Figure 1 Average world Monthly Temperature<sup>7</sup>

Now that La Niña conditions have dissipated, El Niño conditions are forming in the tropical Pacific, bringing an increase in global temperatures. This can also mean increased rainfall in some areas.<sup>8</sup> NOAA reports that 2023 is likely to become the hottest year on record, and 2024 potentially still hotter.<sup>9</sup>

With soaring global temperatures there is concern that many cities are not prepared to protect populations in poor neighborhoods without shelter or air conditioning. For example, a powerful heat wave in India in 2010 had temperatures over 118°F and led to more than 1,300 deaths in Ahmedabad. In June 2023 Germany launched a campaign against heat wave deaths to avoid a similar disaster. In the United States, Chicago and other U.S. cities including Los

Angeles, Miami, and Phoenix, have “chief heat officers” to coordinate planning and response, including opening cooling centers, hydration stations, and checking on the elderly.<sup>10</sup> Meanwhile, this year there have been hundreds of deaths due to heat in Mexico, China, India and other locations, with prospects that the situation will be even worse in 2024.

### **3. Air pollution.**

Air pollution (indoor and outdoor), is responsible for over 7 million deaths annually, ranking third behind smoking and high blood pressure.<sup>11</sup> The massive wildfires in Canada and other wildfires in Europe and Asia added to air pollution in 2023.

### **4. Arctic temperatures.**

Temperatures within the Arctic circle ranged from 36°F to a high of 90°F. In July, Anchorage temperatures typically range from 50 to 60°F, but on July 19 reached 72°F. The highest Arctic temperatures were in Eastern Siberia where Kislokan was 86°F and Vanavara Airport hit 90°F.<sup>12</sup>

### **5. Arctic ice, and Antarctic ice, and glaciers melting.**

Antarctic sea ice at the end of June was nearly 1,000,000 mi.<sup>2</sup> below the average for this time of year compared with data from 1981 to 2010, according to a recent NOAA report.<sup>13</sup> Melting of Greenland’s largest glacier is accelerating, and that may impact sea level rise. Likewise, loss of ice from Himalayan glaciers during the last decade was greater than at any previous time.<sup>14</sup>

### **6. Ocean warming.**

In mid-June another milestone was established when the North Atlantic Ocean temperature set a new record, nearly 1.1°C (2°F) above the mean dating back to 1982. Scientists offer a variety of explanations for the sudden increase in sea temperature, including the early arrival of El Niño, the recent eruption of the Hunga Tonga undersea volcano, new regulations around sulfur aerosol emissions and even a lack of dust from the Sahara Desert. These latter effects are on top of El Niño. The volcano erupted underseas and shot water vapor all the way up into the stratosphere. Water vapor acts as an additional heat trapping greenhouse gas. Reducing sulfur aerosol emissions and lack of Sahara Desert dust are two factors that increase the warming effect of the sun on the ocean. These combined effects are considered responsible for the sudden increase in temperature. Potential effects of such warming including triggering algal blooms, more bleaching of coral, and negatively affecting fisheries. Marine heat waves also provide more energy for tropical cyclones and more moisture for atmospheric rivers and flooding events. Scientists say this is part of a long-term trend.<sup>15</sup>

### **7. Ocean acidification**

Ocean acidification is caused by carbon dioxide being absorbed in the ocean where it creates carbonic acid. Excessive levels are harmful to various forms of sea life. The acidity of a liquid is measured by its pH value. Prior to the Industrial Revolution the average ocean pH was 8.2. Today the average is about 8.1 and is trending down towards 8.0. (A lower pH value corresponds to increasing acidity. Also, since it is a logarithmic scale, small changes in the pH number correspond to large values). Ocean acidification is increasing and by the end of the century could be 150% more acidic than it is now. In May, 2023, the U.S. State Department issued a request for comments on a proposed new United States Ocean Acidification Action Plan. Developing such a plan is a commitment made by all members of the International Alliance to Combat Ocean Acidification. The Alliance includes 120 members from 22 countries.

