Chapter 9
Delusions of Control

> As far as we can tell, from a purely scientific viewpoint, human life has absolutely no meaning. Humans are the outcome of blind evolutionary processes that operate without goal or purpose. Our actions are not part of some divine cosmic plan, and if planet Earth were to blow up tomorrow morning, the universe would probably keep going about is business as usual. As far as we can tell at this point, human subjectivity would not be missed. Hence *any* meaning that people ascribe to their lives is just a delusion.[1]—Noah Yuval Harari (2015)

Armed with data of Chaps. 2, 4, and 7, the energy narratives of Chap. 3, the systems thinking of Chap. 5, the economic modeling background of Chap. 6, and Chap. 8's concept of the economy as a superorganism, this chapter now describes several high-level economic narratives that vie to explain why Western economies are or are not sufficiently solving current economic problems. We might hear that consumers lack confidence, politicians lack "political will," workers and unions have too little "bargaining power," or there is not enough finance. Maybe you've heard that we've already decoupled economic growth from material consumption, thus providing evidence that not only can we run an economy that works for both humans and the rest of the environment, we have been doing so for the last several decades. Perhaps you've read we are simply misled by advertising, lobbying, and public relations campaigns, and if we only had "real" information, we'd make better decisions.

In today's world of enhanced lobbying activity and economic mathematics, many view policy as being made via one of two concepts. The first is that companies and business organizations battle for influence of politicians using political contributions, lobbyists, and public relations campaigns. Often the lobbyists actually draft the bills that lead to legislation. Narratives can go directly to legislation, but most people don't have the money or political access to influence policy in this way. The second is that think tanks, bureaucrats, and academics use their economic models to calculate the option with highest benefits and lowest costs. Cost–benefit calculations

[1] Harari [1, p. 391].

C. W. King, *The Economic Superorganism*,
https://doi.org/10.1007/978-3-030-50295-9_9

were enabled when we created the concept that there is a thing called "the economy" that can be modeled. The vast majority of people don't have a mathematical model of "the economy," and thus they can't influence the cost–benefit game.

The two policy frameworks, lobbyist influence and mathematical cost–benefit analysis, have some merit, but they are usually invoked independently of the physical flow of energy and other natural resources. They too often neglect the control of energy as perhaps the most important and fundamental driver of social and economic phenomena. Thus, they mislead us as to the level of control we have over economic activity. In this sense they are *delusions of control*.

To effectively think about possible energy and economic futures, we must put historical political events in the context of where citizens and workers reside within the networks of energy and economic systems. In this way we see a much clearer physical explanation for economic growth (size) and distribution (structure).

As discussed in Chap. 6, many analysts and pundits don't realize how much their methods assume energy is unimportant for explaining economic growth and organization. Thus, a common flaw in those views is as Timothy Mitchell states, "Innovations in methods of calculation, the use of money, the measurement of transactions and the compiling of national statistics made it possible to imagine the central object [the economy] of politics as an object that could increase in size without any form of ultimate material constraint."[2] If our policymakers assume there is no ultimate material constraint, then they will misdiagnose economic problems, and we might elect leaders with a misguided view of what, why, and how easily the economy's size and structure can change. As this chapter explains, there is a linkage between physical power and political power. However, this is not part of the usual frameworks for the derivation of policy.

Before we dive into social movements, lobbying, and marketing, a little philosophy sets the stage for understanding some limits to our freedom of choice. We can choose to pursue many activities, but we can't successfully act out every idea we can imagine.

Degrees of Freedom to Choose

> The coming century, I think, will be dominated by major social, political turmoil. And it will result primarily because people are doing what they think they should do, but do not realize that what they're doing are causing these problems. So, I think the hope for this coming century is to develop a sufficiently large percentage of the population that have true insight into the nature of the complex systems within which they live.[3]—Jay Forrester (2013)

[2] Mitchell [2, p. 143].

[3] In a conversation with Anupam Saraph as attributed at the following website (https://metasd.com/tag/forrester/) as being recorded in this video clip: https://metasd.com/2013/06/jay-forrester-on-hope-for-the-coming-century/ (both accessed August 2019).

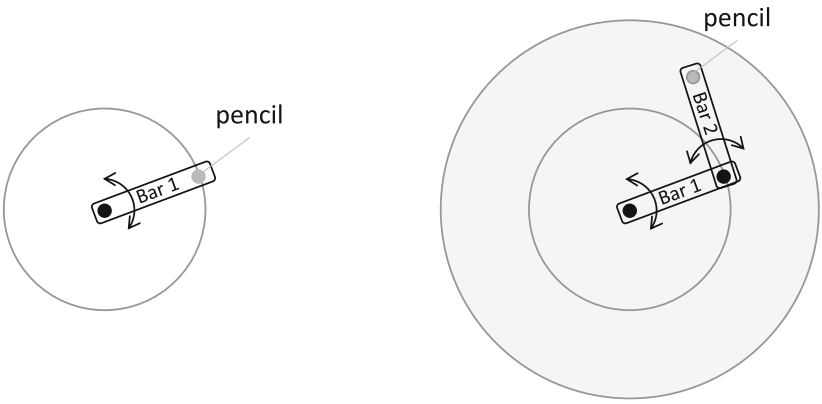

Fig. 9.1 A bar with one degree of freedom can only draw a circle, but two bars with two degrees of freedom can fill in a circle

Educated as an engineer, I was excited to hear philosopher Daniel Dennett describe human consciousness and free will in the context of *degrees of freedom*, such as exists within engineered devices. To understand the concept of degrees of freedom, imagine a bar that can rotate about one of its ends (Fig. 9.1). This is like using a wrench to tighten a nut. Also imagine the non-fixed end of the bar has a pencil which marks on the table upon which the bar resides. This bar can only do one thing, rotate. Thus, the pencil can only draw a circle with radius equal to that of the length of the bar. This device has only one degree of freedom because we can specify the position of the pencil only using one coordinate: the angle of the bar.

Now attach a second bar to the free end of the first bar, and put the pencil at the free end of this second bar. This second bar can rotate about the non-fixed end of the first bar. Now, to describe the position of the pencil I need two coordinates, the angles of both bars, and thus this 2-bar system has two degrees of freedom. Instead of only being able to draw a circle on the table, this 2-bar design can fill in the entire area within a circle. The one and two bar system is easy to imagine by thinking of your arm. Your upper arm bone, the humerus, is like the first bar, and your lower arm bones, the radius and ulna, act like the second bar.

Now transition from the idea of describing a system with two degrees of freedom to more complex interacting systems. The global economy is composed of billions of individual people and billions of individual machines (cars, planes, computers, etc.) each with some number of degrees of freedom ranging from one to several trillions (i.e., individual bits stored on a hard drive or memory stick).

As introduced in Chap. 5, a system cannot understand itself. This is because it cannot describe each and every internal degree of freedom. The total number of degrees of freedom of all people and machines is too large to know, and this opens up

the space for multiple competing narratives. The narratives compete by explaining patterns we observe in data describing the natural world, including our economy.

We cannot unequivocally determine why history has proceeded in the way it has just as we cannot determine the course of future events. Likewise, we can't fully describe the present, and thus don't have this description as a starting point to simulate the future. This lack of information does not prevent philosophers from debating if the future could, in principle, be known to some entity that somehow did know the entire state of the universe.

Determinism is the idea that the current state of the world—really of the universe—determines its future. That is to say, if we precisely knew the velocity and position of every fundamental particle in the universe (or every degree of freedom of particles), and if we knew all of the laws of physics, then we could predict what would happen next. You don't need to know the past for this prediction. You just need to know the present. At this fundamental level there is no difference between the past and future. For the two-bar problem, if I flicked the two bars into a spinning motion, then using the laws of physics I can determine how they would spin forever. I could simulate backward or forward in time.

However, in a practical sense, because we don't know the exact position and velocity of the bars when I set them in motion, and we don't know all the laws of physics, we can only accurately approximate their position and velocity for a limited time into the future. Even for simulating systems in which we assume we "know" all of the physical laws, the science of nonlinear dynamics and chaos informs us that very minute changes in initial conditions, or how the world is now, can translate to wildly different future outcomes. This sensitivity to initial conditions is often called the *butterfly effect*. Edward Lorenz, the father of chaos theory, gave a talk in which he posed the question of whether a butterfly flapping its wings in Brazil might set off a tornado in Texas [3].

> . . . if a single flap [of a butterfly's wing] could lead to a tornado that would not otherwise have formed, it could equally well prevent a tornado that would otherwise have formed. . . . a single flap would have no more effect on the weather than any flap of any other butterfly's wings, not to mention the activities of other species, including our own.[4]—Edward Lorenz (1993)

Many times people use the term "butterfly effect" to say how small deviations *can* lead to large changes later. But as Lorenz cautioned, this concept *does not mean that we can equivocally determine* that the wing flap of a butterfly was indeed *the cause* of some future event, such as a tornado. Part of the reason is that we cannot precisely measure the exact position and velocity of every butterfly, air molecule, etc., in the world. Because we can't precisely measure all of these things, we do not know exactly the state of the world before a tornado forms. And because a slightly different state of the world in the past ends up with no tornado, we cannot say if the butterfly did indeed cause a tornado. There is simply no way for us to know. Even

[4] [4, pp. 14–15].

if we have all of the laws of physics, we are too ignorant of the past to know how we've arrived at the present. You can extend our ignorance to the time of the Big Bang, 14 billion years ago.

This type of determinism by simulating change via the laws of physics is different than me and my wife freely choosing, or "determining," where to go for dinner. We are both a living collection of particles, with a history, and in that sense are systems with emergent properties with different food preferences. Recall from Chap. 5 that emergent properties are ways of speaking of a large collection of objects, or relations among objects, in a way that is both consistent with the underlying parts, and useful. For each underlying system component, time might not matter, but for the entire system composed of many interacting parts, time does matter, and there is a past. If my wife ate Thai food last night, she's very unlikely to want to eat it again tonight. But if she last ate Thai food 1 month ago, she's much more open to eating it tonight. However, as my wife can tell you, you don't need to know what I ate last night to know if I want Tex-Mex food—I tend to want it independently of the past!

But here is an important point. In terms of choosing what cuisine to eat at any given time, if my wife and I want to survive, there is one choice we cannot continually make: eat no food.

In this sense of systems, causes are emergent explanations for describing the patterns we observe in nature and society. I stay alive as an organized system because I eat food as an intake of energy. Therefore, it is useful to say that eating food causes, or continues, life. On the flip side, we might say of an elderly dying person that they stopped eating, and this was the cause of death. However, we could also say that their body was no longer able to process food, and that is the cause of why they stopped eating. Did the person die because they stopped eating, or did they stop eating because they were dying?

There is not necessarily one right answer. The laws of physics themselves don't define causes, such as how my wife and I agreed on what cuisine to eat [5].[5] However, the second law of thermodynamics does state that if we don't eat some type of food, we will die and our bodies will start the process of decomposition, no longer able to maintain a structure that is unique from the environment.

In the same way, if an economic superorganism is to survive and maintain structure, it can choose among many technologies for extracting energy input from the environment, *but it can't make the choice to use none of them.* The infinite substitutability economic narrative often ignores this simple point by focusing on the increasing number of options (e.g., multiple ways to generate electricity) we have for any given economic need, rather than the fundamental needs of an economic system.

Economist Alfred Eichner summed up this point when discussing how increased material standards of living have been associated with substituting energy resources (via technology) for human physical labor:

[5] Carroll [5, p. 44].

> One could, of course, give up the hope of being able to continually economize on the use of human labor. But that would bring an end to the secular trend of the past 300 years whereby an ever increasing portion of the world's population has been able to count on a steadily improving material standard of living. In other words, a solution that requires substituting human resource, or labor, inputs for the various inanimate sources of energy would be self-defeating in terms of the purpose an economic system is intended to serve. The natural resource constraint must therefore be accepted as a real limit on the rate of economic expansion, one that cannot be overcome through substitution. The question is, just how severe a constraint is the availability of fossil fuels and other natural resources.[6]—Alfred Eichner (1991)

Over time people interact with each other and the environment to invent new technologies and uses of natural resources. This cause and effect relationship on the evolution of our freedom to choose among an increasing number of degrees of freedom, even if in a deterministic world, is precisely what Daniel Dennett states:

> . . . there can be a growth in ability over time in a deterministic world, as well as a widening of opportunities and what is made of them by particular deterministic agents. Such increase in ability over time is utterly invisible to the mind-set that adopts the narrow vision of possibility enshrined in the definition of determinism: "There is at any instant exactly one physically possible future." According to that vision, in a deterministic world, at any time *t*, nothing *can do* anything other than the one thing it is determined at *t* to do, and in an indeterministic world, at any time *t*, a thing *can do* as many different things—at least two—as that brand of indeterminism allows for, presumably a deep and immutable fact of physics that could not be perturbed by changes in practices or knowledge or technology. The obvious fact that people today *can do* more than people used to be able to do disappears from sight if we understand possibility this way, and yet this fact is as important as it is obvious.[7]—Daniel Dennett (2003)

Dennett points out the "obvious" fact that, compared to the past, we humans have learned and invented technologies such that we literally have more choices, or degrees of freedom. In 2019 I could buy a ticket to ride in a jet aircraft flying from Los Angeles to Sydney, Australia. By 1519, Leonardo da Vinci had conceived of flying machines, but there wasn't enough collective knowledge of natural laws and engineering capability to enable flight. Also, many people today can't practically fly across an ocean because they don't have enough money for an airline ticket.

> Collectively, society accumulates technological capability and degrees of freedom; individually, the lack of money limits access to those degrees of freedom.

Higher energy consumption enables more technological and cultural development that in turn enables more physical growth via increasing the degrees of freedom, or number of choices, available to society. Individually we choose among our options, but collectively we still follow certain patterns whether most people realize it or not. Because the economy grows within constraints, it necessarily organizes (e.g., into countries, cities, companies) in the same ways summarized by

[6] Eichner [6, pp. 913–914].

[7] Dennett [7, pp. 295–296].

the emergent scaling laws that relate energy consumption to the sizes of animals, trees, and ant colonies (as discussed in Chap. 5).

More degrees of freedom *for the system* means more configurations and relationships among the elements within the system. Thus, there are more configurations, or options, from which to choose. In addition, more options change *the probability* for any given choice. When we gain a new option, some existing options must become less probable to make room for the new option. For example, we can approximate the probability of installing a certain type of power plant as its observed fraction of all new power plant installations. In 2018, photovoltaic solar panels represented about 14% of the newly installed large-scale power generation capacity in the U.S. (see Fig. 4.19).[8] Twenty years ago, due to high cost, the odds of installing a solar panel were much smaller. One hundred years ago the odds of installing a solar panel were zero—the technology did not yet exist. Because solar panels exist today, the odds are lower for installing other types of power plants, such as one that burns coal.

Consider an even larger historical leap. Imagine the options available around 200,000 years ago when our ancestors first evolved into *Homo sapiens*. There was one mode of travel, walking, but there were many different places to walk for food and shelter. Going back even further in Earth's history we can imagine the number of options for the first organisms that could sense light. Go to the light, or away from the light? Was this a choice, or just a reaction to the environment?

Are politicians, business leaders, and consumers making choices, or like primordial organisms that can only sense light, are we simply reacting to signals from the environment? Perhaps the answer is that both are true. These last questions open up an array of similar questions.

Are our forms of government and economic rules, such as labor laws and taxation, a cause or effect from our ability to extract energy from the environment? Do we humans choose how to construct our economic systems, or do the laws of physics drive our social and civil laws in some direction? Are some economic and political ideologies more consistent with the physical and biological concepts supporting the economy as a superorganism? Perhaps more importantly, should we try to push an economy outside of the regularities and patterns in the historical data, or do we have to accept these patterns as sacrosanct?

To think about these questions, we now dive deeper into concepts, dare I say delusions, that vie to influence political and economic discourse. We first explore consumer choice.

[8]U.S. Department of Energy, Energy Information Administration Form 860 indicates that 4911 MW of photovoltaics were reported installed in 2018 (i.e., have an "operating year" of 2018), and 34,213 MW of total capacity were installed, of all types, in 2018.

The Free Will Delusion: Memes and the Engineering of Consent

If people are convinced a false concept is true, this is all that matters for the short-term objectives of the purveyor of the false concept. Consider the following from Edward Bernays:

> When the public is convinced of the soundness of an idea, it will proceed to action. People translate an idea into action suggested by the idea itself, whether it is ideological, political, or social. They may adopt a philosophy that stresses racial and religious tolerance; they may vote a New Deal into office; or they may organize a consumers' buying strike. But such results do not just happen. In a democracy they can be accomplished principally by the engineering of consent. [8]—Edward Bernays (1947)

The "engineering of consent." A scary phrase if you believe each of us has the independent free will, or agency, to govern our choices. But just how much agency does each of us have? The concept of the economy as a superorganism implies that at a high level each of us are cogs in a global economic machine. But as discussed earlier in this chapter, each of us human cogs must eat to survive. Multitudes of advertisements and diet fads attempt to engineer consent for exactly what we should eat, but ultimately, eat we must.

Edward Bernays was a founding father of public relations. In his quote above he indicates one can convince people of "the soundness of an idea" with intent and design. We don't have to rely on luck or random mutations as with evolution. In Bernays' 1928 book *Propaganda*, he states this more explicitly:

> The conscious and intelligent manipulation of the organized habits and opinions of the masses is an important element in democratic society. Those who manipulate this unseen mechanism of society constitute an invisible government which is the true ruling power of our country.
>
> We are governed, our minds are molded, our tastes formed, our ideas suggested, largely by men we have never heard of. This is a logical result of the way in which our democratic society is organized. Vast numbers of human beings must cooperate in this manner if they are to live together as a smoothly functioning society.
>
> . . . in almost every act of our daily lives, whether in the sphere of politics or business, in our social conduct or our ethical thinking, we are dominated by the relatively small number of persons . . . who understand the mental processes and social patterns of the masses. It is they who pull the wires which control the public mind, who harness old social forces and contrive new ways to bind and guide the world.[9]—Edward Bernays (1928)

Shakespeare told us "All the world's a stage, And all the men and women merely players," each changing roles over the course of their life.[10] In the case of a theatrical performance, there are many actors, but there is only one director. When it comes to democratic society, Bernays tells us that there are a "small number of persons"

[9] *Propaganda*, Chapter 1 [9, pp. 9–10].

