DOLLARS TO DOUGHNUTS

IMAGINING A SUSTAINABLE FUTURE

Lloyd R. Prentice

Praise

Dollars to Donuts is a thorough, objective assessment of the earth's sustainability crisis. But more importantly, it outlines a host of actions we, as individuals, communities and governments should embark upon to try to bend the needle towards a sustainable future. It's a great read, not too technical and not superficial and should be in anyone's library who seeks a better, sustainable world.

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Imagining a Sustainable Future

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ISBN 978-0-9825892-8-1

BISEC

NAT011000 NATURE Environmental Conservation & Protection
SCI092000 SCIENCE Global Warming & Climate Change

To my grandchildren, Brooke and Lily

And to Professor Kate Raworth with gratitude
for her inspiring work

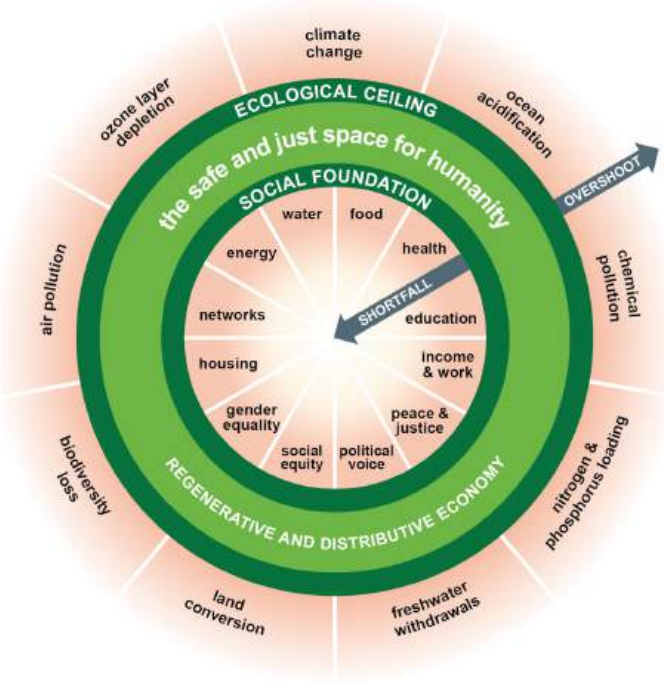

Figure 0.1: Doughnut Economics

Acronyms

FAO	United Nations Food and Agriculture Organization
GDP	Gross Domestic Product
GGH	Gross Global Habitability
GGR	Gross Global Resources
GHW	Gross Human Welfare
GNH	Gross National Happiness
GNP	Gross National Product
IEA	International Energy Agency
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
kWh	Kilowatt Hour
MIT	Massachusetts Institute of Technology
NATO	North Atlantic Treaty Organization
SEEA CF	System of Environmental Economic Accounting Central Framework
SEEA EA	System of Environmental Economic Accounting Ecosystem Accounting
TFR	Total Fertility Rate
UN	United Nations
UNESCO	United Nations Educational, Scientific, and Cultural Organization
US	United States of America
USD	United States Dollar
WBG	The World Bank Group
WDB	Multilateral Development Banks
WHO	World Health Organization

Contents

Introduction

This book is about agency— our power to act. Or not.

Imagine… you've hiked up treacherous trails over arduous mountain passes to a remote wilderness cabin. First night— winds howl. Cabin shakes. Then, dead silence. You awake to find the water pump frozen. You open the cabin door to a solid wall of icy white. You have firewood. Can melt snow. You light a fire in the massive stone fireplace but the chimney is blocked with hard-packed snow. Pine-scented smoke pollutes the cold cabin air. You cough, shiver. Fire burns low. Temperature drops. Not a soul within 30 miles to dig you out. What to do?

What would you do?

Or… your interstellar spacecraft is off course. Life-support systems flashing red. Navigation systems beyond repair. Your crew is rebellious— one faction storms the weapons lockers. Others look to you to bring the ship under control. What to do?

What would you do?

Or… think back. Remember that iconic Apollo 8 photo of our fragile spaceship Earth rising over the moon's horizon?

We know now that the life-support systems of our beautiful planet are flashing red. Temperature rising. Wars raging. What to do?

Temperature rising?

Oh, you know the story. Greenhouse gases accumulate in the atmosphere and trap solar heat reflected off the surface of the Earth— greenhouse effect.

Figure 0.3: Earthrise
Credit: NASA

Greenhouse effect?