Members include national governments, state and provincial regional governments, tribal and indigenous groups, and city and municipal governments.<sup>16</sup>

## 8. Sea level rise, flooding:

Monsoonal flooding in China in June has caused the displacement of about 20,000 people, with at least 15 dead. In July more than 100 people died due to floods and landslides across India, China, and Japan. Hundreds of thousands of people have had to evacuate. Also, Cambodia's capital was hit by flash floods following extremely heavy rainfall, and further south in the Philippines heavy floods occurred near Manila, where the rains cause cancellation of flights from the Manila airport.<sup>17</sup>

The Northeast United States was hit with historic flooding including Vermont, New Hampshire, New York's Hudson River Valley, and Maine. Vermont was among the worst hit when storms dumped up to two month's worth of rain over a period of two days. At least two persons were known dead and damage to cities and farms was widespread. Thousands of homes and businesses have been damaged by flooding and in addition, some roads and bridges have been wiped out and will need substantial rebuilding and repair. Another problem was damage to water treatment plants that were flooded or discharged untreated sewage into waterways, requiring some communities to require homeowners to boil water before drinking.<sup>18</sup>

In previous update reports we reported that the Amtrak rail service between San Diego north to San Luis Obispo along the southern California coast has been disrupted so on several occasions by landslides and crumbling of the sea bluffs. This is a major transportation system carrying around 8 million passengers annually and a billion plus dollars in goods. Service was restored in April 2023 after a six-month, \$13.7 million effort to stabilize the sand beneath the tracks that shifted because of a landslide and tidal erosion. Since then, further damage occurred, which has caused additional shutdown of the rail line and now local officials are considering that it may be necessary to relocate the route inland at a cost of \$5 billion.<sup>19</sup>

## 9. Permafrost melting

In earlier reports we've described how permafrost is melting in Siberia, releasing methane and causing fires and even explosions. Near the town of Batagai in Russia's far east, in an area where substantial deforestation had taken place, a small crater developed when the underground permafrost began to melt. This process has continued until the present day, and today the Batagai is considered the world's biggest permafrost crater, stretching approximately 1 km (two thirds of a mile) in length and having a depth of 100 m (328 feet). The concern here is that with increasing temperatures in Siberia, the crater will continue to expand, with the potential to release an enormous amount of methane.<sup>20</sup>

Permafrost is also melting in Alaska. Here the permafrost is rich in organic matter and in southern Alaska, is warmer than that found above the Arctic Circle. It is thawing at a faster rate. Interestingly enough, local experts say that it's not so much the heat that's affecting the local environment, but rather increased rainfall. In building areas where the permafrost is mixed with gravel, the soil can remain relatively stable as the ice melts. Otherwise, it may be necessary to excavate shallow layers of permafrost and build on the stable ground underneath, or even build on elevated piles.<sup>21</sup> In addition, melting Arctic glaciers are releasing more methane.<sup>22</sup>

## 10. Species extinction and migrations

Not all is well in the oceans. A new study in Australia reports that over 500 species of marine life—fish, seaweed, coral, and invertebrates—have declined in the past decade on Australian reefs. Over 1,000 species were considered, with half having declined and about one-quarter

having seen declines of 30% or more.<sup>23</sup> The decline was most noticeable in Australia's cooler southern waters, an area known as the Great Southern Reef. Ocean warming is believed to be the cause.

According to an aid worker with over a decade of experience in refugee camps in Kenya, Turkey, Greece, and Bangladesh, there are now millions of climate refugees. They all tell the same story: "it got hot. Then hotter. Then the jobs dried up and eventually the food did too." The refugees concluded there was no longer a future where they were living and they began to seek an alternative location.<sup>24</sup> The world is ill prepared to handle growing numbers of climate refugees. Every month in the news we read stories about migrants dying in deserts or lost at sea from overcrowded boats as they seek refuge.

### **11. Extreme weather events**

After experiencing a series of extreme weather events in the United States during June and July 2023, Michael Mann, a professor in the Department of Earth and environmental sciences at the University of Pennsylvania declined to say that we'd reached a limit. He went on to say, "it's worse than that. It's an ever-moving baseline of more frequent and intense weather extremes." He then said "I prefer to call it *a new abnormal*." Of course, he was referring to the wildfire smoke from Canada that had blanketed most of the eastern United States, the massive heat dome that broke temperature records across the southern half of the United States, and the torrential rains and flooding that occurred in the Northeast, all at the same time.<sup>25</sup>

### **12. Droughts:**

Heavy atmospheric river rainfall in California during the winter of 2023 was a mixed blessing. It effectively ended three years of drought, filling lakes and dams that were at dangerously low levels and leaving behind a record snow pack. But it also caused flooding, with damage to transportation systems, broken levees, cause massive power outages, and in rural areas, inundated farmlands and re-created the long-since dry Tulare Lake. More than 20 people lost their lives in floodwaters.<sup>26</sup> by mid-summer 2023, about 27% of the continental United States was experiencing moderate to severe drought conditions. In the Western Mediterranean, southern Spain, Algeria, northern Morocco, southern France were all experiencing record-breaking high temperatures and drought conditions.<sup>27</sup>

### **13. Wild fires**

In Canada, swathes of the country have experienced temperatures up to 14°C above the average for June, along with catastrophic wildfires that have burned more than 20 million acres. Data from the European Union's Copernicus atmospheric-monitoring system shows that, cumulatively, the amount of carbon released to the atmosphere in June surpassed the maximum amount usually released during the entire wildfire season, which runs until late August.<sup>28</sup> (See Figure 2.)