[10] William Shakespeare, *As You Like It*.

controlling the marionette that is the collective public mind. And he was a master puppeteer.

Bernays was the nephew of Sigmund Freud, the founding father of the field of psychoanalysis. Inspired by his uncle's ideas, Bernays convinced Americans to consume items they otherwise would not. During the womens' liberation movement in 1929, in what is regarded as the first major public relations campaign, Bernays was hired by the American Tobacco Company. In this campaign he promoted cigarettes to women as "Torches of Freedom."

The American Tobacco Company gave Bernays money. Bernays, thinking he was tapping into the unconscious minds of women, gave women liberation in the form of a phallic cigarette—the penis they are not born with. Maybe women liked to smoke anyway, and Bernays's campaign just helped make it socially acceptable for them. Regardless, smoking women gave the American Tobacco Company a hefty return on its investment in Bernays' campaign. Bernays later regretted taking the cigarette campaign, only after its cancer-causing reality became undeniable.

Before the Torches of Freedom campaign, Bernays worked for the U.S. government to engender support for World War I. Coming out of World War II his ads promoted mass consumption to American citizens that had practiced conservation, saving, and sacrifice for nearly two decades since the start of the Great Depression.[11]

Whether or not Freud's ideas accurately inspired Bernays to public relations success, Bernays knew how to use advertising and social pressure to make people buy stuff. But he wasn't the only one. The top advertising slogan of the past century, as selected by *Advertising Age* (now *AdAge*) magazine, was that of De Beers Consolidated Mines, Ltd.: "A diamond is forever."[12] Before this campaign, in the late 1800s major diamond finds in South Africa triggered the formation of

[11] For a background on Edward Bernays, see the BBC documentary *The Century of the Self, Part 1: Happiness Machines*.

[12] From the De Beers website on January 19, 2020 (https://www.debeersgroup.com/the-group/about-debeers-group/brands/a-diamond-is-forever):

A DIAMOND IS FOREVER How the slogan of the century changed the diamond industry

1930S DIAMOND SALES IN THE U.S. WERE AT AN ALL TIME LOW They were seen as an extravagance for the wealthy, and sales, already declining for more than two decades, had plummeted during the Great Depression.

DE BEERS NEEDED A STRATEGY TO CREATE A MULTI-FACETED DEMAND FOR DIAMONDS In the unique position of having to create demand for a product that hadn't been widely marketed before.

1938 DE BEERS HIRED ADVERTISING AGENCY N.W. AYER TO CRAFT A CAMPAIGN They were chosen for their approach—to conduct extensive research on social attitudes to diamonds.

A NEW FORM OF ADVERTISING WAS BORN The brilliant concept was to create an emotional link to diamonds, the sentiment being love, like diamonds, is eternal.

1947 FRANCES GERETY A copywriter on the De Beers account at the advertising agency N.W. Ayer solidified the link between eternal romance and diamonds by suggesting the line "A diamond is forever."

THESE FOUR ICONIC WORDS HAVE BEEN USED EVER SINCE Making it one of the longest running and successful campaigns in history.

De Beers as "The major investors in the diamond mines realized that they had no alternative but to merge their interests into a single entity that would be powerful enough to control production and perpetuate the illusion of scarcity of diamonds."[13] Diamond scarcity and demand were engineered such that in 2014, 80% of first time U.S. brides received diamond engagement rings.[14]

Chapter 8 equated ideas, or memes, to genes. Just like genes, advertising campaigns and other memes are not necessarily good or bad from any given person's perspective, but they can be used to influence people for good, bad, or seemingly agnostic purposes. Some memes seek to promote human empowerment and achievement. A high school football coach might ask you to give 110% to inspire you to practice and play with more effort than you think is possible, but 110% exists only as a meme in his and your head, not as reality from your body.[15] On any given day, a football player cannot give more than 100% of his capability. Because each of us does not know with certainty the physical effort equal to 100% of our body's capability, the 110% meme can propagate.

The Internet and social networks are meme-propagating super highways. Memes propagate on the Internet via videos and social network tweets on topics ranging from dance crazes and cooking recipes to government overthrow and jihadist propaganda. Memes can also be "to die for" or promote negative outcomes to an "infected" individual. Just like genetic mutations can reduce its host's fitness, so can memes:

> . . . we must consider as a real possibility the hypothesis that the human hosts are, individually or as a group, either oblivious to, or agnostic about, or even positively dead set against some cultural item [meme], which nevertheless is able to exploit its hosts as vectors.[16]—Daniel Dennett (2003)

BY 1951 8/10 BRIDES IN THE UNITED STATES RECEIVED A DIAMOND ENGAGEMENT RING The engagement diamond tradition was established.

AN EMBLEM OF LOVE "A diamond is forever" became a symbol of enduring love weaving itself into popular culture and inspiring books, films, and songs.

1999 SLOGAN OF THE CENTURY It's no wonder Advertising Age voted the De Beers campaign as the top advertising slogan of the past century.

AN ENDURING EMBLEM OF LOVE: FOREVERMARK In 2008 it was brought to the high street by creating a range of beautiful, rare, and responsibly sourced diamonds. Each Forevermark diamond carries its own distinct timeless mark making it unique to the owner.

A DIAMOND IS FOREVER IS THE ULTIMATE GEM OF AN IDEA

[13]Edward Jay Epstein, *The Atlantic*, February 1982 "Have You Ever Tried to Sell a Diamond? An unruly market may undo the work of a giant cartel and of an inspired, decades-long ad campaign," available 1/19/2020 at https://www.theatlantic.com/magazine/archive/1982/02/have-you-ever-tried-to-sell-a-diamond/304575/.

[14]Uri Friedman, February 13, 2015, "How an Ad Campaign Invented the Diamond Engagement Ring: In the 1930s, few Americans proposed with the precious stone. Then everything changed." *The Atlantic* at: https://www.theatlantic.com/international/archive/2015/02/how-an-ad-campaign-invented-the-diamond-engagement-ring/385376/.

[15]The prominent basketball coach John Wooden was *Coach Wooden: The 7 Principles That Shaped His Life and Will Change Yours* by Pat Williams and James Denney [p. 57].

[16]Dennett [7, p. 178].

Daniel Dennett reminds us that many people have sacrificed themselves for memes.[17] The pressure to fight and die for Japan and its emperor made it hard for most Japanese pilots to decline the Kamikaze suicide missions of World War II. The 1978 Jonestown (in Guyana) massacre is famous for Jim Jones convincing nearly a thousand followers of his California-based Peoples Temple cult to commit suicide and murder children by ingesting a cyanide-laced fruit drink. And American football players, including professional Pro Bowl tackle Korey Stringer in 2001, have died in practice due to heat exhaustion, trying to give 110%.[18]

A few can engineer the consent of the many. When this consent goes against one's own individual livelihood or survival, the idea drives a person past their body's physical limit. The body crashes.

While memes include religions, diets, doll fads, and high school pride, *the memes of concern for this chapter are those that support or refute the energy and economic narratives (as posed in Chap. 1) and the idea of the economy as a superorganism.*

If public relations masters control consumer choices, and their memes can infect us, then why would we care what people and consumers think? Does it matter how much confidence we have with regard to future consumption of energy, other items, or economic growth in general?

The Confidence Delusion

With enough *confidence*, whether via pure speculation or using some behavioral or economic models, we can always grow the economy. We just need confidence in ourselves, in markets, in human ingenuity and technological change. At least, this is what we are often told.

Economists and pundits pay attention to business and consumer confidence surveys. These surveys gather certain types of information about the state of the economy. But as stated in this book, it is both challenging and important to understand how individual actions are connected and constrained by higher system level feedbacks from both information and physical resource inputs.

[17] "Now, am I saying that a sizable minority of the world's population has had their brain hijacked by parasitic ideas? No, it's worse than that. Most people have. (Laughter) There are a lot of ideas to die for. Freedom, if you're from New Hampshire. (Laughter) Justice. Truth. Communism. Many people have laid down their lives for communism, and many have laid down their lives for capitalism. And many for Catholicism. And many for Islam. These are just a few of the ideas that are to die for. They're infectious." Dangerous memes, TED talk by Daniel Dennett, 2002: https://www.ted.com/talks/dan_dennett_on_dangerous_memes/transcript.

[18] Kevin Allen, August 12, 2018, *USA Today*, "Heatstroke dangers reinforced by investigation into death of college football player." Available April 8, 2019 at: https://www.usatoday.com/story/sports/ncaaf/2018/08/12/heatstroke-maryland-death-practice-korey-stringer-jordan-mcnair/967134002/.

Too many ideas assume that individual actions are independent of these feedbacks. Consider this quote from a book entitled *How the Economy Works: Confidence, Crashes, and Self-Fulfilling Prophecies*:

> The wealth of households depends on what other households believe. Wealth depends on confidence![19]—Roger Farmer (2010)

Farmer also states that confidence can be viewed as a "fundamental" driver of the economy:

> Because there is no unique fundamental labor market equilibrium, there is also no unique fundamental value for the price of a stock. By adding confidence as a separate fundamental, we can retain a theory in which everything is determined by fundamentals, including the value of stock prices. Confidence is an independent driving force of the business cycle.[20]—Roger Farmer (2010)

But just what kind of confidence are we talking about here? How is confidence a "fundamental?"

Somewhere around 99.99999% of scientists are confident that we cannot make a perpetual motion machine, but someone could be confident that he can make one. Company executives sometimes state that they just want "certainty" in knowing market rules and regulations will not change quickly so that they can have confidence in their investment decisions. But what if the regulations state with certainty and clarity that the company must be limited in its size or level of profits? Does that certainty provide confidence in the same way that lower tax rates do?

It is easy to see how some concepts of belief and memory affect business cycles for a few years or maybe a little more than a decade. After all, major business cycles have periods of several decades.[21] Stock price bubbles take several years before they pop.

Nonetheless, I have a hard time thinking that confidence is itself some "independent driving force" of long-term growth trends lasting longer than a couple of decades. Just because we say something is fundamental doesn't make it so. A used-car salesman tries to make us confident that we're making a good choice to buy his car. When I signed the mortgage on my house, I was a bit skeptical of what seemed to me as disingenuous praise from people that kept telling me how good of a deal I was getting. This was because their fees depended upon my signature. I'm not claiming that title offices, realtors, and mortgage lenders don't provide valuable services. I'm just stating that their praise didn't raise my confidence level. But, to be fair to them, I'm an engineer, scientist, and a heterodox economist. I seek flaws and enjoy improving designs, models, and our ways of thinking, so in that sense I tend to question those who seem overly confident.

[19] Farmer [10, pp. 163–164].

[20] Farmer [10, p. 113].

[21] For example, Kondratiev cycles or waves, named after Nikolai Kondratiev, are posed 40–60 year cycles in economic activity.

I am confident in some ideas, however. I'm confident that our extraction of energy from the environment is the most fundamental driver of life and the economy, and that this premise is severely and "confidently" neglected by most economists. That is what this book is about. Perhaps my confidence expressed in this book will become a meme to infect others while also curing them of other infectious memes.

But how do we know what to believe? Should we want confidence or information? What information should we have access to? Donella Meadows states the power of having credible information:

> Missing information flows is one of the most common causes of system malfunction. Adding or restoring information can be a powerful intervention, usually much easier and cheaper than rebuilding physical infrastructure.[22]—Donella Meadows (2008)

An example of acquiring information on the state of the economy is the Consumer Confidence Survey®. It asks individuals questions about business conditions, employment conditions, and family income today and six months out to calculate a set of indexes.[23] This survey specifically concerns *consumer confidence*, so asking these questions of consumers can justifiably inform immediate investment decisions for businesses. But are these the right questions to ask? Sure, for some purposes.

A person's appraisal of their current employment and income situation is a valid piece of information for tracking short-term trends such as jobs, income, and consumer spending on energy, computers, and vacations. After all, if at any level we want the economy's purpose to focus on the human condition rather act as an indifferent superorganism, we should know how people perceive it. Individuals know their employment and income status as well as the status of several friends and family members. These types of measurements are easy to make, not only for individuals, but also for companies and governments that track mathematical quantities such as GDP (even though we change the definition of what transactions are included in GDP), stock prices, and market prices of commodities like oil. However, just because some items are easy to measure and quantify doesn't mean that those measurements are what we need, and it doesn't mean that they represent what we think they represent or want them to represent.

Donella Meadows, again, has a good statement on this:

> We try to measure what we value. We come to value what we measure. This feedback process is common, inevitable, useful, and full of pitfalls.[12]—Donella Meadows (1998)

Employment and anticipated near-term purchases aren't so important for assessing the confidence people have in longer-term aspects of their lives that don't involve

[22] Meadows [11, p. 157].

[23] The indexes are based on responses to five questions in the survey: Consumer Confidence Index: 1. Respondents' appraisal of current business conditions. 2. Respondents' appraisal of current employment conditions. 3. Respondents' expectations regarding business conditions six months hence. 4. Respondents' expectations regarding employment conditions six months hence. 5. Respondents' expectations regarding their total family income six months hence. The Conference Board, Consumer Confidence Survey® Technical Note—February 2011, https://www.conference-board.org/pdf_free/press/TechnicalPDF_4134_1298367128.pdf.

acting as a consumer or employee. We think further than 6 months out and about other outcomes. Is short-term confidence a good metric for thinking about long-term policy and observed economic trends? Do consumers, politicians, and business owners know how to put annual and even decadal trends into the context of human history? How do we know that the short-term trends in home prices, or any other economic indicator, are reflecting long-term fundamentals, speculation, or noise? Per Jay Forrester's earlier quote, do we have enough people that "have true insight into the nature of the complex systems within which they live?"

A lack of crucial information and knowledge can prevent us from accurately interpreting a situation. In the case of the 2008 financial crisis, many investors did not have full and correct information on the low quality of mortgage-backed securities. The crisis was triggered by confident belief in the meme that U.S. house prices only go up, never down, such that that investing in mortgages was a safe bet. These beliefs turned out to be very wrong. However, some people knew these beliefs were wrong, and they benefited (financially) by pulling "the wires which control the public mind" (per Bernays) to engineer a sense of confidence that housing prices would keep rising. If a banker were motivated and incentivized to make money by selling packages of low-quality mortgage loans, would he tell a potential buyer to question the level of "confidence" he attributes to what he is selling? Very few bankers did this leading up to the 2008 financial crisis. It was about making money at the moment.

Investors were confident that the ratings agencies properly vetted the securities, if they even thought about it at all. Some bankers issuing securities knew they were bundling low-quality mortgages, but even for some honest bankers, their theory and analysis of historical statistics made them confident that their risk was properly hedged.

One of the problems with considering confidence as a driver of economic growth is that you don't have to be knowledgeable to be confident that you are correct. This ill-placed confidence is known as the Dunning–Kruger Effect, named after the psychologists David Dunning and Justin Kruger. They determined "...people who are incompetent at something are unable to recognize their own incompetence. And not only do they fail to recognize their incompetence, they're also likely to feel confident that they actually are competent."[24]

Some have argued something similar for the use of economic models. Most models can be useful in their proper domain of applicability, but it can be disastrous to rely on them outside of that domain. In 2008, after the beginning of the financial crisis, then Federal Reserve Chairman Alan Greenspan stated "...I discovered a flaw in the model that I perceived is the critical functioning structure that defines

[24]Mark Murphy, University of Michigan, College of Literature, Science, and the Arts, "The Dunning–Kruger Effect Shows Why Some People Think They're Great Even When Their Work Is Terrible": https://lsa.umich.edu/psych/news-events/all-news/faculty-news/the-dunning-kruger-effect-shows-why-some-people-think-they-re-gr.html.

how the world works. I had been going for 40 years with considerable evidence that it was working exceptionally well."[25]

Regardless of whether scientists and economists might be overconfident in their theories and models, some take the perspective that if we understand how any given model is incorrect, it might still be worthwhile to use because it ensures we're all using a common narrative. Thus, even if we know our story of how the economy works is not quite right, but we are knowledgeable in how it is wrong, then at least we're all talking about the same narrative whether on an academic campus or in the cafés of Davos.[26]

So what comes first: confidence or wealth? Can there be wealth derived from confidence that transcends more than a decade, or even more than a century? This book argues a resounding *no*.

Confidence is not specific enough: we can have confidence of future prosperity or stagnation. If we have confidence in stagnation, then the whole economic system breaks down. Nate Hagens summarized this well on a post on the formerly (very) active blog, *The Oildrum*, on why people disagree about the impacts from peak oil extraction:

> It's not about running out of oil, but running out of the perception of growth:
>
> Our debt based capitalist society is based on the ability of everyone to climb the ladder. If it becomes apparent that there is a ceiling, all the rules of the system breakdown. Growth is based on the ability of people to get loans, grow businesses and repay the loans with interest. If there is less and less energy available each year that's one thing—it might just show up as recession/belt-tightening. However, if peoples PERCEPTION is that less and less energy will be available then why would banks give out loans, why would people go to work, etc.?[27]—Nathan Hagens (2007)

It is first wealth, or lack thereof, that creates confidence in interpreting the status of the economy. Wealth derives from extracting energy and natural resources. Differences in the confidence between individuals or groups of people are derived from their historical experience and the times during which they grow from childhood to maturity. Those growing up in times of increasing energy consumption might see things differently than those growing up in times of stagnation.

The U.S. Baby Boom generation is stereotypically more confident that if you work hard and make good decisions, you will earn a good wage and achieve material wealth, the "American Dream." The Millennial generation is stereotypically more confident that if they make the same choices at the same stage in life as the Baby Boomers, they will not gain the material and monetary wealth of the Baby Boomers. To many of the Millennial generation, the American Dream is alive and well, but only in their dreams.

