Book Review – The Decarbonization Imperative

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1. Introduction

I have decided to dedicate a whole post to this review. The main reason is, that this book is the most thorough, well-written, well-organized, and information-packed book I have ever encountered on climate change and potential remedies to this environment-damaging, human-caused disaster. The main part of this book, exclusive of front-matter and end-matter is only a bit over 200 pages long, but it took me over a month to read. For prior books of this length, I've rarely taken more than a week or two to consume, and this includes ones covering roughly the same ground (albeit not nearly as thoroughly nor well-organized).

I just completed this book today (as I'm starting to write this paper), and as I saw the end approaching, I started to think about how I wanted to review it. I've decided to start by describing the subject-matter of the book in (sort-of) an outline-form, and then start to fill this in descriptions of content in each heading. This will not be in lock-step with the section-structure of the book, but rather my take on the importance of each subject.

2. Climate Crisis, Today & Tomorrow

We are starting to see major impacts from climate-change, even though it is just 2025. There may be areas of the world where these are minimal, but where I live (and I expect where most of my readers live) they are not minimal, but neither are they major. In Northern California we have seen many destructive wildfires but these have only directly damaged a small percentage of infrastructure and only caused a few deaths and injuries among non-firefighting populations compared to other causes of comparable damage.

The above paragraph is the good news. The bad news is that we have seen many positive feedback mechanisms. Climate change is caused by human-generated greenhouse gas (GHG) being released into the atmosphere. This absorbs and retains solar energy thus warming the atmosphere. The main GHG is carbon dioxide (CO_2). If a wildfire races through a section of landscape, whether or not there are any human-infrastructure or people in its path, it releases several types of GHG, but the dominant GHG is CO_2. Thus, each wildfire accelerates climate change. This is a type of positive feedback.

As the climate warms there are two other examples of positive feedback. The first is that a warmer atmosphere can hold more water-vapor. This results in more rain in some areas. This results in growth of large amounts of grasses and bushes. Note that there is "…more rain in some areas." Like all weather, the amount of rain received in each area in each season is driven to a large degree by chaotic atmospheric dynamics. Thus, many areas will have "wet" seasons and years followed by "dry" seasons and years. In this case, these areas will be susceptible to large wildfires, possibly sparked by a dry lightning storm we have many of these in dry seasons in California, which typically run from May through October. However, lately our wet and dry seasons have been inconsistent.

The second example of positive feedback is that the (worst-case) wildfires described in the prior paragraph will be virtually impossible to fight using conventional fire-fighting ground forces. Thus, they may quickly evolve into major fire-storms as described below.

Climate scientists warn that climate change does even more than increase the severity of heat waves and droughts and increase the number of fire-igniting lightning strikes. In addition, in the process of creating more and larger wildfires, climate change also increases the occurrence of a frightening and deadly phenomenon that occurs only in the biggest, hottest fires. Called a firestorm, it consists of a highly concentrated mass of heat and flames that becomes so enormous and intensely hot that it creates its own weather. Most often, the experts say, it takes the form of an incredibly powerful windstorm.[1]

The formation of a firestorm in a forest begins when a wildfire becomes so huge that its hot air and smoke no longer billow outward horizontally or toward the sides of the blaze, as happens in small- and medium-sized blazes. Instead, the heat and smoke form a vertical plume in scientific lingo, a thermal column-that pushes upward into the sky. Such nearly red-hot columns have been known to rise as high as 9 miles (15 km).

Typically, the plume contains not only heat and smoke but also a certain amount of moisture. Often, therefore, when it blasts upward, much of it condenses and forms a cloud. This bizarre weather effect, known as a pyrocumulonimbus cloud (pyroCb), is best described as a powerful thunderstorm swirling within the thermal column. As that storm spins in almost tornado-like fashion, it sucks in extra air from the surrounding atmosphere, which supplies it with additional energy. That can make it even hotter.

A serious danger of a firestorm is that it can, and often does, create still more wildfires in the areas surrounding the initial fire. One way this happens is when the thermal column becomes so hot that it spontaneously ignites unburned materials lying thousands of feet, or even a few miles, beyond the central fire. Another danger is that the thunderstorm at the firestorm's center can create its own lightning bolts, which shoot out in all directions, igniting still more new patches of fire.

Firestorms have occurred within wildfires in the past. Yet they tended to be fairly rare, mainly because immense, extremely hot wildfires were themselves fairly rare. However, that situation is rapidly changing. Meteorologist Mike Fromm with the US Naval Research Laboratory notes that he and other scientists have seen, increasing pyroCb and other firestorm-related events that "we've never seen before or in locations we've never seen [them in] before. Spanish wildfire expert Marc Castellnou has little doubt that these events are increasing in number because of climate change. In the 1990s, he recalls, when he began studying firestorms worldwide, only three in that decade seemed big enough to warrant his attention. In contrast, between 2017 and 2021 he investigated eighty-three such events.