If you've ever opened the door of a car parked long in hot sun with windows rolled up, you know most of what you need to know about greenhouse effect.

Globally, 2024 was the warmest year on record.

Since the 1850s global average temperature has risen at least 1.28 °C (2.3 °F).[1]

The Arctic's northern Barents Sea is a hot spot, heating up seven times faster than lower latitudes, with unknown consequences for the Barents Sea ecosystem.[2] Over the past quarter of a century, temperatures across the Arctic as a whole have risen four times faster than lower latitudes.[3]

Why?

Ice reflects more solar energy than land or open ocean. As sea ice melts, it exposes darker areas of land and water. These areas retain more solar energy and heat up more than reflective ice.

The geopolitical and climate implications of rising temperatures across the Arctic are significant. Open sea lanes and exposed land masses invite fossil fuel and mineral exploration and extraction. Russia, China, and NATO members Canada, Denmark, Finland, Iceland, Norway, Sweden, and the United States of America (US) contend for sovereignty and rights.[4]

Melting permafrost due to higher temperatures in the Arctic threatens infrastructure such as roads, railways, pipelines, and buildings supporting entire communities.[5] And more, melting permafrost releases greenhouse gases

into the atmosphere. It may also release viruses and other dangerous pathogens.[6]

Oregon State University ecosystem scientist William J. Ripple and colleagues tell us that despite decades of warnings by climate scientists, extreme climatic conditions are now in uncharted territory. Escalating global temperatures caused by human activities have placed life on Earth under siege. And more, they say that "…time is up."[7]

And wars—

As I write, wars are raging around the globe. Ukraine. Gaza. Sudan. Myanmar. Elsewhere, tensions are high. Taiwan encircled by Chinese military forces. Vladimir Putin and Kim Jong Un threatening to launch nuclear weapons.

The 2024 Global Peace Index reports that 92 countries were involved in 56 international conflicts, the most since World War II:

> The rising number of minor conflicts increases the likelihood of more major conflicts in the future.[8]

By my reading of history, wars rate among the most deplorable manifestations of human behavior. Yet they persist. Pick a century, name a year, and it's likely that somewhere on Earth war was reaping human lives.[9]

Why?

I do understand that many profit from war and not a few seem to enjoy it. And certainly when a people are attacked by aggressive actors they have little choice but to defend themselves. Climate change is also a factor.

Human rights advocates report that drought, flooding, and extreme weather have driven conflict around the world and, at the same time…

> …warfare has devastated ecosystems, imperiled access to vital resources and left behind toxic legacies that sicken civilian populations.[10]

Violent conflict over land and other resources dates back at least 10 millennia.[11] Yet devastating wars persist with little indication that they will be footnotes of history any time soon. For eight decades now we've lived under threat of nuclear annihilation.

The study of global warming extends back two centuries.

In 1824, French mathematician Joseph Fourier hypothesized that gases in the atmosphere must trap heat.[12]

In 1856, Eunice Foote, a scientist and women's rights campaigner from Seneca Falls, New York, confirmed the link between CO_2 and global warming with a simple backyard experiment involving four thermometers, two glass cylinders, and an air pump. She filled one cylinder with CO_2 and water vapor; the other with ordinary air. When she measured the gases in both sunlight and shade, she found that CO_2 and water vapor absorbed more heat than ordinary air. She concluded that more CO_2 in the atmosphere could warm the planet.[13]

A male colleague read her paper to scientific peers during the the 1856 meeting of the American Association for the Advancement of Science. Women weren't allowed. Her findings were met with indifference by the scientific community.

In 1896, the Swedish physicist Svante Arrhenius concluded that "every time the CO_2 concentration in the atmosphere doubles, Earth's temperature will rise between 2 and 5 degrees Celsius (3.6 and 9 degrees Fahrenheit)."[14]

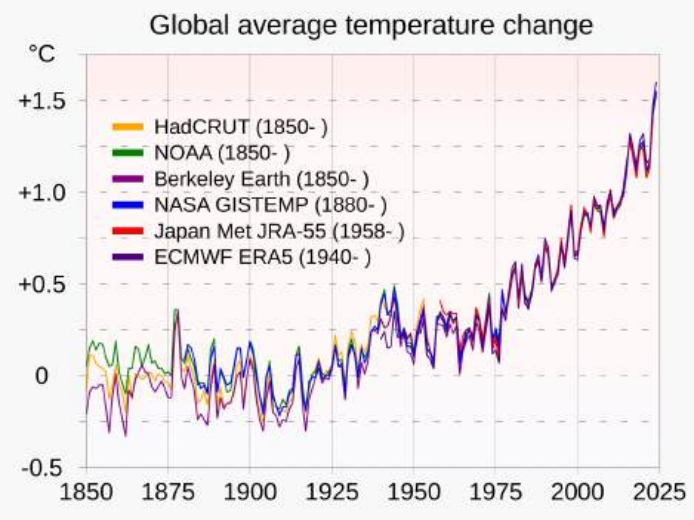

Figure 0.5: Correlation of measured global average temperature, from several different scientific organizations