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[25] Andrew Clark and Jill Treanor, "Greenspan—I was wrong about the economy. Sort of," *The Guardian*, October 24, 2008 at https://www.theguardian.com/business/2008/oct/24/economics-creditcrunch-federal-reserve-greenspan.

[26] Davos is a town in Switzerland where the World Economic Forum gathers the world's business and banking elite each Winter to discuss world economic affairs.

[27] http://www.theoildrum.com/node/2367.

A short and poignant example of the contrast between American generations is the 2019 Saturday Night Live comedic skit of a game show entitled "Millennial Millions."[28] In this skit, two Millennials have the chance to win cash, health insurance, or debt relief. All they have to do is listen to a Baby Boomer complain about their life for thirty seconds, without interrupting. As the game show host indicates (sarcastically), "It sounds easy, but I know how you Millennials love anything that challenges your worldview." Even for hundreds of thousands of dollars, the Millennial contestants can't stay quiet during the Boomer rants. In response, the game show host only replies: "I'm Gen X. I just sit on the sidelines and watch the world burn."

As far as my own self-reflection regarding the writing of this book, my assessment is this: I am an academic Generation X-er writing a book, not running a business, not appreciably engaged in politics at the moment. I'll have to admit that the reader might see me as sitting on the sidelines making commentary, just like the Saturday Night Live game show host of "Millennial Millions." A common caricature of academics is that we hang out next to ivory towers on campus, disconnected from the "real" world. My office literally resides in the building next to the ivory tower at the University of Texas at Austin. I see it from my office window.

That said, I'm writing this book because I believe it provides societal value by explaining why natural resource and energy consumption are often underappreciated or neglected factors for explaining our contemporary economic situation. Energy consumption and the feedbacks from finite Earth effects help explain why Baby Boomers can't see eye-to-eye with the Millennials. Baby Boomers are confident that their accumulation of monetary wealth can be used to maintain their wealth via lower taxes or at least the maintenance of a relatively low tax regime. Millennials are confident that the same principle prevents them from achieving what the Boomers have. This interpretation is entirely consistent with the idea that young voters increasingly seek more drastic, rather than incremental, changes to tax policies and functions of the federal government.

Much of this change can occur by electing representatives with viewpoints more in tune with the struggles of the younger generation. So what about the representatives that we, of different generations, elect to make collective decisions for our economy and communities? Do politicians need a particular kind of confidence, and from where do they get it? Do politicians, and the judges who determine the validity of our laws, have any more free will than citizens and consumers? To answer these questions, we now shift to a discussion of political will.

[28] Saturday Night Live, January 19, 2019, Millennial Millions skit: https://www.nbc.com/saturday-night-live/video/millennial-millions/3867395.

The Political Will Delusion

Political Will Perhaps you've heard this term used or read it in a news article. Consider the following quote regarding the lack of global action to reduce greenhouse gas emissions:

> The problem is not the Paris agreement, which is the best climate pact ever negotiated; rather the problem is inadequate political will in capitals around the world.[29]—Nigel Purvis (2018) (Chief Executive of Climate Advisers at the 24th Conference of Parties meeting, Katowice, Poland)

Inadequate political will to do what? Do politicians and citizens have only one goal, to limit global temperature rise by capping greenhouse gases in the atmosphere? Certainly some political will exists to mitigate climate change, but some political will also opposes climate change mitigation. Aside from energy and climate concerns, elected officials also have political will to fix potholes, achieve affordable health care, educate the public, and maintain a strong national military. How is political will distributed, and how are we to know which political desire overcomes another?

This question reminds me of the start-up company I worked for in the 2000s. At some point the executives decided to assign priorities to tasks. In theory this would help me and the main technician determine which design work to perform next. The problem was that we just accumulated too many "highest priority" tasks. I was pretty sure I was living in a *Dilbert* cartoon. Ultimately the technician and I ignored the prioritizations and decided the next task to work on by ourselves. This is exactly the problem with political will. A politician has many constituents, each possibly having a unique number one priority. So how does he or she decide how to prioritize their legislative efforts among multiple "highest" priority items?

Often political will is viewed as taking actions that benefit the majority of the people rather than a smaller subset of connected factions. Similarly, *social power*, or political power, is the ability of an individual or group to influence the behavior of others, often without the powerful group having to change its own behavior in an undesirable manner.

As referenced in Chaps. 4 and 7, government support to maintain workers' rights and bargaining power for wages is a common example to explain the concept of political will. The immediate post-World War II decades are often viewed as those with high political will in the United States. Paul Collier explains the end of the glorious thirty years (Phase 1 highlighted in Chap. 7) of successful social democracy in the U.S., U.K., and some European nations:

[29]Busby, Joshua "The latest global climate negotiations just finished. Here's what happened," *Washington Post* Monkey Cage blog, December 17, 2018, accessed December 20, 2018 https://www.washingtonpost.com/news/monkey-cage/wp/2018/12/17/the-latest-global-climate-negotiations-just-finished-heres-what-happened/.

> Social democracy worked from 1945 until the 1970s because it lived off a huge, invisible and unquantifiable asset that had been accumulated during the Second World War: a shared identity forged through a supreme and successful national effort. As that asset eroded, the power wielded by the paternalistic state became increasingly resented.[30]—Paul Collier (2018)

By *social democracy*, Collier refers to political arrangements in which people agree to pool resources and co-own assets to implement policies that address the concerns of everyday people. Concerns such as health care, pensions, education, and unemployment insurance became mainstream political concepts, embodied in legislation after the Great Depression and World War II. The policies were social because most people both contributed to them, via taxes, and benefited from them by having educated children and retirement security. People gave into the system, and the system gave back services they wanted. There was reciprocity, an important requirement for a well-functioning social order. If people contribute to the greater good, and never receive anything in return, this reduces the desire to contribute to collective goals.

Time is said to be the healer of all wounds, but in this case, Collier implies that perhaps it was time that forged a divide between any common purpose that previously spanned generations. Winning a war helps forge a national identity that brings people together. Wars are, of course, also destructive, and forging unity under a nationalist banner can lead to discord and war itself, as it did via the rise of the German Nazi party instigating World War II. Thus, we need alternative constructive ways to bring citizens together.

Unions are often seen as entities that can bring workers together for their common cause. Figure 9.2 shows U.S. union membership along with the percent of income going to the top 10% income bracket.[31] Clearly higher union membership coincided with workers obtaining a larger share of the economic pie. We should try to understand why union membership *could or was allowed to* increase in the 1930s and the run-up to World War II while it has declined since the early 1970s.

High union membership might be easier during times of increasing rates of energy consumption. As noted in Chap. 7, when resources are more abundant, people are more willing to share. In the case of rising employee compensation in the decades leading to 1970, businesses were more willing to share with workers. Was it political will that established social democratic policies in the 1930s and

[30] Collier [13, p. 15].

[31] Lawrence Mishel and Jessica Schieder, "As union membership has fallen, the top 10% have been getting a larger share of income," Economic Policy Institute website, May 24, 2016 at https://www.epi.org/publication/as-union-membership-has-fallen-the-top-10-percent-have-been-getting-a-larger-share-of-income/. Per this reference: (1) data on union density follows the composite series found in Historical Statistics of the United States; updated to 2014 from unionstats.com. and (2) Income inequality (share of income to top 10%) from Piketty and Saez, "Income Inequality in the United States, 1913–1998," *Quarterly Journal of Economics*, 118(1), 2003, 1–39. Updated data for this series and other countries is available at the Top Income Database. Updated 2016.

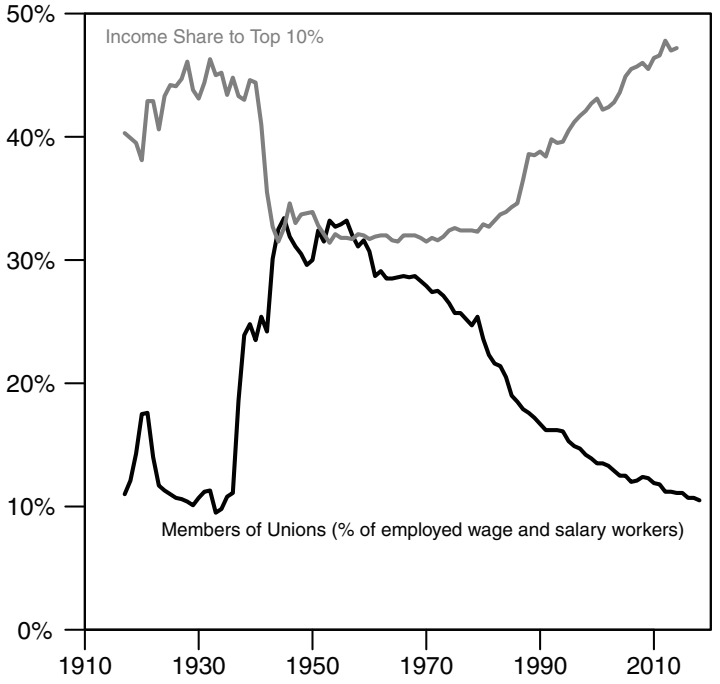

Fig. 9.2 Higher union membership has been associated with a higher share of income to lower income brackets (the lower 90%) and a lower share of income to the top 10% of earners. While the percent of American workers belonging to labor unions rose dramatically during the New Deal 1930s, peaking at the end of World War II, it has fallen dramatically since the early 1970s when per capita energy consumption no longer increased (see Fig. 7.1e)

1940s, or that undermined them after the 1970s? Or was it abundant and cheap energy resources that enabled social democratic policies to work until the 1970s, and energy constraints that forced a restructuring of policy after the 1970s?

Recall that my economic modeling discussed in Chap. 6 shows that, even with no change in the assumption related to labor "bargaining power," you can explain a shift from increasing to declining income equality (higher equality expressed as a higher wage share) by a corresponding shift from a period of rapidly increasing per capita resource consumption to one of constant per capita resource consumption. This thesis is supported by both the data and an economic theory that consistently links the flows of resources and money.

> What scientists, economists, politicians, and citizens alike need to appreciate is that rapidly increasing energy and material consumption supported post-World War II socially-democratic and distributive policies.

It doesn't take as much political will, or social power, to distribute pieces of a rapidly expanding economic pie versus one of a constant, shrinking, or slowly

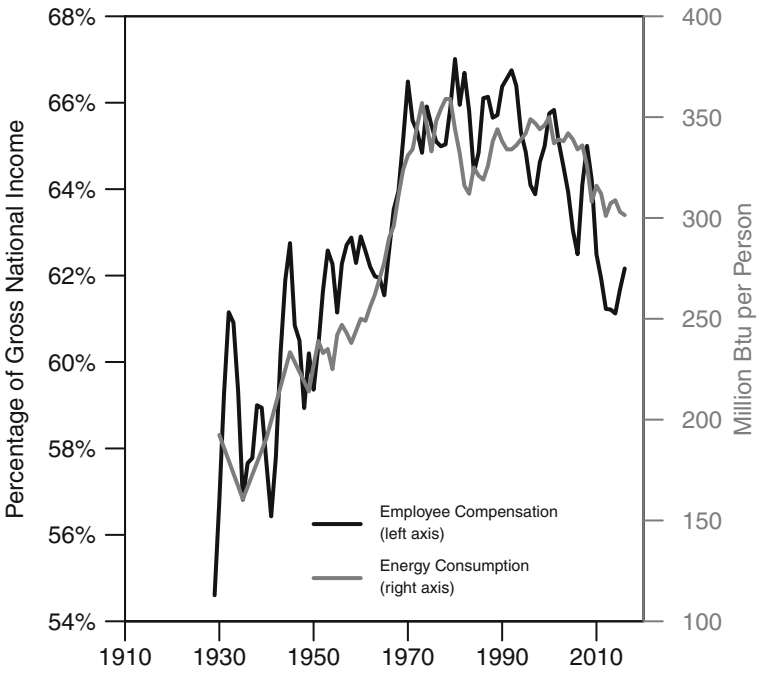

Fig. 9.3 The fraction of total U.S. income to workers (black line, left axis) follows the same trend of U.S. per capita primary energy consumption (gray line, right axis (data as in Fig. 7.1))

increasing size. When everyone gets more, it is easier for everyone to be satisfied. If the flow of energy or money per person shrinks, one or more groups will have to get less. If all groups do not decrease their share by the same percentage, this can be interpreted as a decline in political will. But from the standpoint of laws of conservation of flow of money and energy, it is a mathematical necessity to decrease the flow to some.

The connection between U.S. worker compensation and energy consumption is clear in Fig. 9.3 (same data as in Fig. 7.1a and e). The difficult situation we face is the glory years of high equality and political will only came during a time of unprecedented increases in per capita energy consumption, and because of the constraints of a finite Earth, we can't indefinitely increase per capita energy consumption (at least with a growing or constant population). Thus, it is unclear how we maintain high income equality in any economic system, particularly in our current system based on capitalism and debt-based finance. Most political will discussions ignore this energy-income equality conflict.

I had a useful discussion on this conflict between energy consumption and "bargaining power" with a colleague, an economist in the U.K. He noted that during the Golden Age after World War II, or Phase 1 of Fig. 7.1, inflation was low and employment was high. Even though wages were rising, there was no

upward inflation because labor productivity also increased with wages (refer back to Fig. 4.11). However, company profits declined toward the late 1960s due to growing labor costs, so the Golden Age might not have continued even without the 1970 peak in U.S. oil extraction and 1974 OPEC oil price increase. After the OPEC oil price hike, inflation surged, and many labor unions were powerful enough to gain matching wage rises, thus maintaining the wage–price spiral that brought inflation to 10%. The Federal Reserve then reacted by increasing interest rates to over 15% (refer back to Figs. 4.9 and 4.10), causing stagflation and recession, shifting power to business.

This colleague and I could not come to full agreement on the interpretation of the U.S. shift from Phase 1 to Phase 2 of Fig. 7.1. We did agree that the situation forced a change in economic operation. My position is that increasing wages reduced profits to the point of stressing the capitalist system, and that one important reason it took about 30 years (starting in 1945) to realize this was because of the rapid increase in low-cost energy consumption. Without the abundant and low-cost energy, the political will for increasing wages and union membership might have materialized, but it would have likely had less longevity.

As soon as oil prices and total energy expenditures rose outside of the control of U.S. businesses and policymakers, and energy consumption declined, the economy was forced into some combination of falling wages and profits. In the U.S. and U.K., policies favored profits more than wages. Some European countries such as Germany, France, and those within Scandinavia placed more emphasis on labor stability and socially democratic benefits.

These economic and social arrangements are becoming more stressed today, as many OECD countries are in the same Phase 3 situation as the U.S.

Given that higher wages, higher income equality, and more political will existed during the three decades after World War II when energy consumption increased more rapidly than any time in history, is this correlation simply a coincidence? While we know companies influence our consumer decisions via advertising and public relations campaigns, companies also have other people they want to influence: politicians and regulators.

The Political Will Delusion: Lobbying

We can't change the structure of the economy by changing the physical laws. There is no other viable choice but to change the *legal rules and social norms* that guide relations between citizens, governments, and corporations. By legal rules I mean corporate, civil, and criminal laws enforced by governments, as well as social and religious norms. Social norms are less explicit rules that also guide social and economic relations.

By definition, we can take any action that is possible within the bounds of physical laws and enabled by the degrees of freedom at our disposal. In turn, social rules reduce the allowable degrees of freedom to a subset of all degrees of freedom.

Thus, collectively social norms and legal rules affect "... the data that actors in the system have to work with, and the ideas, goals, incentives, costs, and feedbacks that motivate or constrain behavior."[32]

Edward Bernays understood the importance of controlling the data and information flows to influence consumer behavior. Likewise, Lewis Powell understood how to influence the economy via its civil and corporate laws.

The quote below comes from Lewis Powell's August 23, 1971 letter to his friend Eugene Sydnor, Jr., the Director of the U.S. Chamber of Commerce. This letter is also known as *The Powell Memo* and *The Powell Manifesto*. At the time, Powell was a corporate lawyer. Two months later President Richard Nixon nominated Powell to become a Supreme Court Justice. (Powell was confirmed in December 1971.)

> No thoughtful person can question that the American economic system is under broad attack. This varies in scope, intensity, in the techniques employed, and in the level of visibility.
>
> There always have been some who opposed the American system, and preferred socialism or some form of statism (communism or fascism). Also, there always have been critics of the system, whose criticism has been wholesome and constructive so long as the objective was to improve rather than to subvert or destroy.
>
> But what now concerns us is quite new in the history of America. We are not dealing with sporadic or isolated attacks from a relatively few extremists or even from the minority socialist cadre. Rather, the assault on the enterprise system is broadly based and consistently pursued. It is gaining momentum and converts.[33]—Lewis Powell (1971)

To Powell, the "American economic system" is that of capitalism and free enterprise, as opposed to the only undesirable alternatives with "... varying degrees of bureaucratic regulation of individual freedom":

> There seems to be little awareness that the only alternatives to free enterprise are varying degrees of bureaucratic regulation of individual freedom—ranging from that under moderate socialism to the iron heel of the leftist or rightist dictatorship.
>
> We in America already have moved very far indeed toward some aspects of state socialism, as the needs and complexities of a vast urban society require types of regulation and control that were quite unnecessary in earlier times. In some areas, such regulation and control already have seriously impaired the freedom of both business and labor, and indeed of the public generally. But most of the essential freedoms remain: private ownership, private profit, labor unions, collective bargaining, consumer choice, and a market economy in which competition largely determines price, quality and variety of the goods and services provided the consumer.[34]—Lewis Powell (1971)

Why did Powell state that the "American economic system is under broad attack?" Because from his perspective, he thought it was under attack from the federal government and American citizens themselves. From the breakup of

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[32] Meadows [14, p. 237].

[33] "Confidential Memorandum: Attack of American Free Enterprise System." Available July 2019 at: http://reclaimdemocracy.org/powell_memo_lewis/ and https://d1uu3oy1fdfoio.cloudfront.net/wp-content/uploads/2012/09/Lewis-Powell-Memo.pdf.