[1] Don Nardo, "Climate Change Impact – Wildfires," ReferencePoint Press, https://www.amazon.com/Climate-Change-Impact-Don-Nardo/dp/1678208302

Not only were such firestorms rarer before climate change began markedly affecting the planet in the 1980s and 1990s, so too were large-scale heat waves and droughts, the buildup of the massive stores of burnable materials on forest floors, and the number of giant wildfires stoked by those accumulated materials. One thing is certain, according to climate scientists: these unwanted conditions and events are presently increasing in number and likely will continue to do so in the decades ahead.

The huge firestorms as described above also produce huge amounts of additional GHG, and, as also described above, these are rapidly becoming more common. Thus, climate change is not just bad (on many fronts), it is accelerating, and time is running out. We MUST make much progress in mitigating climate change in the next 25-years or many of the world's people will suffer really bad consequences.

3. Book Review

Note that the words in the prior section were not drawn from "The Decarbonization Imperative," but were my words or drawn from other (referenced) sources. The authors of the book being reviewed[2] made a reasonable case for the need to strongly mitigate climate change by 2050, but I felt I could make a better one.

However, given the 2050 target-date, "The Decarbonization Imperative' described the primary (emitting) sectors of our economy that we should focus on (below), and the methods we should use to disrupt their current "business as usual" mind-set. Most of the remainder of this book examined each sector in detail and describe the proposed methods to reduce, offset and potentially eliminate their GHG emissions.

Annual Global Greenhouse Gas Emissions by Sector

Electricity and Heat Production	25%
Agriculture Forestry and Other Land Use	24%
Industrials	21%
Transportation	14%
Other Energy	10%
Buildings	6%

Source: IPCC Contribution of Working Group II to the Fifth Assessment Report

In order to give you a feel for this book, I decided to give a brief excerpt of text from the book. This excerpt is a paragraph from the beginning of an early section in Chapter 2 "The Energy Sector." Note that, not only is this book extremely information-dense, all significant information is extensively referenced, so I've included the references below the excerpt.

[2] Michael Lenox and Rebecca Duff, "The Decarbonization Imperative," Stanford University Press, ©2021 by the Board of Trustees of the Leland Stanford Junior University, https://www.amazon.com/Decarbonization-Imperative-Transforming-Global-Economy/dp/1503614786

HYDRO AND NUCLEAR

THE ORIGINAL DECARBONIZED ENERGY

The story for decarbonized sources of energy is equally mixed. Hydroelectricity was arguably the original renewable energy source. Using water to power machinery dates back thousands of years to the Greeks, who used it to grind flour. Hydroelectricity emerged in the late 1800s just as electricity was becoming recognized as a major power source. The Edward Dean Adams Power Plant of Niagara Falls, N.Y.(3,700 kW), owned by the Niagara Falls Power Company, was the first large-scale generating plant in the world, built in 1895. Its earliest facility was called Niagara Power Station No. 1.[5] In 1933, President Franklin D. Roosevelt's New Deal ushered in the so-called "big dam period" in the US, exemplified by the Hoover Dam.[6] By 1940, 40 percent of the nation's electricity was being generated by hydropower.[7] A similar story unfolded globally as other countries invested in large hydropower projects. The largest such project was the Three Gorges Dam, built in the Hubei Province of China. Completed in 2012, the dam is the world's largest power station, with an installed capacity of 22,500 megawatts.[8] Hydropower represents about 17 percent of China's electricity generation.[9]

References:

5. Bureau of Reclamation, Hydropower Program, US Department if the Interior, updated February 3, 2016, https://www.usbr.gov/power/edu/history.html

6. "Discover Hydropower;' National Hydropower Association, accessed December 2017, https://www.hydro.org/waterpower/hydropower/

7. Office of Energy Efficiency & Renewable Energy, "Hydropower Technology Development; US Department of Energy, accessed December 2017, https://energy.gov/eere/water/hydropower-technology-development

8. This is equivalent to powering nearly eighteen million American homes in the Northwest United States. "Megawatt;' Northwest Power and Conversation Council, accessed March 2, 2020, https://www.nwcouncil.org/history/Megawatt

9. "Country Profile: China" (from the 2020 Hydropower Status Report), International Hydropower Association, https://www.hydropower.org/country-profiles/china