Credit: RCraig09, CC BY-SA 4.0, via Wikimedia Commons[15]

We know now that rising temperatures around the globe are an existential issue for humanity. Environmental economist Giacomo Falchetta and colleagues estimate that the number of people worldwide at risk of chronic extreme heat

exposure will likely double or more by 2050 due to global warming.[16] Indeed, global warming stresses nearly every ecosystem on earth. We know the causes and how to bring them under control. Yet powerful economic interests and political elites choose cynical denial and obstruction over decisive action.

A 1968 report prepared by Stanford Research Institute scientists E. Robinson and R.C. Robbins for the American Petroleum Institute warned that rising CO_2 levels in the atmosphere could lead to serious environmental damage worldwide.[17]

In 1977 Marathon Oil reported that global temperature rise linked to "industrial expansion" could one day cause "widespread starvation and other social and economic calamities."[18]

That same year scientists at ExxonMobil submitted reports to management that fossil fuels contributed to global warming.[19]

What did Exxon management do? Denied. Authorized millions of dollars to pervert public opinion and delay action. From 1998 through 2019, ExxonMobile spent more than $37 million USD to cast doubt on global warming.[20]

The fossil fuel industry — oil, gas, coal — piled on. A three-year investigation by the Democratic staff of the US House Committee on Oversight and Accountability confirmed that fossil fuel companies have known that fossil fuels contribute to climate change since the 1960s. But they chose to deny—orchestrated a decades-long campaign to deceive the public and investors.[21]

The Institute for Policy Studies, in collaboration with the Climate Accountability Institute, analyzed tax returns of charities promoting climate disinformation and denial and the private foundations and donor-advised funds that support them. They found that 137 climate disinformation organizations received charitable donations from 2020 to 2022. Based on their findings, the researchers estimate that the total amount spent on climate disinformation likely exceeds "$219 million into the billions of dollars."[22]

In 2015, in response to the growing urgency of climate impacts, nearly every country in the world signed onto the Paris Agreement, a landmark international treaty under which 195 nations pledged to hold the Earth's temperature to "well below 2° Celsius above pre-industrial levels," and, going further, aim to "limit the temperature increase to 1.5° Celsius above pre-industrial levels."[23]

Oh, did I mention? BBC reported in February 2024 that "For the first time, global warming has exceeded 1.5°C across an entire year, according to the EU's climate service."[24]

What to do?

What can we do?

This book is not about climate change, nor war. It's about imagining a sustainable post-climate-crisis future. But climate change, environmental assault, and war provide context. It's taken our kind three centuries to stumble into impending planetary catastrophe. When and how did we go wrong? Without understanding missteps it's near hopeless to imagine a sustainable, just, and life-affirming future.

The jury is out, but hopeful signs nudge optimism that humanity will curtail greenhouse gas emissions before all terrestrial life on Earth dies of heat death.

— Independent energy think tank Ember reports that wind and solar are the "fastest-growing electricity sources in history."[25]

— Over the decade from 2009 to 2019 the price of electricity from solar declined by 89 percent.[26]

— Battery costs plunged from $1,200 USD per kilowatt hour (kWh) in 2015 to $150 USD per kWh in 2023 and, by one estimate, are likely to continue their downward trajectory toward $32 to $54 USD per kWh by 2030.[27]

Ending war is an iffier matter. ICAN, the International Campaign to Abolish Nuclear Weapons, reports that "...in 2023, the nuclear-armed states spent $91,393,404,739 USD on their arsenals — equivalent to $2,898 USD a second," up 13 percent over the previous year.[28]

The Bulletin of Atomic Scientists' Doomsday Clock as of April 2025 is 89 seconds to midnight— "...a moment of historic danger."[29]

What can we do?