[34] Lewis Powell, August 23 1971, *Confidential Memorandum: Attack of American Free Enterprise System*. A memo to Eugene Sydnor, Jr., the Director of the U.S. Chamber of Commerce.

Standard Oil in 1911 as violating the Sherman Antitrust Act, to the 1929 stock market Great Crash starting the Great Depression and ushering in President Franklin Delano Roosevelt's New Deal. Increasingly after World War II, U.S. policies favored workers' rights and incomes, as demonstrated in Figs. 9.2 and 9.3.

The 1950s and 1960s continued to witness landmark laws governing individual rights and the environment. The 1964 Civil Rights Act outlawed discrimination based on race, color, religion, sex, or national origin. The 1965 Voting Rights Act put in place measures to enforce 15th Amendment (ratified 95 years earlier in 1870) that established the right to vote for African Americans.

As I've emphasized, in interpreting the energy and economic narratives, it is important to consider that many economic, resource, and environmental trends came to a head at the same time during the late 1960s through the 1970s. In April 1970, 20 million U.S. citizens marched into streets and parks to celebrate the first Earth Day [15]. After a century of industrialization, "They demanded a better balance between corporations and people and better stewardship of our land, water, and air."[35] In response, many environmentally related governmental programs or regulations were either started or enhanced in the 1970s. For example, the U.S. Environmental Protection Agency (EPA) was established in 1970 along with an enhancement to the Clean Air Act. The Clean Water Act passed in 1972. The list goes on.

The influence of citizens and workers on the passage of these civil and environmental laws is undeniable, and these and other laws significantly influenced the historical course of events. Before the U.S. EPA was formed, air and water pollution were getting worse; after the EPA was established, air and water became cleaner. Political scientists and activists study this type of cause and effect relationship.

These political relationships are, however, emergent concepts, just as with physical cause and effect relationships. Matter does not move or change in shape without a corresponding energy-consuming process. As this book emphasizes, *the long-term economic growth and structural trends we have seen over the last century must be understood by considering the rate of energy consumption as a necessary input into economic processes.*

When I've made this case to political scientists and economists, some tell me that I need to get my cause and effect relationships correct. As a physical scientist, my initial reaction was a combination of confusion and insult. I then try to explain: 'Of course I consider cause and effect relationships. Didn't you just hear me explain that energy consumption and conversions are the cause of economic activities?' While the cause and effect distinction becomes less obvious the closer you get to physical and philosophical foundations, we can say that certain phenomena tend to come together, rather than separately. Energy conversions come with economic activity.

But there is a more important point. It's not that I was wrong and my policy and economic colleagues were correct. We are all correct. From the standpoint of the philosophy of poetic naturalism, we can simultaneously hold multiple ideas in our heads if they are compatible and useful.

[35] Clements [15, p. 14].

> The statement "human decisions and policies causally affect economic behavior and outcomes" is compatible with the statement "energy consumption causally drives economic activity."

Because of the near simultaneous timing of many important political, environmental, and energy events with the span of a decade, there will likely *never* be complete agreement on the relative influence of each applicable cause and effect relationship. The fight over economic allocation between workers (or labor) and owners of property and corporations (or capital) is a continuous battle.

Many credit Powell's 1971 memok as starting a decades-long process of increasing rights and influence of corporations in legislative and judicial processes. Powell indeed intended to kick-start American corporate influence in the political and judicial system. Before Powell was a Supreme Court Justice, he resided on the Board of Directors of the cigarette company Philip Morris.

While Edward Bernays used advertising to convince women to smoke cigarettes in the 1920s, in the 1960s Lewis Powell used legal arguments to defend the industry against the emerging science that smoking was harmful to human health [15].[36] Given his pro-corporate tendency, and observing that liberals and the "far left" already used the judicial system for their end goals, Powell realized that businesses should do the same:

> American business and the enterprise system have been affected as much by the courts as by the executive and legislative branches of government. Under our constitutional system, especially with an activist-minded Supreme Court, the judiciary may be the most important instrument for social, economic and political change.[37]—Lewis Powell (1971)

Corporate America executed the campaign that Powell suggested by starting several organizations, or "legal foundations," in the 1970s. As Jeffrey Clements stated in his book *Corporations are not People*: "These legal foundations were intended to drive into every court and public body in the land the same radical message, repeated over and over again, until the bizarre began to sound normal: corporations are persons with constitutional rights against which the laws of the people must fall."[38]

Thirty-nine years after his memo, and 12 years after his death, Powell's dream came true in the form of the Supreme Court ruling known as *Citizens United v. Federal Election Commission*. The non-profit corporation Citizens United won its argument that an existing law (the Bipartisan Campaign Reform Act) "…violated the First Amendment right of free speech because it prevented Citizens United …from engaging in 'electioneering activity' and for-profit corporations from contributing to Citizens United's electioneering activity."[39]

[36] Clements [15, pp. 19–22].

[37] Lewis Powell, 1971, *Confidential Memorandum: Attack of American Free Enterprise System*.

[38] Clements [15, p. 23].

[39] Clements [15, p. 9].

While running for the Republican nomination for U.S. president in 2011, the *Citizens United* ruling led Mitt Romney to say to a heckler at an Iowa rally: "Corporations are people, my friend."[40] The heckler replied: "No they're not!"

Many Americans are justifiably confused upon learning their common sense definition of a corporation conflicts with the current legal definition implied by *Citizens United*.

The memes that define our economy and society matter.

The Political Will Delusion: The Battle Over -isms

In his 1971 memo, Powell presented two basic options for societal organization. The first is the free enterprise system within *capitalism* that is defined by private ownership of companies and capital. To Powell, this system can do nothing but maximize individual freedom and prosperity. However, many argue that, in part due to Powell, this system has morphed into something that does indeed limit individual freedom, and we will soon return to this concept when discussing neoliberalism.

Powell's second option is some range of government control, or regulation of individual freedom. At the worst, we could live under a dictator within a (leftist) communist modern day North Korea, a (rightist) World War II era Nazi Germany under Adolf Hitler, or a (rightist) fascist Italy under Benito Mussolini.

Per Powell's quote, "moderate socialism" is the least bad alternative to free enterprise. *Socialism* is defined by state, or government, property ownership. In the strict definition a central government owns every factory, hotel, farm, and mineral, but it does so for the benefit of the citizens. When pro-socialist Americans think of socialism, they think of Scandinavian countries such as Sweden, Norway, Finland, and Denmark.[41] These countries are not strictly socialist. They are social democracies that currently exhibit many of the pro-worker/citizen characteristics that Americans seem to increasingly support.

In 2018, Gallup reported that while the percentage of Americans with a "Positive view of socialism" remained steady within each age category from 2010 to 2018, the 18–29-year-old group has had a more favorable view, ranging from 49% to 55%, than that of older age groups at less than 40%. The major change during this time span relates to the "Positive view of capitalism" in 18–29-year-old category—it dropped from 68% in 2010 to 45% in 2018—indicating that in 2018 the young

[40] Ashley Parker," 'Corporations Are People,' Romney Tells Iowa Hecklers Angry Over His Tax Policy," *The New York Times* August 11, 2011 available at: https://www.nytimes.com/2011/08/12/us/politics/12romney.html. Also see YouTube video of the Iowa rally: https://www.youtube.com/watch?v=St1wSWtm_BI.

[41] Pew Research Center, October 2019, "In Their Own Words: Behind Americans' Views of 'Socialism' and 'Capitalism' ", available at https://www.people-press.org/wp-content/uploads/sites/4/2019/10/PP_2019.10.07_Socialism-and-Capitalism_FINAL.pdf.

had a more positive view of socialism than capitalism.[42] Statistics such as these prompted President Trump to confront the concept of socialism in his 2019 State of the Union address, stating:

> Two weeks ago, the United States officially recognized the legitimate government of Venezuela, and its new interim President, Juan Guaido.
>
> We stand with the Venezuelan people in their noble quest for freedom—and we condemn the brutality of the Maduro regime, whose socialist policies have turned that nation from being the wealthiest in South America into a state of abject poverty and despair.
>
> Here, in the United States, we are alarmed by new calls to adopt socialism in our country. America was founded on liberty and independence—not government coercion, domination, and control. We are born free, and we will stay free. Tonight, we renew our resolve that America will never be a socialist country.[43]—U.S. President Donald J. Trump (2019)

When anti-socialist Americans think of socialism, they think of Venezuela and Russia.[44] (As opposed to Scandinavian countries.)

One can make a *straw man* or a *steel man* argument. To argue against a steel man is to argue against the strongest and most accurate description of the concept in question. To argue against a straw man is to argue against a weak and simplified description.[45]

It is certainly easier to attack corrupt Venezuela as a straw man petro-state with a failed vision of socialism than Norway as a steel man social democracy whose petroleum proceeds fund its Government Pension Fund Global that "…is owned by the Norwegian people …" and holds "…the people's money, owned by everyone, divided equally and for generations to come." Norway is not strictly socialist but its Pension Fund exhibits significant socialist flavor.[46]

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[42]Gallup, August 13, 2018, "Democrats More Positive About Socialism Than Capitalism," available March 23, 2019 at: https://news.gallup.com/poll/240725/democrats-positive-socialism-capitalism.aspx?version=print.

[43]Remarks by President Trump in State of the Union Address, Issued on: February 6, 2019, available March 23, 2019 at: https://www.whitehouse.gov/briefings-statements/remarks-president-trump-state-union-address-2/.

[44]Pew Research Center, October 2019, "In Their Own Words: Behind Americans' Views of 'Socialism' and 'Capitalism' ", available at https://www.people-press.org/wp-content/uploads/sites/4/2019/10/PP_2019.10.07_Socialism-and-Capitalism_FINAL.pdf.

[45]Arguing against a steel man is the opposite of a arguing against a straw man. "Intentionally caricaturing a person's argument with the aim of attacking the caricature rather than the actual argument is what is meant by "putting up a straw man." Misrepresenting, misquoting, misconstruing, and oversimplifying are all means by which one commits this fallacy. A straw man argument is usually one that is more absurd than the actual argument, making it an easier target to attack and possibly luring a person towards defending the more ridiculous argument rather than the original one." [16]

[46]Because of significant state ownership of companies, Norway is perhaps the European country closest to the definition of socialist. The government owned about 60% of net national wealth in 2015, including a two-thirds stock ownership of Equinor, Norway's major oil and gas company. Norway's sovereign wealth fund, the Government Pension Fund Global that began in 1990, was created to invest revenues from oil and gas extracted from the North Sea. As stated by a video summarizing the fund: "The fund is owned by the Norwegian people …" and "It is the

Whether a straw man or steel man, when choosing among a set of conflicting policies, we must make arguments for and against them. Increasingly, up to and ever since the *Citizens United* ruling, policies are analyzed using economic models. A policy calculated to have more benefits than costs is seen as better. Benefits can include more income, more jobs, and increased choices and degrees of freedom. Costs can include more spending, a loss of jobs, environmental impacts, and a loss of options.

Decision makers within corporations and governments run cost–benefit calculations to determine which investments and policies to pursue. This is why economic modeling is so important. For example, the U.S. EPA runs cost–benefit analyses to determine how to implement programs that affect air and water quality, and these analyses even include what is called the "value of a statistical life" that monetarily quantifies human health impacts, including premature death.[47]

Within an economic model resides some equation or algorithm that defines how to calculate benefits minus costs. Thus, running the model to maximize benefits minus costs is like maximizing the utility of the superorganism as discussed in Chap. 8. However, as that chapter's utility monster example showed, a maximized outcome for "the economy" does not guarantee a maximized outcome for each person.

What if those who benefit aren't the same as those that bear the costs? Doesn't that matter?

In its purest form *communism* is defined by citizens, without social class division, sharing property ownership for land, factories, and other natural and industrial resources. Everyone is equal, and the community collectively owns all property and distributes proceeds from everyone's work based on each person's needs. Today, people often relate communism to North Korea, Cuba, China, and the former United Soviet Socialist Republics (U.S.S.R, or Soviet Union) in which each has (or had) only one political party, the Communist Party.

It is unclear how closely an idealized communist society can be achieved and maintained in practice, particularly in a modern industrial economy. In practice the aforementioned countries do not (and did not) reach the textbook definition of communism. Practically they more closely approached *socialism* as more strictly defined as a system with state control of property. While modern-day China is governed by

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people's money, owned by everyone, divided equally and for generations to come." As of 2019, Norway's sovereign wealth fund was valued at almost 1.1 trillion US dollars, or about $200,000 for each of Norway's 5.3 million citizens. Quotes in this passage are from the Norges Bank Investment Management, video "The fund in brief" at https://www.nbim.no/en/the-fund/about-the-fund/. Also see https://www.equinor.com/en/about-us/corporate-governance/the-norwegian-state-as-shareholder.html.

[47]Dave Merrill, "No One Values Your Life More Than the Federal Government," *Bloomberg*, October 19, 2017, available at: https://www.bloomberg.com/graphics/2017-value-of-life/. For detail see EPA documentation at https://www.epa.gov/environmental-economics/value-statistical-life-analysis-and-environmental-policy-white-paper and "Value of Statistical Life Analysis and Environmental Policy: A White Paper and Appendices A-J (2004)" at https://www.epa.gov/sites/production/files/2017-12/documents/ee-0483_all.pdf.

the one and only Communist Party, it exhibits a complex mix of socialism (state ownership), capitalism (private ownership), and market competition. Aside from post-2000 China, these countries are not known for high levels of average material standards of living and immigrants don't flock to live inside their borders. All have restrictions on freedom of expression or movement, at least more than in Western democracies. (The laws of the United States do not allow absolute and complete expression and movement for all citizens.)

Sharing one's proceeds with everyone does sap away significant incentive to innovate because you cannot accumulate material and monetary wealth based on your personal work. For example, in Cuba, ninety percent of business sales goes to the government as taxes. Only ten percent of food, products, or other sold services can be sold directly to others while keeping one-hundred percent of the proceeds. This has driven many skilled people (e.g., engineers, teachers) to take jobs within the tourism industry because the tips one receives enable a higher income. This form of taxation reduces Cuba's capability to engage in a variety of economic activities, but the government does prioritize health care and basic education. While Cubans generally have access to basic education and health care, the services are, well, basic. Many doctors have necessary skills, but they lack equipment and supplies. Children are literate, but the country doesn't produce a high proportion of engineers and scientists.

Thus, it seems communism is a unicorn—it doesn't exist in the real world. In practice, we observe some other system.

As hinted in the Powell Memo, a practical question for communism is exactly how to prevent a totalitarian ruling class from suppressing the freedom of the masses that are supposed to collectively own everything. George Orwell explained this conundrum of oppression in his 1945 book *Animal Farm*, that parallels the early history of the former Soviet Union, formed in 1917. In the book, the overly exploited farm animals (the commoners) overthrow their human owners (capitalists). Upon kicking out the humans, the animals operate the farm as a communist collective, but it doesn't last. The pigs become a ruling class and use the dogs to enforce increasingly unequal rules, just as Joseph Stalin ruled the Soviet Union as a totalitarian state. Eventually the pigs walk on two legs while coordinating with the humans because, after all, "All animals are equal, but some animals are more equal than others."

Thus, Lewis Powell, Donald Trump, and many others state, given the practical problems with achieving communist or socialist states, we should pursue capitalism and free markets. But the two concepts of free markets and capitalism have at least one thing in common with communism and socialism: they are also unicorns. They practically do not exist in their pure forms. There are no such things as free markets because by definition they are defined by legal rules and norms that restrict degrees of freedom.

This now brings us to the operative word of this subsection: *neoliberalism*.

This term captures much of the popular discontent over what's wrong with the current state of the global economy. The data presented in this book demonstrate

that several trends driving this discontent (stagnant wages and a declining share of GDP going to wages) have been five decades in the making.

But what is neoliberalism? As Philip Mirowski laments, this is one of the most misused words within modern political economy:

> While it is undeniable that neoliberals routinely disparage the state . . . it does not follow that they are politically libertarian or . . . that they are implacably opposed to state interventions in the economy and society.
>
> . . .
>
> From the 1940s onward, the distinguishing characteristic of neoliberal doctrines and practice is that they embrace [the] prospect of repurposing the strong state to impose their vision of a society properly open to the dominance of the market as they conceive it. Neoliberals from Friedrich Hayek to James Buchanan . . . all explicitly proposed policies to strengthen the state. [17]—Philip Mirowski (2018)

Thus, the neoliberal ideology is *not* equivalent to neoclassical economic theory, the libertarian notion of a minimally functional government (or state), or the promotion of free markets with no barriers to entry for new companies. Libertarians realize legitimate governments must enforce rules of competition. However, as implied above by Mirowski, *neoliberals use government to legitimize their "vision of a society,"* competition be damned. This legitimacy comes not from a weak government, but a government strong enough to write and enforce laws that might be unpopular to the people. These laws tend to support markets that provide signals, such as prices, that direct our purchasing decisions. Per Lewis Powell, laws can be written to support corporations.

Chapter 8 introduced us to Friedrich Hayek and his idea for ". . . how to provide inducements which will make the individuals do the desirable things without anyone having to tell them what to do." [18] The book *The Road from Mont Pèlerin* discusses Hayek's ideas and explores the history of the "neoliberal thought collective" [19]. In that book, Mirowski points out that Hayek saw the economy as the ultimate information processor that was smarter than any one person or group of persons. Thus, government officials, or really any centralized authority, can't know enough to make good economic decisions. But they can set up markets to induce purchasing decisions, or might we say, reactions. To Hayek markets are distributed information systems interacting with each other and aggregating data in the most effective way to produce the "correct" signals that direct people on what to make and what to buy.

Need better decisions? Make another market! Lack information? Make another market!

To neoliberals, it's markets all the way down, and there is little to no need for people to think for themselves. The market knows better. In an extreme world with markets for everything, each of us becomes an automaton responding to price signals that might have very little to do with personal and human well-being.