While a huge fire in Canada continued to burn, the first major fires of the season broke out in Southern California. Four separate blazes caused evacuations and were burning thousands of acres in July. Firefighters were forced to fight the blazes in temperatures that hit 105°F and higher. As Southern California became part of the heat dome covering the southeast United States,<sup>29</sup> the prospects for more heat, poor air quality, and additional fires loomed large.

### **14. Agriculture**

West Africa is facing its worst food crisis in 10 years, with more than 27 million hungry people, due to drought, conflicts, and the Covid 19 pandemic. Because of food shortages, malnutrition rates in West and Central Africa have surged, with millions of children experiencing acute

symptoms. The problems have been aggravated by the war in Ukraine, where recent Russian actions are stopping vital grain shipments needed to feed thousands of hungry people.<sup>30</sup>

The early arrival of El Niño conditions this year in addition to causing extreme weather conditions—high temperatures and heavy rainfall—it is expected to reduce rice yields across Asia, where a majority of the world's rice is grown. As it is, global stocks are low already due to devastating floods in Pakistan last year. Some countries are restricting exports due to shortages. In addition, the war in Ukraine has disrupted shipments of chemical fertilizers and many countries are trying to find new sources for essential fertilizers.<sup>31</sup>

Figure 2 Emissions from Canadian Wildfires

### **15. Deforestation:**

For a change, there is some good news. Deforestation declined by 29% in 2022, the lowest level in ten years. During the first half of 2023, deforestation in Brazil declined by 34 percent, hitting its lowest level in four years due to stricter environmental regulations imposed by new President Lula da Silva.<sup>32</sup>

### **16. Public health**

Today a big concern is heat-related deaths. Our research indicates that extreme temperatures kill about 5 million people per year, world-wide. Historically, more people die from cold weather than heat waves, but climate change is increasing the risk with more frequent and intense heat waves.<sup>33</sup> During Europe's heat wave in 2022, over 60,000 people in 36 countries died from the heat. In 2023, over 120 million people in the U.S. are under heat alerts. It is estimated that heat related illness and emergency care cost the U.S. health care system about \$1 billion per year.<sup>34</sup>

### **17. Financial crises**

The most visible sign of the impact of global warming on the world's economy is the growing bill for responding to and recovering from natural disasters of increasing frequency and intensity. Not to make a bad pun, but this is just the tip of the iceberg. There are myriad ways that the world economy is being impacted directly or indirectly by climate change. We are seeing rising food costs, increased costs of energy, greater medical expenses related to public health, and the need throughout the world for increased investments in green energy power projects and improved transmission and distribution systems for electricity, just to mention a few. The International Monetary Fund monitors and prepares reports on various economic aspects of global warming. In addition to infrastructure expenses as mentioned above, the IMF is concerned about risks to

corporate viability, potential recessions, and a very definite risk of stranded assets as renewable energy forms replace fossil fuels.<sup>35</sup>

### 18. National security

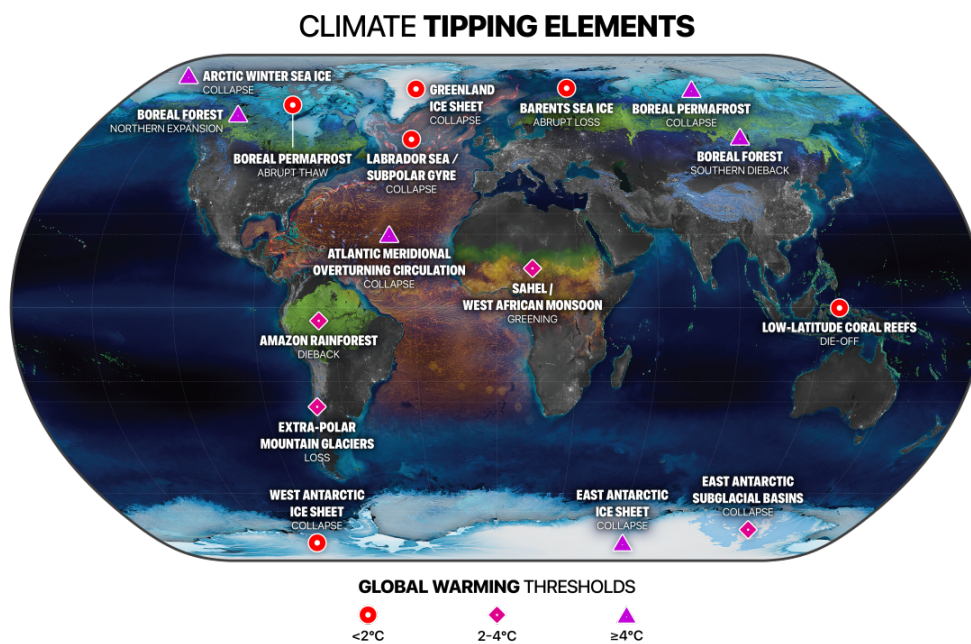
With much of the United States sweltering in high temperature heat waves, one would think that the cooler temperatures in Alaska would be an attraction. However, the top one-third of Alaska lies within the Arctic Circle, an area which is warming at 2 to 4 times faster than the rest of the world. This has implications for U.S. national security. Warming and melting ice has led to rising seas on Alaska's shoreline that has caused military facilities to be moved. High temperatures in summer rains are melting permafrost, causing structures to sink into the earth. Also, less sea ice in the summer has opened new shipping lanes and allowed Chinese and Russian vessels to operate near U.S. shores. The military has expanded equipment and resources in the area, but besides the expense of new equipment, construction costs under Alaska's conditions are much higher.<sup>36</sup>