Kate Raworth's *Doughnut Economics: Seven Ways to Think Like a 21st-Century Economist* provides a powerful thematic metaphor to guide our thinking about sustainability. Her book diagrams the safe and just space for humanity as a doughnut. The doughnut vividly illustrates the boundaries between the outer ecological ceiling of resource availability and the inner social foundation of basic human needs.[30]

For humanity to thrive in a resource-constrained world, Raworth tells us, we must fundamentally revise economic assumptions and practices. We must move away from today's economic-growth-at-all-cost drivers of natural resource extraction, transformation, consumption, and waste toward circular energy and material flows that function within the reproductive capacity of nature.

Kate Raworth's book is consciousness-altering— an operating system for

navigating spaceship Earth.

Inspired by Professor Raworth's brilliant metaphor, this book asks, "How can we best traverse the thorny maze from here-and-now to sustainability?" It's a reflective meditation on the opportunities and the challenges— what will it take to assure well-being and abundance for our children and all who follow in a natural resource-constrained world? This book is about limits and opportunities. Culture and economics. Governance and the power of individuals to influence change.

Sustainability... habitability of Earth... the welfare of future generations is in our hands. But what to do?

What can we do?

Deny? Delay? Party on? Let the tree huggers worry? Trust in higher powers?

Or, roll up our sleeves and do what we can?

My take? There's only one answer. We must act.

As individuals we have little agency in the face of global issues. We can, however, acquaint ourselves with the facts and consider contending ideas, points of view, and alternative courses of action. We can advocate. Agitate. Innovate. The clock is ticking. We must do all we can.

The goal of this book is to stimulate thought, research, discussion, and, dare I hope, constructive action. The path to sustainability is the work of millions. Here I pose questions that may help illuminate that path— naive, aggravating, but essential questions.

Climate science and sustainability research are fast-evolving topics. By the time you read this, many details will be yesterday's news. I'm not a climate scientist, policy specialist, nor expert in any topic covered. But, as an editor advised me long ago, "You can become expert on any topic by asking the right questions and doggedly tracking down answers from the real experts in the field."

Think of me as a doggedly curious writer and grandfather with deep concerns about the future and well-being of my children and grandchildren— and yours.

Two pressing questions inspire this book:

1. What kind of world do we want for our children and theirs?
2. How must we manage affairs on spaceship Earth to achieve it?

This book is about urgency. If we don't act— what then?

Part I

The Challenge

The best way to predict the future is to create it.

Peter Drucker 1991

1

Population

June 29, 2024

Yow!

I'm sitting here watching numbers flip by. Going up and up.

Current World Population

https://www.worldometers.info/world-population/

World population now 8,118,759,299. Oops! 8,118,760,320, no, no... up, up as I watch, fast approaching 8,119,000,000 and on up. Check it out. No doubt the number will be higher when you do. Within the last six months world population up more than the total population of Saudi Arabia. Thirty six million more mouths to feed within just six months; 36 million more young brothers and sisters of the world with lives before them; hopes and dreams to fulfill.

World population has quadrupled within my lifetime.[31]

Now more than 8.1 billion people with so much in common— shared need for air, water, food, shelter, and community. But in our ability to meet basic needs we couldn't be more diverse.

The richest one percent of the world's adult population owns almost half of total global wealth.[33] Some 3,028 individuals are collectively worth $16.1 trillion USD, says *Forbes* magazine.[34] This is more than $5.3 billion each, with no practical limit to opportunity, appetite, or ability to satisfy wants.

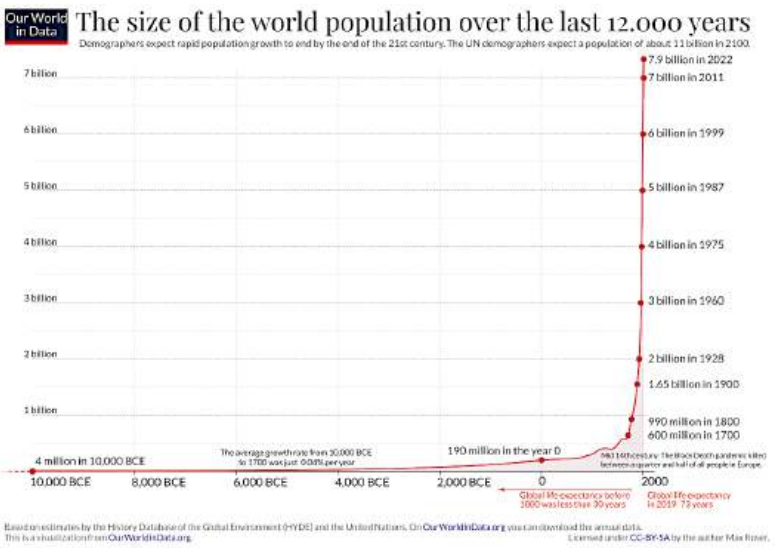

Figure 1.1: The size of the world population over the last 12,000 years
Credit: Max Roser - Our World in Data[32]