But individual consumers and producers aren't the only agents that can respond to market signals. Individuals within governments can too. The last quote from Mirowski also mentions James McGill Buchanan. Buchanan was awarded the 1986

Nobel Prize for Economics for his "Contributions to the theory of political decision-making and public economics."[48]

Using what became known as *public choice theory*, Buchanan applied economic analyses to the political arena.[49] He assumed that politicians acted in their own interests. While public officials don't necessarily react to prices, they do react to bids from companies coming to their city, county, or state with jobs for their electorate. And what do politicians have to offer these bidding companies? Tax breaks.

In the market for locating corporate offices and factories, companies perform cost–benefit calculations to determine which location enables a higher profit. Politicians then compete by selling their "commodities" of lower taxes and business-friendly laws. After all, taxes are just one more cost to minimize. "The rule of law has a monetary price, and so does your corporate tax rate and regulatory environment."[50]

Ironically, it was the left-leaning economist Charles Tiebout who sparked the idea that you could determine a homeowner's "revealed preference" for tax rates and public amenities by observing where they locate. In his 1956 paper "A Pure Theory of Local Expenditures" Tiebout thought local governments could balance taxes and public services to benefit both companies and citizens [21]. It hasn't worked out this way.

Using Tiebout's approach, integrated with public choice theory, neoliberals have convinced everyone that we are all better off (i.e., higher wages, more jobs) when our governments compete in a race to the bottom of lower taxes. As Nicholas Shaxson points out in his book *The Finance Curse*:

> It's not hard to see how subversive all this [competition among governments] was. The rule of law has a monetary price, and so does your corporate tax rate and regulatory environment. Once this awesome intellectual land grab by corporate and financial interests began to enter mainstream politics in the late 1970s, it would lead inevitably to corruption, oligarchy, bank bailouts, and the growth of international organized crime.[51]—Nicholas Shaxson (2019)

One of the most recent high-profile examples of this reality was in 2017 when Amazon announced plans to build a second headquarters, HQ2, within the U.S. In response, 238 cities courted the online behemoth with incentive packages, each worth several billions of dollars. This enabled the company to gather data to inform the term sheet delivered to the mayors of the cities in which it wanted to locate all along: ultimately Long Island City in Queens, New York and Crystal City in Arlington, Virginia.[52]

[48] https://www.nobelprize.org/prizes/economic-sciences/1986/buchanan/facts/.

[49] https://www.neh.gov/about/awards/national-humanities-medals/james-m-buchanan.

[50] Shaxson [20, p. 44].

[51] Shaxson [20, p. 44].

[52] Amazon numbers from Nicholas Shaxson's *The Finance Curse* [20, pp. 50–51], and for further discussion of cities and countries competing to attract businesses, see in particular Chapter 2 "Neoliberalism Without Borders."

The politicians most willing to play the game can more easily gain support. After all, politicians are supposed to listen to their constituents, and the *Citizens United* ruling has now enshrined elections as a political marketplace for corporations as people. "That is, corporate dominance of elections becomes possible when political life as a whole is cast as a marketplace rather than a distinctive sphere in which humans attempt to set the values and possibilities of common life."[53]

But politicians don't only speak for the interests of cities and states within their country. Officials elected and appointed to national positions also speak for their country. Multinational companies and wealthy persons can shop around for the *country* with the lowest taxes, least transparency, and laxest regulatory environment. The Panama Papers, leaked in April 2016, showed just how extensive is this global marketplace: "The Panama Papers are an unprecedented leak of 11.5 m files from the database of the world's fourth biggest offshore law firm, Mossack Fonseca. . . . The documents show the myriad ways in which the rich can exploit secretive offshore tax regimes. Twelve national leaders are among 143 politicians, their families and close associates from around the world known to have been using offshore tax havens."[54]

In the extreme case of offshore tax havens, there were no existing tax laws for local officials to change to benefit the foreign influx of money. For example, "The Panama Papers . . . revealed how Mossack Fonseca . . . effectively wrote the tax haven laws of Niue, a tiny Pacific island of 1500 people. Mossack Fonseca got an exclusive agreement to register offshore companies there, and this operation was soon generating 80 percent of that territory's government revenue."[55]

While this book is not focused on corruption and tax evasion, I discuss these concepts simply to recognize they exist. They are part of our reality, and we should understand their influence on society.

The foci of this book are energy and economic narratives, some of which can be expressed in mathematical models that only approximate observed economic trends. These models can be powerfully persuasive. They derive from worldviews and narratives spanning techno-optimism and techno-realism and theories ranging from neoclassical to biophysical economics. These narratives and theories assume wildly different economic rules and physical constraints for economic activity.

How can we think of the relationship between the distribution of political power and actual physical power defined as the flow of energy?

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[53] Quote from Wendy Brown during interview with the Institute for New Economic Thinking, November 19, 2019, "How Neoliberal Thinkers Spawned Monsters They Never Imagined." Accessible at: https://www.ineteconomics.org/perspectives/blog/how-neoliberal-thinkers-spawned-monsters-they-never-imagined.

[54] Quote from *The Guardian*, April 5, 2016 "What are the Panama Papers? A guide to history's biggest data leak": https://www.theguardian.com/news/2016/apr/03/what-you-need-to-know-about-the-panama-papers. For extensive information see the Panama Papers website of the International Consortium of Investigative Journalists https://www.icij.org/investigations/panama-papers/.

[55] Shaxson [20, p. 83].

The Political Will Delusion: The Power of Physical Power

As stated earlier, political power is the ability of an individual or group to influence the behavior of others and often without the powerful group having to change its own behavior in an undesirable manner. However, in addition to controlling the flow of information via changing legal rules and social norms, one can influence the rules and norms by directly controlling the flow of energy.

Anthropologist Richard Adams separated the concept of *social power* from that of *control* :

> . . . *control* over the environment is a physical matter. An actor either has it or does not. . . . *Power* over an individual is a psychological facet of a social relationship . . .
>
> The difference between power and control is very important . . . Control is a nonreciprocal relationship in the sense that it exists between and actor and some element of the environment that cannot react rationally to shared behavioral experiences. This does not mean that the thing being controlled does not have its own peculiar behavior. A rock will act like a rock, a horse like a horse, and a stream of water like a stream of water, etc., and a corpse like a corpse. Thus control is always contingent upon understanding the nature of the object being controlled and thereby requires a set of techniques appropriate to those characteristics.
>
> Power, however, is a social relationship that rests on the basis of some pattern of controls and is reciprocal. That is, both members of the relationship act in terms of their own self-interest and, specifically, do so in terms of the controls that each has over matters of interest to the other. The behavior that results from an awareness of power is such that the actor tries to calculate what the other individual might do that could affect the actor's interests.[56]—Richard Adams (1975)

Adams goes on to say:

> It is the actor's control of the environment that constitutes the base of social power . . .
>
> In speaking of "control over the environment," the word *control* refers to *making and carrying out decisions about the exercise of a technology.* The thing doing the controlling may be an individual or some social unit that has an internal power structure of its own.[57]—Richard Adams (1975)

Adams used the diagram in Fig. 9.4 to demonstrate the difference between social power and the control of physical power as the flow of energy from the environment.

Entities A and B are social entities that could be people, businesses, countries, etc. Each might have some control over the environment, X, via the use of technology in the generic sense of ideas, knowledge of the natural world, machines that both extract energy and matter from the environment and transform them for useful purposes, etc. These relationships are demonstrated via the top diagram of Fig. 9.4. If entities A and B have equal control over the environment, then neither A nor B is subordinate to the other (Fig. 9.4b). However, if A has more control over the environment than B, then B is subordinate to A (Fig. 9.4c), and A can create a situation to have more social power over B. That is to say, A is in a position to make

[56] Adams [22] [pp. 21–22].

[57] Adams [22, p. 13].

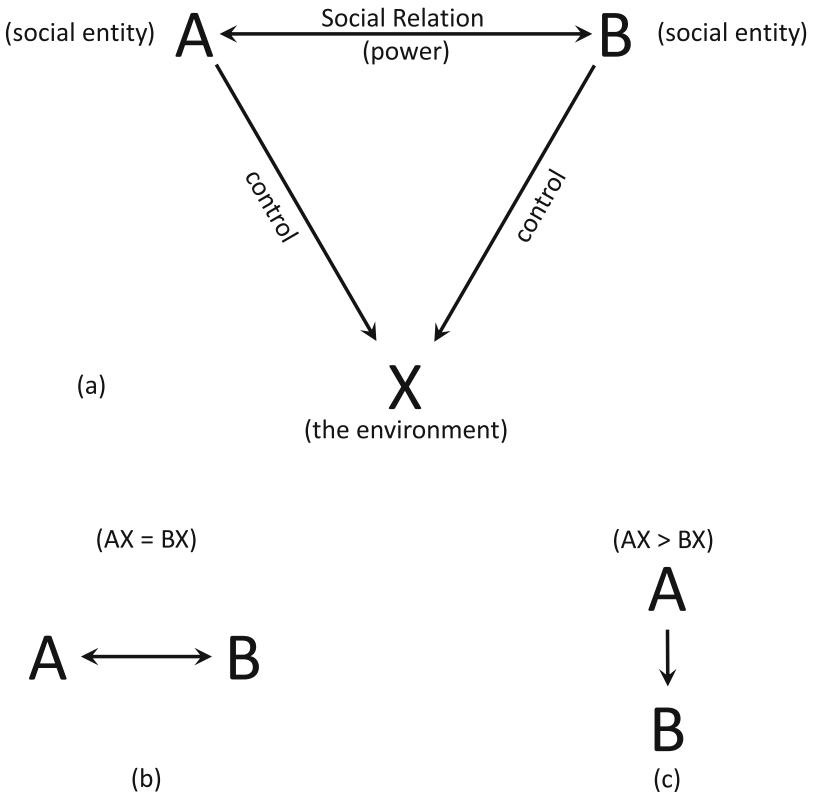

Fig. 9.4 (**a**) The basic components of power relations indicating the difference between social power (relations between social entities A and B) and control each entity has over the environment, X, via use of technology. (**b**) A and B have equal control over the environment, and neither has social power over the other. (**c**) A has more control over the environment than B, and thus has social power over B. Modified version of Figure 1 in [22]

choices that forces B to alter its behavior in an undesirable manner, but A does not have to change its own behavior in that same manner.

Thus, we cannot separate social and economic relations from their association with energy and the environment. "Power is thus clearly a relational issue between parties, but it is also a relation that exists with reference to things that can be described as external to any particular actor: the energy forms and flows, and the equivalence of values."[58]

Having control of the flow of energy resources and the technologies to extract, transport, and consume them was one way that workers were able to obtain increased political power from employers. The control of physical power by some workers

[58] Adams [22, p. 17].

directly led to improved working conditions and bargaining power for themselves and other workers.

Timothy Mitchell describes the historical linkage between fossil fuels and democracy in *Carbon Democracy* [2]. During the several decades before World War I, the democratic political power of workers emerged within the coal industry. In industrializing nations, such as the United States, a vast network of railroads and water ways connected coal mines, ports, cities, and power generating stations. These networks had a tremendous amount of energy flowing within them, and there were several choke points of concentration:

> Great volumes of energy [within coal] now flowed along narrow, purpose-built channels. Specialized bodies of workers were concentrated at the end-points and main junctions of these conduits, operating the cutting equipment, lifting machinery, switches, locomotives and other devices that allowed stores of energy to move along them. Their position and concentration gave them opportunities at certain moments, to forge a new kind of political power. The power derived not just from the organisations they formed, the ideas they began to share or the political alliances they built, but from the extraordinary quantities of carbon energy that could be used to assemble political agency, by employing the ability to slow, disrupt or cut off its supply.[59]—Timothy Mitchell (2013)

The battle between coal miners and owners was not civil. It was fought with blood and violence. But as coal miners persevered, and their strikes continued, eventually owners acquiesced to some of their demands. As workers felt left out of the profits from their labor, they demanded higher wages, safer conditions, and shorter hours. Their labor was needed to ensure the flow of energy that underpinned the unprecedented increase in economic growth powered by coal.

In Adams' terms, the workers had control of the environment, and, therefore, they had social power to increase their working conditions and pay. In the late 1800s U.S. coal miners went on strike two to three times more than workers in other industries.[60]

> The flow and concentration of energy made it possible to connect the demands of miners to those of others, and to give their arguments a technical force that could not easily be ignored. Strikes became effective . . . because of the flows of carbon that connected chambers beneath the ground to every factory, office, home or means of transportation that depended on steam or electric power.[61]—Timothy Mitchell (2013)

You don't have to be coal miners restricting the flow of coal to realize that control of energy provides social power. Vladimir Lenin recognized that for communism to succeed as a counter to capitalism, he must confront this link between physical and social power. He well understood the need for useful work, in the form of electricity, in the early days of the Soviet Union:

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[59] Mitchell [2, p. 19].

[60] Mitchell [2] cites P. K. Edwards, *Strikes in the United States, 1881–1974*, New York: St Martin's Press, 1981: 106. "The strike rates per 1,000 employees for coal mining and for all industries, respectively, were 134 and 72 (1881–86); 241 and 73.3 (1887–99); 215 and 66.4 (1894–1900); and 208 and 86.9 (1901–1905)."

[61] Mitchell [2, p. 21].

> Communism is Soviet power plus the electrification of the whole country. Otherwise the country will remain a small-peasant country, and we must clearly realize that. We are weaker than capitalism, not only on the world scale, but also within the country. That is common knowledge. We have realized it, and we shall see to it that the economic basis is transformed from a small-peasant basis into a large-scale industrial basis. Only when the country has been electrified, and industry, agriculture and transport have been placed on the technical basis of modern large-scale industry, only then shall we be fully victorious.[62]—Vladimir Lenin (1920)

Lenin was wondering how to compete with capitalist countries, both economically and militarily. Military organizations must spend time considering the links between force, or the exercise of control over the environment (e.g., a bomb), and the political will for peace or war. They don't have the liberty to ignore how physical resource abundance and constraints can drive people or leaders into action from hubris or fear.

U.S. Admiral Rickover, the father of the nuclear submarine, provides a poignant perspective on political will, or more specifically geopolitical power:

> High-energy consumption has always been a prerequisite of political power. . . . Ultimately, the nation which control[s]—the largest energy resources will become dominant. If we give thought to the problem of energy resources, if we act wisely and in time to conserve what we have and prepare well for necessary future changes, we shall insure this dominant position for our own country.[63]—U.S. Admiral Hyman Rickover (1957)

For Rickover, just like Richard Adams, energy consumption, or control over physical power in the environment, comes first. Political, or social, power comes second. Physical power "causes," or enables, political power as the effect. We do not have to interpret Rickover's statement to mean that no other political force exists other than that from the command of physical power. But the control of physical power is a known means to social power.

Rickover is effectively applying Alfred Lotka's maximum power principle (Chap. 8) to economies. Accordingly, economic systems that promote more extractive behavior will more often survive and overcome those that do not. This concept is consistent with avoiding the internalization of long-term environmental impacts. Thus, while the maximum power principle might induce activities that are detrimental to the long-term survival of various species, ecosystems, or humanity, it posits that if you don't survive until tomorrow, you'll never get to the next year, decade, or century.

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[62] Report on the Work of the Council of People's Commissars. December 22, 1920, Original Source: Polnoe sobranie sochinenii, 5th ed. (Moscow, 1975–79), Vol. 36, pp. 15–16. Available at website of "Seventeen Moments in Soviet History," November 30, 2019 at http://soviethistory.msu.edu/1921-2/electrification-campaign/communism-is-soviet-power-electrification-of-the-whole-country/.

[63] For Delivery at a Banquet of the Annual Scientific Assembly of the Minnesota State Medical Association St. Paul, Minnesota May 14, 1957. Available at http://large.stanford.edu/courses/2011/ph240/klein1/docs/rickover.pdf.

This is why it is so difficult to attach too much agency, or free will, to our collective decisions. Individually we make decisions that have meaning, but we're not completely in control of what we decide. Each of us is a part of our country's economic system, and at some level each country is competing with other economies. Increasingly, multinational companies shape the terms of the global economy by searching for the lowest tax rates, putting into question the independence of state governments.

Does our economy really exhibit the behavior as implied by the maximum power principle and suggested by ecologists, anthropologists, some ecological and biophysical economists, and military leaders like Admiral Rickover? We can say that *the maximum power interpretation is compatible with the data*. Each of us might not be consciously trying to increase our personal power consumption, but the data indicate this is happening at the global level.

Over time our global economy and humanity have collectively consumed energy at a higher rate to achieve higher GDP (refer back to Figs. 2.10 and 5.2). More countries are adopting capitalistic and neoclassical economic features (i.e., minimize marginal costs) into their economies because these promote higher power consumption. China is the largest and most prominent example, particularly after it joined the World Trade Organization in 2001.

The Political Will Delusion: Willpower and Temptation

The quote at the beginning of this Political Will section stated the need for more political will with regard to the Paris Agreement. It did not explicitly refer to energy consumption, but instead it referred to reduced greenhouse gas (GHG) emissions.

For the last 200 years, increasing global energy consumption has translated to increasing global GHG emissions. While this might not be the case in the future, how do we consider the conflict between our instincts to react to immediate circumstances (i.e., consume more energy now, grow the economy now) and the political will to choose a different path based upon a future goal (i.e., limit human-caused climate change)? As Daniel Dennett asks in *Freedom Evolves*:

> Where does the oomph come from to overrule our own instincts? Tradition would say it comes from some psychic force called *willpower*, but this just names the phenomenon and postpones explanation. How is "willpower" implemented in our brains?[64]—Daniel Dennett (2003)

Psychologists and economists use the term *discount rate* to describe how people make decisions, within our brains, when there are multiple options that present benefits at different points in time. Do I want one dollar now or two dollars ten years from now? Largely driven by natural selection and perhaps some idea similar to the

[64] Dennett [7, p. 210].

maximum power principle, humans tend to have "steep" discount rates indicating that we tend to select rewards that come sooner rather than later.