### 19. Renewable energy

Renewable energy continues to grow worldwide. In 2023 global solar generating capacity exceeded 1000 GW and wind power is expected to also exceed this milestone in 2023. This growth is expected to accelerate as costs continue to decline. For the first time, in 2023 combined wind and solar electricity generation in the U.S. was greater than that produced by America's coal-fired power plants.<sup>37</sup> However, as we have mentioned previously, there is an urgent need to modernize the electrical transmission and distribution systems, not only in the U.S. but globally. Already there is evidence of inability to connect new renewable energy generating capacity to the existing grids. Other issues include opposition to siting and right-of-way for transmission lines. These are critical measures that must be addressed. Some are opposed to siting wind farms and solar farms in rural or scenic areas. They propose that rooftop solar is a way to avoid land conflicts and unsightly installations. Unfortunately, surveys of building rooftop areas and other suitable structures in the United States indicate that they would only accommodate enough solar panels to meet 20 U.S. demand to 30% of the electrical by 2050.<sup>38</sup>

### 20. Tipping

Figure 3 illustrates potential tipping points and average temperature that might trigger them. Those with red dots (signifying for triggering less) are the immediate that could lead to sea level rise.<sup>39</sup>



points illustrates tipping the increase trigger marked potential at 2°C or ones of concern lead to

Figure 3: Potential tipping points

### The last Word

*(One of our readers recently submitted this letter to the editor of the Los Angeles times. It was published on July 20, 2023. We thought you might find it interesting.)*

#### **Fossil fuels are killing us.**

Re: “Another day of wildfire risk and eyeball-stinging heat,” *Los Angeles Times*, July 19 2023.

“This is what climate change feels like —“eyeball stinging heat.” Our planet has not been this hot in 125,000 years.

So why are we not screaming “enough.” Why aren’t we identifying the culprits—coal, oil and gas companies—and demanding that they stop producing fuels that are literally killing us? The climate crisis is a fossil fuel crisis. Too many news articles like this one fail readers by not more prominently connecting the dots to the fossil fuel industry.

Eighty percent of all the energy used in the world today comes from fossil fuels, yet affordable clean energy like solar and wind is readily available to replace them. Through deceit, deception and delay, this industry and its political allies use their power to protect this pernicious business.

Governments must stop subsidizing these fuels, power the grid with clean energy, speed permitting for renewable energy, invest in healthier forests, and tax fossil fuel companies on their carbon pollution.”

***By Robert Taylor***

#### **Our Outlook**

Regrettably, we do not find much to report that is positive, based on developments in the first half of 2023.

- Global greenhouse gas emissions will set a new record in 2023.
- With the impact of the Covid-19 pandemic lessening, travel and economic activity is surging with a concomitant rise in emissions.
- Despite the war in Ukraine and other ongoing economic problems, the global economy continues to grow.
- With the war in Ukraine, China threatening Taiwan, and other international tensions, the chance of global cooperation to reduce greenhouse gas emission is declining.



- In the very near term, by 2025 to 2030 if not sooner, Earth's average temperature increase will exceed 1.5°C.

***Craig B. Smith and William D. Fletcher***

Bill Fletcher and Craig Smith are coauthors of *Reaching Net Zero: What It Takes to Solve the Global Climate Crisis*, Elsevier, July 2020. ( <https://reachingnetzero.com/book/>)

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