Yet, one in 11 human beings globally is afflicted by hunger according to a 2024 UN report.[35] More than 10 percent of people on Earth struggle to secure the most basic life-sustaining needs.

In 2024 the World Health Organization (WHO) estimated that 149 million children are too short for their age, 45 million suffer low weight, and 37 million are overweight, many due to poor nutrition.[36]

And shelter...

According to the United Nations' (UN) urban development agency, some 40 percent of the global population lacks adequate housing, secure land, and basic water and sanitation services. Some 300 million are homeless— "...lacking any form of stable shelter."[37]

In my country, the United States of America, with by far the largest Gross Domestic Product (GDP) in the world, 771,480 people experienced homelessness on a single night in 2024, including nearly 150,000 children.[38]

Unhoused populations are at increased risk of death due to disease, as well as other serious health issues.[39] As global temperatures rise, the unhoused are also the most vulnerable to heat-related illness and death. A study by Boston University public health researcher Zihan Lin and colleagues found that

between the years 2015 and 2022, 8,648 deaths occurred among people experiencing homelessness in Los Angeles County, California— approximately three per day.[40] During a blistering heat dome that descended over California's Los Angeles County in August 2023, nearly half of deaths from heat illness or heat exposure were among the unhoused population.[41]

Just this week, as I write, the US Supreme Court ruled that cities can enforce bans on homeless people sleeping outside in public places.[42]

Across the country, more than 770,000 people are in shelters or on the street. They're forbidden to sleep on sidewalks or in public parks. Hassled. Assaulted. Arrested. Where can they go? Some politicians and pundits are advocating internment camps for homeless people.[43]

In the US, natural disasters, the cost of housing, and more people seeking asylum have driven up the homeless population in recent years.

In some countries the cause of homelessness is far more dire. More than 6.5 million Ukrainians have been driven out of their country and another 3.7 million internally displaced by Russian missiles, bombs, and on-the-ground military aggression.[44] Nearly 2 million Palestinians have been displaced in Gaza by the Israeli/Palestinian conflict.[45]

Sudan has the largest internally displaced population in the world— 11 million people.[46]

Al Jazeera reports that, post-coup, the Myanmar junta has driven at least 3 million out of their homes (not to mention killing more than 5,000 civilians and taking more than 20,000 political prisoners.)[47]

As conflicts in Ukraine, Gaza, Sudan, and Myanmar rage on, yet more are at risk of homelessness.

People are also driven from their homes by climate-driven sea level rise, floods, and drought. The World Bank projects that by 2050 as many as 216 million people in the world could be forced to move within their own countries due to slow-onset climate change impacts.[48]

Is the Earth now so resource poor that it can't provide sufficient nutrition nor shelter for all of humanity?

As to nutrition, the food is there. But current political, economic, and wealth inequalities make its equitable distribution "...debatable."[49]

As to shelter, it's a "...serious concern."[50]

The need for food and shelter, of course, is driven by population.

Total Fertility Rate (TFR) of a population is the average number of children born to a woman over her lifetime. *The Lancet* tells us that global TFR fell from 4.84 to 2.23 over the period from 1950 to 2021.[51] TFR above 2.1 leads to an increase in population size. When TFR is less than 2.1, population declines. The authors project that fertility rates will decline to 1.83 by 2050 and 1.59 by 2100.

Birthrate, that is, the number of live births per 1,000 people, is another measure of population growth or decline. Birthrates vary widely by country. African countries such as Angola, Niger, Mali, Chad, and Uganda have more than 40 live births per 1,000 people; the US has 11; many European and Asian countries have fewer than 10.[52]

Population dynamics suggest that humanity is between a rock and a hard place. Population stresses global ecosystems; declining populations provide fewer young people to support the elderly, which, in turn, creates social and economic stress.

Not all population forecasts foresee decline of total fertility rate. The website *database.earth* estimates that within one generation world population will exceed 9.4 billion— more than 10 billion within two generations.[53]

What then?