Dennett uses the story of Ulysses and the Sirens in Homer's *The Odyssey* to demonstrate the link between willpower and the idea of the discount rate. The goddess Circe warns Ulysses that during his journey home, he will sail past the Island of the Sirens. The Sirens appear to have exquisite beauty and a sweet song that lures sailors to their shores. But on approach, the sailboats crash on the rocks, and the sailors remain on the island, unwilling to leave as they listen to the song of the Sirens until they wither and die. Ulysses wants to return home to reunite with his family, but he also knows he will fall into the temptation of the Sirens as he sails by their island. He heeds Circe's advice on how to safely pass the Sirens. Upon approach of the island, Ulysses orders his men to fill their ears with beeswax, a gift from Circe, such that they will not hear the song of the Sirens. As for himself, Circe has given Ulysses a way to hear the sweet Siren song yet not be lured to his death. Ulysses orders his men to lash him to the ship's mast, but under no circumstances are they to untie him, no matter how much he commands while he listens to the Sirens' song.

The important concept related to political will is one of planning for a future time. Ulysses knows the situation that will confront him in the future, and he also knows himself. He knows his steep discount rate will not allow him to resist the Sirens when the time comes. Thus, before he is in the presence of the Sirens, he does exactly what is needed. He enacts a plan to avoid a disastrous fate. He restrains himself by ordering his men to physically tie him to the ship's mast. Thus, when his ship passes the Island of the Sirens, Ulysses' previous decision has removed his choice, or degree of freedom, to go to the island. While hearing the Sirens' song, he absolutely believes he would be happier on the island at that moment than with his family later. Only his previous decision has allowed him to experience the life he wants in the long term.

Homer likely did not know when writing *The Odyssey* that he was demonstrating the concept of the discount rate. But he knew of temptation. Temptation is the base of many stories of struggle. Perhaps no more famous quote exists than that of Saint Augustine of Hippo when praying to God: "Give me chastity and continency, only not yet."[23] As a young man, St. Augustine knew he should not lust, or at least he believed that he should not. When praying, he asked to be healed, but "not yet" because he "…feared that you [God] would hear me quickly, and that quickly you would heal me of that disease of lust, which I wished to have satisfied rather than extinguished."[65]

In the context of the energy and economic narratives, who needs more willpower? Do our political leaders need "political will" to constrain the choices for both public and private energy company investments? Do we as citizens need the "political will" to elect leaders that will constrain our energy choices to those with low-carbon impacts? Do we, as consumers, need the willpower to buy fewer products

[65] Book VIII, Chapter 7, *The Confessions of St. Augustine* [23].

and services? Do company executives and shareholders need the willpower to direct more investment and profits to low-carbon energy and conservation instead of to what they think is the most profitable investment option?

In considering these questions, we can consider our modern situation in light of both St. Augustine and Ulysses. Ulysses had highly reliable information from the goddess Circe, and he was certain that proper actions could avert a single bad outcome in the near term. He was not restricting the degrees of freedom for the long-term future choices that he or his crew could make once they made it home. He only needed the willpower to restrict himself during his homeward journey, not for the rest of his life. This is akin to a company or country planning for the next year or so, but as if with absolute certainty of what to expect.

On the other hand, St. Augustine struggled with the opposite time horizon as Ulysses. He sought the willpower to restrict himself from the lust he craved, not only for a while, but for the rest of his life. Immediate temptation was always too strong for him to change.

So why don't we restrict ourselves to less than our full suite of greenhouse gas-emitting energy options, much like Ulysses tied himself to his mast? The renewable energy narrative posits that all we need to do is plug our ears as we renewably sail past the Island of the Fossil Fuel Sirens. However, the problem is not that we'll quickly approach and pass the Sirens in the near future. The problem is *we're already on the island!*

Thus, St. Augustine's lust is the more apt analogy. The temptation to continuously grow the economy is ever present, and the historical data, maximum power principle, and drivers of evolution imply that our economy as a superorganism seeks more physical growth requiring higher energy consumption via the laws of physics.

But there is no God to whom to pray, or single authority that will command us, to restrict our lust for growth. To reduce greenhouse gas emissions we have to rely on ourselves, our institutions, and political officials to restrict some available energy and economic options. But countries compete for resources just as living organisms compete within ecosystems. Per evolution, a system or country that restricts its energy options more than another will in all likelihood reduce its fitness.

Physical growth on our finite planet will stop someday, but unconsciously hitting some inexact upper limit is different than consciously choosing to stay below a predetermined target.

When I think of the 2015 Paris Agreement, signed by practically all countries in 2016, in which countries agreed to non-binding "nationally determined contributions" to reduce greenhouse gas emissions, I imagine rephrasing St. Augustine's words in the context of political leaders that vote to rapidly reduce greenhouse emissions (my changes in italics):

> Give me *rapid reductions in greenhouse gas emissions*, only not yet. For I fear that *the economy* would hear me quickly, and that quickly *it* would heal me of that disease of *growth*, which I wished to have satisfied rather than extinguished.

But I don't have to rephrase St. Augustine to demonstrate the strength behind the infinite growth and substitutability economic narrative. We find this sentiment with

economist William Nordhaus, who won the 2018 Nobel Prize in Economics "for integrating climate change into long-run macroeconomic analysis." On the day of announcement of his prize, he stated to his undergraduate class: "Don't let anyone distract you from the work at hand, which is economic growth."[66] The "task at hand" for Nordhaus and many other economists is growth, not some limit in atmospheric concentration of greenhouse gases.

This is not to say that Nordhaus's statement is correct or incorrect, or that I agree or disagree with his statement. This is to say that his view is that the goal is growth *now and in the future*. If achieving this goal involves reducing greenhouse gases today to mitigate climate change, then so be it. If it involves increased greenhouse gas emissions today, then so be that as well. He has an economic growth model, based on neoclassical theory discussed in Chap. 6, that runs a cost–benefit calculation, and that tells him a world with 4 °C of warming optimally balances costs and benefits. Some vehemently disagree.[67]

One can argue about the structure of Nordhaus's and others' integrated assessment models (as in Chap. 6) and how they calculate benefits (i.e., economic growth) and the economic losses from climate change. Given the high-level abstraction and uncertainty of economic damages from climate change, some economists claim current modeling efforts are "close to useless as tools for policy analysis" [24].[68] One can also argue against using any such economic models at all. In all likelihood, we won't be able to tell if we ever reach some "optimal" level of warming.

To wrap up this section on political will, let's make an analogy of Nobel Laureates to the mythological stories of the Greek Gods, who regularly fought among themselves. We can contrast Nordhaus to the scientists within the Intergovernmental Panel on Climate Change (IPCC) and Al Gore who together won the 2007 Nobel Prize for Peace for emphasizing the need to limit climate change impacts by urgently reducing GHG emissions. If we are Ulysses, is the IPCC our Circe, warning us to constrain ourselves in the short term so that we will achieve the future we want? Is Nordhaus a god or a Siren tempting us with the song of immediate growth?

[66] Mike Cummings, *YaleNews*, "Cheers and roses from undergrads for Yale's latest Nobel laureate," October 8, 2018, https://news.yale.edu/2018/10/08/cheers-and-roses-undergrads-yales-latest-nobel-laureate.

[67] Steve Keen, " '4 °C of global warming is optimal'—even Nobel Prize winners are getting things catastrophically wrong," *The Conversation*, available November 14, 2019 at: https://theconversation.com/4-c-of-global-warming-is-optimal-even-nobel-prize-winners-are-getting-things-catastrophically-wrong-125802.

[68] The abstract from Pindyk [24] states: "A plethora of integrated assessment models (IAMs) have been constructed and used to estimate the social cost of carbon (SCC) and evaluate alternative abatement policies. These models have crucial flaws that make them close to useless as tools for policy analysis: certain inputs (e.g., the discount rate) are arbitrary, but have huge effects on the SCC estimates the models produce; the models' descriptions of the impact of climate change are completely ad hoc, with no theoretical or empirical foundation; and the models can tell us nothing about the most important driver of the SCC, the possibility of a catastrophic climate outcome. IAM-based analyses of climate policy create a perception of knowledge and precision, but that perception is illusory and misleading."

Our Nobel gods are in disagreement. The Earth systems models of the climate tell the scientists that we need to rapidly reduce GHG emissions to zero in a few decades. The economic models tell us we don't because they assume the economy grows about the same whether we transform the energy system to reduce emissions or not. Further, the Earth system models must assume the Earth is finite to model the feedbacks of GHG accumulation. The economic models generally assume the Earth is infinite.

No wonder we seem to get conflicting signals! The tragedy (pun intended) is these narratives speak past each other even when cobbled together in the integrated assessment models that force them to have dinner at the same table. The submodels speak the same language of mathematics, but their narratives are incompatible.

I write these paragraphs as a 40-something intently studying energy and economic systems and modeling, but in 2019, 16-year-old Swedish climate activist Greta Thunberg reached the same "Greek tragedy" conclusion and quickly reached the very broad audience of an assembly of the United Nations:

> People are suffering. People are dying. Entire ecosystems are collapsing. We are in the beginning of a mass extinction and all you can talk about is the money and fairytales of eternal economic growth. How dare you? . . .
>
> The popular idea of cutting our emissions in half in 10 years only gives us a 50% chance of staying below 1.5 degrees [Celsius] . . . How dare you pretend that this can be sold with just business as usual and some technical solutions? . . . There will not be any solutions or plans presented in line with these figures here today because these numbers are too uncomfortable and you are still not mature enough to tell it like it is.[69]—Greta Thunberg (2019)

I suppose it is hard to state a lack of political will more succinctly, so let's now turn from tragedy and political will to a narrative that Thunberg railed against. This is the techno-optimistic narrative that many leaders and energy analysts promote: the idea that we can have our cake and eat it too—that we can grow the economy while decreasing energy consumption and greenhouse gas emissions.

The Decoupling and Services Delusion

Decoupling No, this isn't about breaking up with your boyfriend or girlfriend. In the context of economic growth, Chap. 4 defined a decoupled economy in two ways. *Relative* decoupling allows for increased energy and material consumption, as well as higher environmental impacts, as long as they increase more slowly than economic growth. *Absolute* decoupling restricts the energy, material, and negative environmental flows to absolutely decrease even when the economy grows.

[69]Greta Thunberg speech at the United Nations Climate Action Summit, September 23, 2019. Transcript available October 10, 2019 at: https://www.npr.org/2019/09/23/763452863/transcript-greta-thunbergs-speech-at-the-u-n-climate-action-summit.

A McKinsey and Company article summarizes the arguments for relative decoupling:[70]

> The decoupling of the rates of economic growth (climbing steadily) and energy demand growth (ascending, but less steeply) will largely be a function of the following four forces:
>
> 1. a steep decline in energy intensity of GDP, primarily the consequence of a continuing shift from industrial to service economies in fast-growing countries such as India and China.
> 2. a marked increase in energy efficiency, the result of technological improvements and behavioral changes.
> 3. the rise of electrification, in itself a more efficient way to meet energy needs in many applications.
> 4. the growing use of renewables—resources that don't need to be burned to generate power—a trend with the potential not only to flatten the primary energy demand curve but also to utterly change the way we think about power.

I'll save the first item for last and start with the second of their four forces that justifies relative decoupling: energy efficiency. As discussed in Chap. 6, technological improvement might be best defined in terms of the efficiency in converting primary energy into useful work. In this sense, technology and efficiency are effectively one in the same. Data support the idea of the Jevons Paradox, in that energy efficiency is an approach to increase output in absolute, not decrease material inputs in absolute. Thus, energy efficiency and the Jevons Paradox are consistent with the concept of relative decoupling.

Discussing energy efficiency as "behavioral change" is a more daunting prospect. I can directly purchase a new and more energy efficient product, such as a light bulb, car, or air conditioner, such that I obtain the same of level of service with less energy, or more service with a similar amount of energy. If I avoid purchasing a car or as an adult live with my parents, then that might be more related to behavioral change that could lead to conservation, or absolute decoupling.

As noted in Chaps. 5 and 7, the global and U.S. economies transitioned to a different mode of operation during the 1970s, one including behavioral change from both physically and economically constrained energy supplies. One of the major changes was to focus on end-use energy efficiency itself. This change has so far promoted higher absolute growth and consumption, although many did not anticipate that effect. In addition, as summarized in Chap. 7, energy efficiency and other policy responses enacted in response to the 1970s energy constraints promoted, or at least did not prevent, increasingly unequal income distribution.

[70] McKinsey & Company, "The decoupling of GDP and energy growth: A CEO guide," April 25, 2019: https://www.mckinsey.com/industries/electric-power-and-natural-gas/our-insights/the-decoupling-of-gdp-and-energy-growth-a-ceo-guide?cid=other-e%E2%80A6.

McKinsey's third item of increased electrification is consistent with an energy and economic system attempting to reduce energy necessary for operating itself as a set of physical networks. As discussed in Chap. 5, an economy trying to grow and accumulate more "mass" of capital will seek energy efficient distribution of people, materials, and other general stuff. For example, an energy network based on electrons competes against one based on molecules. If you are distributing an energy carrier, do you want to distribute it in a stored state of chemical energy in molecules, such as gasoline in the fuel tank of your vehicle, or an unstored state of flowing electricity?

Historically, fossil fuel molecules have been cheap to extract, and the storage comes almost for free. These benefits outweighed the cost of molecule distribution. The trend toward electricity is driven by the uncertain long-term cost, environmental impact, and availability of fossil energy molecules. Because energy storage in molecules dominates transportation fuels, increased electrification largely translates to increased electric-powered travel. Electric travel might not move away from molecules completely. This depends on whether it will be cheaper to store electrons in batteries or to use electric-driven processes that make new energy molecules such as hydrogen and synthetic fuels, derived from carbon dioxide and water, as drop-in renewable replacements for fossil fuel-based diesel and gasoline.

For the fourth item on McKinsey's list, the authors refer to the company's 2019 Global Energy Perspectives Summary, which states "After more than a century of rapid growth, primary energy demand plateaus around 2030, primarily driven by the penetration of renewable energy sources into the energy mix" and "It [2030] is the first time in history that growth in energy demand and economic growth are "decoupled."[71]

It does seem strange to refer to the future year 2030 as a time in history, but aside from that, how does their reasoning work? A "growing use of renewables," largely from wind and solar farms, affects the accounting of primary energy such that the same amount of final or end-use energy can be associated with less primary energy. Even if we demand the same quantity of electricity in a wind and solar-powered world, the primary energy we associate with that electricity can go down, just due to accounting.[72]

[71] McKinsey & Company, "Global Energy Perspective 2019: Reference Case, Summary," p. 9.

[72] This conclusion is due to two energy accounting artifacts. The first is related to the physical energy content method mentioned in the Appendix. The second relates to how we account for renewable energy flows that we don't convert to energy carriers. Imagine a home where say 100,000 kilowatt-hours (kWh) of solar radiation hit the property per year. With no installed solar panels, the sunlight hitting the house is converted to electricity at 0% efficiency. Now put 20% efficient solar panels on half of the house facing the sun so that 10,000 kWh/year of electricity is generated. Standard energy accounting assumes the 10,000 kWh of electricity start at 100% efficiency because it does not account all sunlight hitting the Earth as primary energy. Physically speaking, in this example, sunlight is converted to electricity at 10% efficiency after installing solar panels but 0% before.

The term "primary energy demand plateaus" is not the most accurate way to describe this effect because consumers like you and I do not directly demand primary energy resources such as oil, wind, and coal. We buy final energy carriers like electricity and gasoline. But will we eventually decrease our final demand of energy carriers, or even our consumption of total useful work? If we do, how can we know if this declining demand is most consistent with either the techno-optimistic or techno-realistic economic narrative? Should one conclusion make us feel better than the other? As the techno-optimistic narrative implies, will we happily chose to decrease energy demand because we found a better way to live? Or as the techno-realistic narrative implies, will we be forced into behavioral changes due to finite Earth constraints?

Let's return to the first item in the McKinsey decoupling list, the metric of energy intensity and its link to often misleading discussions of a service economy.

Declining primary energy intensity is nothing new, but it hasn't always been the case. Recall Fig. 5.3 comparing U.S., U.K., and global energy intensities. Figure 9.5 extends the U.K. and England data backwards for 700 years, to 1300. The industrialization of Britain shows an increasing energy intensity for about 100 years starting after the mid-1700s when heavy industrial output increased rapidly with the steam engine. The U.K.'s current decline in energy intensity started around 1890, while total energy consumption still increased through 1913, at the start of World War I.

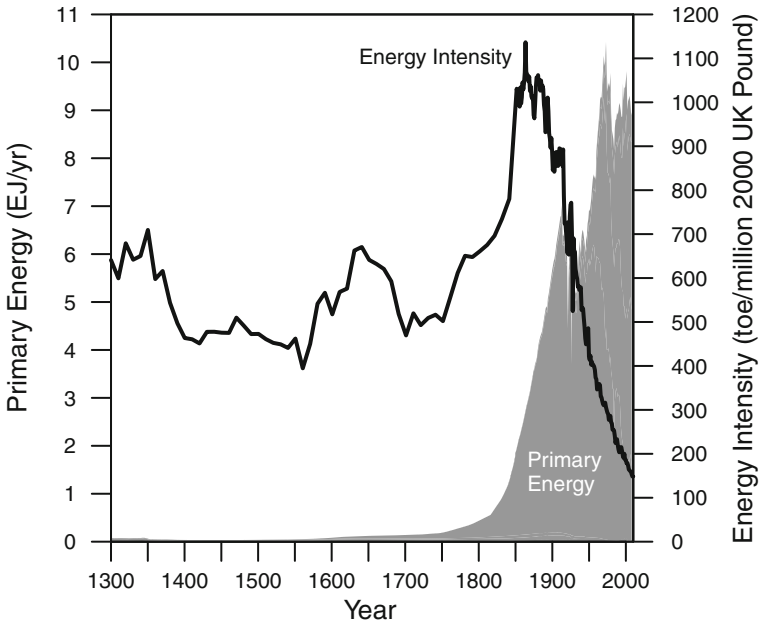

Fig. 9.5 U.K. data show that a decline in energy intensity does not necessarily translate to a decline in total energy consumption. Data from [25]

Estimated U.S. data since 1850 show an overall declining energy intensity, but with a hiatus and rise from approximately 1880 to 1920 (refer to Fig. 6.4). This period of increase also corresponds to the time of rapid expansion in construction of basic infrastructure like buildings and railroads. For example, during this time U.S. steel production increased from hundreds of thousands to tens of millions of tons per year, and railroad track miles increased from 49,000 in 1870 to 254,000 in 1916.

Global data starting in 1900 indicate energy intensity rose until around 1920, remained approximately constant through 1970, and has declined since. Due to the dominance of the U.K. and U.S. as a combined share of global GDP from the 1850s through the Great Depression (between 30% and 43%), those two countries heavily influence the global trend. Thus, both in the U.K. and the U.S., the rapid expansion of heavy industry translated to a period of constant or increasing primary energy intensity. Both the U.K. and U.S. energy intensities started declining while primary energy consumption was still increasing, and well before their primary energy consumption peaked in the first decade of the 2000s. Data to date also show declining global energy intensity with increasing primary energy consumption.

One troubling aspect of using energy intensity and the increasing dominance of service sectors as measures of progress is that the metrics depend on the definition and accounting of GDP itself. As mentioned in the description of GDP in Chap. 2, for most of history, banking services and interest on loans were seen as non-productive costs of business, not as an added contribution to GDP from the banking sector.[73] This changed in the 1990s such that the more net interest and fees a bank charges its customers, the more "productive" the banking sector appears in GDP accounting.

So, energy intensity can decline if all things stay the same, but banks charge higher interest. If the collective masses owe bankers and capitalists more and more interest on debt, then yes, people will have less of their remaining income left to buy material and energy goods. Is this the future you want, or is it the desired future of "the relatively small number of persons" that Bernays told us about, "who pull the wires which control the public mind?"

The McKinsey article also states, "Advanced economies tend to become service economies, and the energy intensity of service sectors is substantially lower than that of industrial sectors—in some cases, as low as one twentieth."

How are we to think of energy intensity as a metric for informing the structure of the economy? How do we interpret what it means to be a service economy? The McKinsey statement itself is fine, but we must include a few important caveats that are lost in many discussions.

First, energy intensity is a blunt metric, but properly interpreted, it still provides insight. By definition it is a measure of relative, not absolute, decoupling. Second, service economies don't have lower energy and materials consumption in aggregate than agricultural or heavily industrial economies. That is, evidence does not show

[73] See [26, pp. 106–108].

absolute decoupling of energy and material consumption for "service economies." Lastly, this is because service sectors don't exist in isolation. Services sectors are only parts of the larger coupled economy composed of many types of sectors and companies.

Let's break down these caveats.

When people refer to service economies, they refer to those with a majority of jobs or GDP in knowledge and care sectors such as business, finance, insurance, and health care instead of raw material extraction, manufacturing, and construction. By only looking at these parts, or sectors of a country's economy, we miss the holistic perspective of how they work together.

Think about your body as an example. Each organ in our body consumes energy at a certain rate, and each performs a valuable function to ensure complete health. We can think of an energy intensity, or energy consumption per mass, of different organs. Our brain consumes about 240 kilocalories per kilogram per day (kcal/kg/day), makes up 2–3% of body weight, and consumes about 20% of our resting metabolism, more than any other single organ.[74] In terms of energy per mass, some organs consume more and some less than the brain. Our heart consumes energy at higher intensity, near 440 kcal/kg/day and the skeletal muscles in our arms and legs at a lower intensity near 13 kcal/kg/day [27].

It is fantasy to think we could convert our body to a lower intensity "skeletal muscle economy" by eliminating or severely reducing the size of our heart and brain. The growth and size of mammals in relation to their metabolism, as summarized by Kleiber's Rule, occurs because lower energy intensity skeletal muscle is *predicated on the existence of the higher energy intensity heart to begin with.*

Only in *The Wizard of Oz* can Dorothy dream of a living tin man with no heart and a living scarecrow with no brain.

One can also analyze the patterns among individual countries. Using data from over 200 countries from 1991 through 2017, Blair Fix analyzed whether there was evidence for either lower fossil energy consumption or lower carbon dioxide (CO_2) emissions from countries that had a larger service sector [28]. He measured the size of the service sector in two ways: the share of total country employment in services sectors and the share of total country value added (or wages and profits) associated with services sectors. In both cases when measuring the trends between countries, the statistics show that a larger services sector is not associated with decreasing fossil fuel consumption or CO_2 emissions.

To summarize, "…the evidence indicates that a service transition does not lead to absolute carbon dematerialization."[28] The reason is that in order to provide more employment or value from services, you first need to be able to take care of more basic material needs such as housing, food, and energy provision. The catch

[74]Lectures of Physics in Medicine, University of Notre Dame, Chapter 2, The Energy Household of the Body. Available July 23, 2019 at https://www3.nd.edu/~nsl/Lectures/mphysics/Medical%20Physics/Part%20I.%20Physics%20of%20the%20Body/Chapter%202.%20Energy%20Household%20of%20the%20Body/2.2%20Energy%20consumption%20of%20the%20body/Energy%20consumption%20of%20the%20body.pdf.

is that more services-oriented economies have tended to provide those basic needs by first consuming a high quantity of energy. A service economy also first needs to build a sufficient base infrastructure during industrialization upon which the service economies later depend. Again, this is the same way our bodies grow.

In the same way that our body's organs and economy's sectors couple together, we can't look only at data within individual countries. Each country is interconnected within a global economy, just like sectors within one country and organs within one body. At the global scale the data clearly show a decline in energy intensity with an increase in total primary energy consumption for the last 50 years (see Figs. 5.2 and 5.3). That is, there is relative decoupling, not absolute decoupling of energy consumption.

The techno-optimists sometimes ignore this global trend of increasing energy consumption to focus on individual country data. Some conclude the U.S. and other rich countries have already experienced absolute decoupling.

For example, Andrew McAfee concludes:

> . . . a great reversal of our Industrial Age habits is taking place. The American economy is now experiencing broad and often deep absolute dematerialization.[75]—Andrew McAfee (2019)

and

> With the help of innovation and new technologies, economic growth in America and other rich countries—growth in all of the wants and needs that we spend money on—has become decoupled from resource consumption. This is a recent development and a profound one.[76]—Andrew McAfee (2019)

McAfee justifies his conclusion by examining data collected by the United States Geological Survey (USGS) on U.S. *apparent consumption* of minerals spanning more than 100 years. He notes that apparent consumption ". . . takes into account not only domestic production of the resource but also imports and exports. For example, to calculate America's total apparent consumption of copper in 2015, the USGS would take the amount of copper produced in the country that year, add total imports of copper, and subtract total copper exports."[77] He presents several charts of apparent consumption of a wide variety of metals (aluminum, copper, nickel, steel, gold) and other materials (stone, cement, sand and gravel, timber, paper). These charts generally show slow growth or a constant level of apparent consumption from 1970 until the late 1990s or early 2000s before a decline in apparent consumption starting sometime in the 2000s. McAfee also recognizes the U.S.'s stagnant primary energy consumption since the mid-2000s.

[75] McAfee [29, p. 84].

[76] McAfee [29, p. 108].

[77] McAfee [29, pp. 78–79]. Further, the USGS "Historical Statistics for Mineral and Material Commodities in the United States": https://www.usgs.gov/centers/nmic/historical-statistics-mineral-and-material-commodities-united-states defines: Apparent Consumption = Production + Imports − Exports plus/minus (Stock Change).

Unfortunately, McAfee's conclusion of U.S. dematerialization is too hasty. Why? The answer has to do with how and where you count material consumption.

Consider buying a new car in the U.S. This car contains steel (mostly made of iron), aluminum, copper, plastics, and other materials. Further, let's assume the metal ores were mined in another country (e.g., copper in Chile). In the natural environment, the metal ores are only a fraction, often less than 5%, of the total mined material. Thus, the vast majority of total extracted material is not merely the targeted metal ore, but other rocks and soil, or mine tailings. There are two important considerations for interpreting apparent consumption. First, it ignores mine tailings. Second, mine tailings exist outside of the U.S., where you have purchased your car. Once you assume these mine tailings are associated with you, the car owner in the U.S., "the broad and often deep absolute dematerialization" disappears like a mirage.

A 2015 paper by Thomas O. Wiedmann and other authors explains the specious nature of McAfee's conclusion [30]. The apparent consumption of the USGS is similar to the concept of *domestic material consumption*, or DMC. If the metal ores are mined in the U.S. and you buy the car in the U.S., then DMC associates the mass of the mine tailings with your car purchase. However, if you mine the metal ores in another country, then DMC associates these mine tailings with the mining country that exported the metal ores, or the refined metal, to the U.S.

Wiedmann and co-authors compared DMC to another consumption-based metric, the *material footprint* (MF), that associates material usage, such as mine tailings, with the country that uses the final product, in this case the car, instead of the country that mines the raw materials of which the car is made.[78] If there were no such thing as globalized trade, we wouldn't need to distinguish material footprint from domestic material consumption.

The researchers used a worldwide data set of material trade and extraction from 1990–2008 to compare the material footprint of the U.S. and other rich countries to their GDP. Upon completing the calculations, it became apparent that *there has been no decoupling of material use.* In the authors' own words:

> The EU-27 [27 countries of the European Union], the OECD, the United States, Japan, and the United Kingdom have grown economically while keeping DMC at bay or even reducing it, leading to large apparent gains in GDP/DMC resource productivity [e.g., relative decoupling]. In all cases, however, the MF has kept pace with increases in GDP and no improvements in resource productivity at all are observed when measured as the GDP/MF. **This means that no decoupling has taken place over the past two decades for this group of developed countries** [30] (emphasis added).

[78] "The difference between DMC and the MF can be explained by the fact that traded goods require much more material than what is physically incorporated in them. Wealthier countries' imports of finished and semifinished products are linked to a larger amount of raw materials compared with the physical quantity traded. This also applies to metals, which are traded in the form of concentrates rather than ores. Nonexported mine tailings are included in DMC of the exporting country, where the MF allocates them to the importing (final demand) countries. DMC will therefore overestimate consumption for exporters of metals and biomass and underestimate it for importers of metals and biomass." [30].

My conclusion, which concurs with many others, including Tim Jackson in his book *Prosperity Without Growth*, is that there is practically no evidence for absolute decoupling of energy and material use.[79] Services-based economies of the rich world seem to have lower material consumption only if you neglect the material use that occurs outside of their borders.

This poses a serious question of whether absolute decoupling is possible. Can we have some kind of prosperous economy that actually consumes fewer resources?

The word *prosperity* in Jackson's book title points to a different viewpoint for services. He calls for servicization of the economy versus the usual notion of a services-based economy.[80] What he means is that to have good livelihoods while consuming fewer resources, we should focus our economies on *human services* rather than economically well-defined service sectors and jobs.

These human services could be provided by companies or governments. Instead of providing food, we should provide nutrition. Instead of providing drugs and medical tests, we should provide health. Instead of providing homes, we should provide shelter. Instead of selling vacation packages, we should provide for leisure and recreation. In addition, somehow we must value the maintenance and protection of physical and natural assets.

Yes, this is easy to write, and not so obvious how to get there. If this sounds like fantasy, Jackson specifically states he does not see this occurring within our current economic paradigm:

> So it all comes down to whether or not it's possible to implement this potential for decoupling. The most crucial question of all turns out to be about society rather than about technology. Is this massive technological transformation possible in our kind of society?
>
> To summarize massively, the answer suggested in this book . . . is: no. In our kind of society, in this kind of economy, it is highly unlikely that we will be able to decouple fast enough to remain within environmental limits or (ultimately) to avoid resource constraints.[81]—Tim Jackson (2017)

Why does Jackson state that we can't decouple our way to indefinite growth? As Raj Patel and Jason W. Moore point out in *A History of the World in Seven Cheap Things*, it is because of the nature of capitalism as well as the use of markets as the main basis for information and decision making. Jackson's human services are exactly those that the economic superorganism, operating within the structure of capitalism, seeks to provide as cheaply as possible:

> What every capitalist wants is to invest as little as possible, and profit as much as possible. For capitalism as a system, this means that the whole system thrives when powerful states and capitalists can reorganize global nature, can invest as little as possible, and receive as much food, work, energy, and raw materials possible.[82]—Raj Patel and Jason W. Moore (2017)

[79] For an extended discussion of decoupling, see Tim Jackson's *Prosperity Without Growth*, Chapter 5: The Myth of Decoupling.

[80] Jackson [31, pp. 142–143].

[81] Jackson [31, p. 164].

[82] Patel and Moore [32, p. 21].

Profits increase not only by accessing cheap nature, energy, and food, but also the human services of care (the health of people and the raising of the young), work, and the maintenance of the nation-states that keep the law and order under which capitalism can thrive. Though law and order are desirable under any socio-economic system, under capitalism companies might seek to provide as little of it as possible or charge as much as possible if their business is law and order. Privatized U.S. prison companies are examples of the latter.

Thus far, this chapter of delusions has gone from degrees of freedom and engineering consent to confidence, political will, and lastly decoupling via services. There is one services sector that deserves special attention, and for which people hold opinions spanning a wide spectrum from the most innovative to the most destructive. Some see the expansion of this sector as the reason why we can absolutely decouple material consumption from prosperity, but others see it as Exhibit A for the decline in prosperity of the middle class. Its activities and restructuring within the last several decades forced rethinking of just how the modern economy actually operates. It exposed the "flaw" in Alan Greenspan's model of the world. It is "too big to fail." I have sporadically referred to it throughout the book. It is indeed the financial services sector.

The Finance Delusion

Finance We often hear the word, but how many of us know what it really means? When I hear people speak of "financing" energy infrastructure investments, I'm reminded of the episode of the 1990s TV sitcom *Seinfeld*, "The Package." In this episode Kramer says he'll help Jerry get a refund on his broken stereo. But because the warranty on the stereo is expired, Kramer comes up with his own plan: make it appear as though the stereo was damaged during shipping. Upon opening the package Jerry receives from the post office, he and Kramer have the following exchange:[83]

> Jerry: What happened to my stereo? It's all smashed up.
> Kramer: That's right. Now it looks like it was broken during shipping and I insured it for $400.
> Jerry: But you were supposed to get me a refund.
> Kramer: You can't get a refund. Your warranty expired two years ago.
> Jerry: So we're going to make the Post Office pay for my new stereo?
> Kramer: It's just a write-off for them.
> Jerry: How is it a write-off?
> Kramer: They just write it off.
> Jerry: Write it off what?
> Kramer: Jerry, all these big companies, they write-off everything.

[83] October 17, 1996 episode of the TV sitcom *Seinfeld*, "The Package." https://www.seinfeldscripts.com/ThePackage.htm.

> Jerry: You don't even know what a write-off is.
> Kramer: Do you?
> Jerry: No. I don't.
> Kramer: But they do, and they are the ones writing it off.

In his scam, Kramer seems to believe that the Post Office incurs no loss of money in providing the $400 in insurance against breakage. In the context of the *Seinfeld* dialogue, a write-off is a business expense, or cost of doing business, that reduces taxable income. By reducing taxable income, there are fewer profits and thus fewer taxes paid. Thus, the write-off is not painless for the company because it is a cost that reduces profits.[84]

Many times people view some barriers to investing in energy projects just like write-offs. What might be holding back investment? Finance. What is finance? Kramer and Jerry could have told the tale in a parallel episode:

> Kramer: Jerry, all these big companies, they *finance* everything.
> Jerry: You don't even know what *finance* is.
> Kramer: Do you?
> Jerry: No. I don't.
> Kramer: But they do, and they are the ones *financing* it.

This book is not about the details and various instruments of finance, but it is worth noting that finance is not one thing. It encompasses a wide array of activities. One such category is derivatives. Warren Buffett and Charlie Munger have often been quoted on what they wrote in Berkshire Hathaway's 2002 letter to shareholders:[85]

> Charlie and I are of one mind in how we feel about derivatives and the trading activities that go with them: We view them as time bombs, both for the parties that deal in them and the economic system.

and

> . . . derivatives are financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal.

I've heard investment managers say that "finance has no moral compass." The gist of that statement is that these managers don't need to think about the consequences of their investments. They just need the rules for investment. To them it is the job of regulators and politicians to set the constraints for finance, but as this chapter's discussion of neoliberalism indicates, the revolving door for lobbyists and regulators means bankers often end up setting the rules anyway.

As Buffett and Munger further noted, the lack of constraints on derivatives is what scared them. Derivatives ". . . call for money to change hands at some future

[84] Using numbers from the *Seinfeld* episode, if the Post Office wrote-off $400 to pay for the stereo insurance claim, and their profits were taxed at 28%, then the cost of the write-off is $288, or 72% of $400, which is less than $400, but not $0.

[85] Available http://www.berkshirehathaway.com/letters/2002pdf.pdf.

date, with the amount to be determined by one or more reference items, such as interest rates, stock prices, or currency values," and to them the scary part is that "The range of derivatives contracts is limited only by the imagination of man (or sometimes, so it seems, madmen). At Enron, for example, newsprint and broadband derivatives, due to be settled many years in the future, were put on the books."[86]

Remember Enron? Enron was voted "America's Most Innovative Company" by *Fortune* magazine for six consecutive years (1995–2000) before its bankruptcy in December 2001. It was the company founded on trading energy, such as natural gas and electricity, and the company that manipulated electricity markets in California. It also manipulated its accounting so much that it fooled practically everyone and triggered the demise of its auditor, Arthur Anderson, at the time one of the top five accounting firms in the U.S. It was the company in which former CEOs Ken Lay and Jeff Skilling were convicted of conspiracy and fraud.[87]

In 2002, events like the Enron bankruptcy were on the minds of Buffett, Munger, and many other people.

On the more mundane side of finance, to which I will now turn, is loaning money to an energy company to extract energy from the environment, whether drilling for oil or building a solar farm. This is the same practice as you taking out a loan for a home or a car, but with one important difference. As a home or car owner, we pay back the loans by earning income from work and perhaps other investments. The income to pay back the loan does not directly derive from the home or car itself. When a company receives a loan for an energy project, however, it generally expects to pay back the loan from the revenue directly generated by selling the energy extracted by the project. The revenue equals the quantity of energy extracted (barrels of oil or kilowatt-hours of electricity) multiplied times the price of the energy. Profit equals revenue minus costs, and at the time of acquiring a loan, future costs and revenues are uncertain to one degree or another. This is the basic risk of debt-based finance, or taking out a loan. Just like write-offs, finance is not free, because it is not free of the risk of losing the money you have invested. Finance is a cost of investment.

The Finance Delusion: Fracking Finance

Consider the cost uncertainties in drilling for oil. First, the cost of drilling, the major cost of oil extraction, can be quite uncertain a few months out. Drilling companies hire drilling rigs by the day, and the drilling cost increases with the number of

[86] Berkshire Hathaway's 2002 Letter to Shareholders, available http://www.berkshirehathaway.com/letters/2002pdf.pdf.

[87] Bethany McLean and Peter Elkind, "The guiltiest guys in the room," July 5, 2006. Accessed July 24, 2019 at: https://money.cnn.com/2006/05/29/news/enron_guiltyest/. For a comprehensive story of Enron, see *The Smartest Guys in the Room: The Amazing Rise and Scandalous Fall of Enron* by Bethany McLean and Peter Elkind.

operating drilling rigs which in turn generally increases with the price of oil. Second, the price for selling oil is uncertain, and this price is influenced by an array of domestic and global economic factors. Because drilling rig costs track oil prices, extraction companies are somewhat, but not fully, shielded from oil price changes. This leads to a third uncertainty, the amount and timing of oil extraction. If you drill today, the oil comes out over several subsequent years or decades. You don't know future oil prices or output, and, thus, your ability to pay back the cost of drilling today is determined by selling oil in the future.

Data provide some confidence in one conclusion from the last decade of U.S. fracking boom: the majority of U.S. companies that primarily drill in shales (i.e., using hydraulic fracturing and horizontal drilling) don't actually make money. The consulting firm Rystad Energy tracks 40 of these companies, and over the last several years, on average only 20% of them have *positive cash flow* after paying for drilling costs.[88] That is to say, 80% of these companies spend more money than they make. In addition, the U.S. Energy Information Administration reported that out of 119 global oil and gas companies, only 15–50% of them had generated more cash from operations than their capital expenditures.[89]

(Now for a three-handed economist-type remark, usually it is just *two-handed*.) On hand one the idea of shale (or tight) oil companies spending more than they make is not all that disturbing. Companies spend money to drill today and possibly build operational capacity, and they sell oil over the next several years. Thus, for any given well, only after several years do they expect to make more money than they spend. This is the nature of waiting for a return on investment.

On hand two this *is* disturbing because this trend has been going on for several years since the drop in oil price in 2014. From any given tight oil and gas well, the rate of extraction typically falls 70–90% after the first three years [33]. Thus, the vast majority of revenue comes in the first few years, actually decreasing the uncertainty in revenue. Because of this high decline rate, it seems that after three to five years since 2014, the industry would be closer to making more money than it spends just to operate and drill new wells. As Rystad notes, "With negative cash flows, shale companies have historically relied on bond markets to finance their operations. Without additional funding and any debt refinancing, capex [capital expenditures, or spending on drilling] would have to be cut." Translation: unless these companies continue to borrow money at interest, they can't afford to pay drilling rigs to keep drilling.

This brings us to the third hand. Investors tend to want to put their money somewhere, and oil and gas is so critical that it commands investment. As noted in Chap. 4, interest rates have resided at unprecedented low levels since the Great

[88]Rystad Energy, "JUST 10% OF SHALE OIL COMPANIES ARE CASH FLOW POSITIVE," Press Release, May 29, 2019. Available July 24, 2019 at https://www.rystadenergy.com/newsevents/news/press-releases/Just-10-percent-of-shale-oil-companies-are-cash-flow-positive/.

[89]Energy Information Administration, "Financial Review of the Global Oil and Natural Gas Industry: First-Quarter 2019," July 2019, available at: https://www.eia.gov/finance/review/archive/pdf/financial_q12019.pdf.

Recession, so borrowing had never been cheaper. Investors couldn't make much money investing in low-interest government bonds, so they moved to corporate bonds, such as with oil and gas companies. Investors were willing to invest in growth of oil extraction, getting paid back via interest payments on debt rather than profitability of the company selling oil. As a result, U.S. tight oil extraction rose from about 0.5 million barrels per day in 2008 to close to 7 million barrels per day by the end of 2018, and total U.S. extraction climbed to more than 11.5 million barrels per day in 2018, higher than the previous peak in 1970.[90]

Low interest rates promoted debt financing that enabled investors to continue to fund drilling. If you believe that oil is still the life blood of the economy, then you have to fund oil extraction because otherwise the rest of the economy can't fully operate. Even many people holding the renewable energy narrative can agree on this point. However, when coupled with the techno-optimistic economic narrative, the renewable narrative posits we can seamlessly replace oil. When coupled with the techno-realistic narrative, it posits the transition might not be as prosperous, but that finite Earth effects force a renewable transition to occur anyway.

So, how long can shale oil companies spend more money than they make? I certainly can't tell the future, and we need much more holistic understanding of how profitable the energy sector might need to be relative to other parts of the economy. Reports show that from 2015 to the first quarter of 2019, 172 North American oil companies went bankrupt, and 100 of these occurred in the two years immediately following the oil price drop in 2014.[91] Almost all of these companies had names you have never heard of, and their assets get gobbled up by companies with names you have heard of. Keep in mind that not all oil and gas companies are solely "shale" companies. The large oil and gas companies that you have heard of (ExxonMobil, Royal Dutch Shell, Chevron, BP, etc.) don't have all their wells in the shale basket.

In the "fracking boom" we have at least the following two narratives, and they both have merit. One narrative is that hydraulic fracturing and horizontal drilling in shales spurred a new era of oil and gas production in the U.S. Absolutely. Companies drilled, and the oil came out. The other narrative is that we are scraping the bottom of the proverbial oil barrel, now going after the source rock where the oil is first formed, and in doing so many companies can't make money. Yes, we drilled and got oil, but we had to spend more money to use more materials to drill a lot more for each drop. This is also true. As with almost all boom–bust cycles from gold to oil, someone is making money, usually those who sell the tools to those prospecting for riches and those that facilitate the financial transactions.

[90]Energy Information Administration, "EIA adds new play production data to shale gas and tight oil reports," February 15, 2019. Accessed July 24, 2019 at: https://www.eia.gov/todayinenergy/detail.php?id=38372.

[91]Haynes and Boone, LLC., Oil Patch Bankruptcy Monitor, May 16, 2019, obtained from: https://www.haynesboone.com/publications/energy-bankruptcy-monitors-and-surveys.

> Thus, the *finance delusion* associated with fracking, or hydraulic fracturing in shales, is not one that denies finance has played a critical role in the U.S. oil and gas boom, it is that it deludes us into thinking it is economically as viable as the previous one hundred years of the industry.

The Finance Delusion: You Want to Finance How Much Renewable Energy?

The finance delusion doesn't hold only for a new era of U.S. fossil extraction. Companies and governments can also finance too much renewable energy. One example is that of Georgetown, Texas, and its local electric utility, Georgetown Utility Systems (GUS). Georgetown is a relatively politically conservative city 30 miles north of Austin. In the early 2010s, Georgetown signed two major power purchase agreements (PPAs) for renewable wind and solar electricity. PPAs are contracts in which a buyer of electricity agrees to purchase all of the electricity from a developer's power plant over some period of time. Even with another existing natural gas power contract, Georgetown had purchased enough wind and solar power to declare, with some fanfare, the city was powered by 100% renewable electricity.

This declaration brought Al Gore to town as he championed Georgetown and its mayor, Dale Ross, as leading the fight against climate change. Gore even featured Georgetown and Ross in his 2017 film *An Inconvenient Sequel: Truth to Power*, a follow up to the 2006 movie *An Inconvenient Truth*.

This Gore-Georgetown connection spurred great headlines, such as "a conservative town leads the way with renewable energy." But while Gore promoted the low-carbon energy angle, Georgetown's major touted how the utility's contracts were based on business fundamentals and the low-cost electricity they locked-in for two decades. Collectively, Gore's and Ross's messages perfectly combine the narratives of renewable energy and techno-optimism.

But by 2018, all was not sitting well with GUS customers. The problem was not that Georgetown was 100% renewable. It was that Georgetown was 160% renewable![92] In 2019, the situation led GUS residential customers to pay for electricity at about 14.4 cents per kilowatt-hour (¢/kWh) instead of the 10–11 ¢/kWh that was typical across the rest of Texas. Assuming a customer consumes about

[92] In 2018, the Georgetown's electricity contracts amounted to annually purchasing 1070 giga-watt hours (GWh) of electricity, but the city only needed 679 GWh. Thus, Georgetown utility customers paid for 390 GWh, or 57%, more electricity than they needed. As of the middle of 2019, the city estimated excess electricity purchases would total 580 GWh, or 85% more than consumed."FAQ Georgetown Energy Contracts" from City of Georgetown website, accessed July 3, 2019 at https://gus.georgetown.org/electric/faq-georgetown-energy-contracts/.

1000 kWh per month, we're talking about spending an extra $400–$500 per year per household.

The city was forced to respond to the controversy, as the "Rumor Control" document from the city's website stated:

> The crux of the current challenge hinges on the large amount of energy the City must clear to the market that is not currently consumed in Georgetown. Like most city-owned utilities, Georgetown contracted for more energy than it currently needs. Any energy that is not consumed by Georgetown customers must be cleared into the energy market.[93]—City of Georgetown, Texas (2019)

It's never a good thing if you need a link on your website labeled "rumor control." While it is true that other city-owned utilities sometimes buy more electricity than they need, the situation of Georgetown is a bit out of the ordinary.

So why did GUS agree to buy so much electricity? Some might say it was because city and utility officials were wined and dined by the Wall Street bankers who financed the deals. Another reason was to obtain a better PPA price due to economies of scale in building larger wind and solar farms. Further, Georgetown assumed the city would keep growing in population such that in 10 or so years their higher demand would absorb the excess electricity. Georgetown also planned to sell the excess electricity into Texas' wholesale electricity market. Georgetown had banked on forecasts that projected electricity prices would be higher than their PPA prices. Thus, they thought they had bought low and were going to sell high. As of 2019, the opposite was occurring.

The full story takes a few pages to lay out, and I've put this story in the Appendix. It explains in more detail why GUS's purchases of *low-cost* wind and solar electricity led them charging *higher electricity prices* to their customers.

Needless to say, Georgetown's electricity situation was ripe for attack for those promoting the fossil energy narrative. A lead actor was the Texas Public Policy Foundation (TPPF), a Texas-based conservative think tank that promotes markets and limited government.[94] They pounced on Georgetown's decisions as exemplary of the overreach and poor decision making by a few elected officials and bureaucrats that can occur within cities and regulated utilities like GUS.

In a summary of an August 2018 community event in Georgetown, TPPF stated "Attendees received a thorough run-down of everything energy including why renewables are unreliable, more expensive, and unsustainable. And why 100% renewable simply isn't doable."[95]

[93] "Rumor Control" document from City of Georgetown website, accessed July 3, 2019 at https://gus.georgetown.org/electric/rumor-control/.

[94] The Texas Public Policy Foundation website states "Through research and outreach we promote liberty, opportunity, and free enterprise in Texas and beyond.", accessed July 25, 2019 at https://www.texaspolicy.com/.

[95] "Is Georgetown Really 100% Renewable?" https://www.texaspolicy.com/is-georgetown-really-100-renewable/.

To the "more expensive" comment, see the Appendix which describes how to consider Georgetown's costs and power purchases in the context of the entire electric grid. I will not readdress the oversimplified "reliability argument" since it was discussed in Chap. 3.

The TPPF's comments on Georgetown, Texas provide an opportunity to end the chapter on a social meme. Their Vice President stated:

> . . . there is a multitude of things that may distract an elected official from attending to local voters' concerns. Unelected staff may have their own agendas that they seek to impose upon the elected officials for whom they ostensibly work. Outside special interests may appeal to them. Popular issues that have little or nothing to do with their office may command their attention—for instance, city council members passing foreign policy resolutions or environmental ordinances that aren't within their scope of responsibility.
>
> In the City of Georgetown's case, the distraction from the basic services came in the form of a virtue signaling energy policy cloaked in the guise of responsible fiscal policy.[96]—Chuck DeVore (2018)

Virtue signaling is a meme describing a person expressing an opinion for the purpose of displaying his moral superiority. It has been used to mock people who post political or social stances via social media platforms, but who otherwise take no concrete action or have no direct authority to promote their view.

The term comes from the biological concept of *signaling* where a prey provides a visible signal to a predator that it is either dangerous or futile to try to eat it. For example, when a gazelle notices a stalking cheetah, it might perform a jump (called stotting or pronking) as a ". . . way of telling the cheetah that he sees her, has a head start, and that a chase would be futile." [34][97] Because of this communication, the cheetah smartly does not waste her energy on chasing the gazelle. We presume the gazelle and cheetah have no notion of these logical thoughts in their heads, but the data show what predators do avoid going after pronking prey.

Instead of virtue signaling, Georgetown's contracts for 160% of its electricity consumption are actually *over signaling*. Georgetown's actions are more akin to a gazelle jumping up and down so much such that it tires itself out, allowing the cheetah to more easily chase it down. In the context of the economy as an evolving superorganism, we might say Georgetown is a species that mutated so much more than the rest of the economy that it incurred higher immediate costs relative to other utilities that purchase a lower percentage of renewable energy. The utility's mutation was in the right direction of lower-cost electricity (particularly low operating costs), but perhaps a little too far for its immediate benefit in a slower changing economic environment.

To focus only on Georgetown is to be too narrow, however. For all of the higher electricity costs paid by Georgetown's utility customers as of the writing

[96]Chuck DeVore, "Texas Taxpayers Pay For Political Virtue Signaling With Costly Renewable Energy," *Forbes* online, December 17, 2018. Available June 20, 2019 at: https://www.forbes.com/sites/chuckdevore/2018/12/17/texas-taxpayers-pay-for-political-virtue-signaling-with-costly-renewable-energy/#5bbc9acd46a6.

[97]Lents [34, p. 279].

of this book, they have, if ever so slightly, decreased the *negative environmental externality* from carbon emissions. Since Georgetown's PPAs led to more actual physical power plants generating low-carbon electricity, they also move the needle, if ever so slightly, toward a lower-carbon grid. Because GUS bought more renewable electricity than its customers need, it also lowered wholesale electricity prices for others. In other words, electricity is more expensive for Georgetown, but for Texans overall, electricity is cheaper, thus providing a *positive economic externality* to other Texans.

What is Georgetown to do? TPPF was happy to pose three options: "As of today, residents of Georgetown who aren't pleased with paying more for their electricity for the privilege of making the dubious claim to 100% renewable power have three options: vote in a new set of elected officials who promise to focus on the basics of local governance, convince the legislature to end the electric monopoly extended to municipal government, or move out of town." Of course, these false choices aren't the only three options. By default, most residents will stay. Instead of appealing to state lawmakers, the residents could help their utility find buyers for their extra electricity. While it might seem strange that an entity promoting individual liberty suggests the invocation of action from state officials who are even further removed from individual circumstances, recall that neoliberalism promotes a strong government to enforce increased use markets, such that attacks on municipal authority are common. Remember the Denton, Texas story at the beginning of the book?

As of the writing of this book, we don't know the full value of Georgetown's renewable electricity contracts because there are still about 20 years to go to find out. Given this future uncertainty, in 2019 Georgetown's mayor Ross stuck with his earlier decisions: "I don't think I've let citizens down . . . We did what we believe was the right thing. I was very effective at spreading the message of green and our success story. I think the long term is going to prove that to be true."[98] Only time will tell.

Summary: Delusions from Free Will to Finance

This chapter discussed how an overreliance on economic narratives, or memes, such as confidence, political will, and decoupling via services and finance can distract us from understanding how the physical basis of the economy plays a role in our socio-economic outcomes and decision making. It is not that these ideas are false, but we must understand how our choices, what we see as freedom of choice among our

[98] Sharon Jayson, US News & World Report, "Texas City Leaders Face Wrath of Residents Over Green Energy Deal," March 28, 2019. Accessed July 25, 2019 at: https://www.usnews.com/news/cities/articles/2019-03-28/in-georgetown-texas-a-clean-energy-deal-falls-flat.

various options, or degrees of freedom, are constrained by what we understand to be the energetic and physical nature of ourselves, our world, and our economy.

While we each have a large degree of agency, or ability to choose our actions, collectively the economy follows certain patterns as outlined in Chaps. 5 and 8. The concepts of confidence, in economic growth and future social outcomes, and political will are linked to social power, and social power is linked to the technological ability to use physical power by extracting energy (at some rate) from the environment and converting it to useful work. Social power is the ability of an individual or group to influence the behavior of others, by controlling energetic processes of interest to them, without the powerful group having to change its own behavior in an undesirable manner, such as accessing fewer resources and energy.[99] Thus, a lack of political will can be seen as politicians recognizing they do not have social power over businesses' or citizens' access to resources. Social power also exists for entities such as countries, and any social power of one country over another depends on their relative abilities to extract energy from the environment. As Richard Adams stated, "It is the actor's control of the environment that constitutes the base of social power."[100]

The meme of decoupling material and energy consumption from economic growth attracts many, but at a high level the data do not support that it happens for developed economies, much less the global economy. We come to this conclusion by looking at the historical data—the data describing all economic and physical processes.

While we can try to understand the past by looking at data, we cannot do this for understanding the future. That is part of the definition of the future—there are no future data. To infer what we think is possible in the future, we must use our existing knowledge, worldviews, and models. As this book has discussed, everyone neither shares the same knowledge nor uses or believes the same worldview and models. Given that premise, the final chapter describes how we can both contemplate a wide range of future scenarios and discuss some of the important ongoing and future energy and economic questions facing society for the next several decades.

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[99] See [22, p. 121].

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