

# **The Economic Superorganism**

Chapter Abstracts (5/9/20)

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## **1 Energy and Economic Narratives**

This chapter introduces the reader to the concepts and ideas within the book. A real-world story of a Texas town voting on whether to allow natural gas drilling within its borders leads to defining the two types of narratives, those of energy and economics, that form the basis of the book. The competing energy narratives are those that promote fossil fuels versus those that promote renewable energy. The competing economic narratives are those whose worldviews center on technological optimism and the assumption of infinite substitutability of technology and human capability for physical resources versus those whose worldviews center on technological realism and the consideration of feedbacks from the finite Earth. Using these narratives for context, the chapter includes contemporary stories and debates that show how the narratives play out in media and the public sphere.

## **2 Energy and Food: The Megatrend of Megatrends**

This chapter introduces the core data and concepts of energy. It provides a brief history of the concept of energy, and distinguishes the concept of energy from that of power. The chapter focuses on historical data for both energy consumption and spending on energy, including food, for the United Kingdom, United States, and world economies. The data provide the context for understanding both how the world economy has grown to the present time and how contemporary economic struggles relate to the rate and cost of energy consumption. The data show that in the history of mankind, the cost of energy plus food has never been cheaper than around the year 2000.

## **3 The Energy Narratives: Fossil Fuels versus Renewables**

This chapter summarizes the competing narratives for and against the use of fossil and renewable energy resources and technologies. The chapter presents pros and cons as expressed by each narrative so that the reader understands how the narratives do and do not relate to data from Chapter 2. The pros and cons are expressed via several concepts used in debating the energy narratives: energy resource size, the price of energy, energy reliability, morality, energy in economic development, environmental impacts such as land and greenhouse gas emissions, and government support, or subsidies.

#### **4 Other Megatrends**

Along with energy consumption and expenditures, there are several other megatrends of the global economy whose data provide context for navigating and interpreting the energy and economic narratives. This chapter summarizes several of the most important trends for assessing the state of society and the economy: population growth and age demographics, debt and interest, wages and income distribution, and infrastructure. The reader is introduced to data for considering such questions as “How would population growth and age distribution change if the Earth were infinite versus finite?”, and “How might we relate growing debt-to-GDP ratios and declining central bank interest rates to energy consumption?”

#### **5 Systems Thinking for Energy and the Economy: Size and Structure**

In Chapter 5 the book shifts from exploring data trends and stories to a synthesis of how the trends relate to each other. The chapter begins by describing the concept of systems as a method of thinking and modeling before summarizing the philosophy of naturalism as a means for understanding the world in which we live. The chapter describes the concept of net energy, or how much energy it takes to extract energy from the environment, as a concept for understanding the feedback of energy costs to economic growth. The idea of distribution networks is used to compare observed trends in biological organisms to that of the economy. The chapter uses the concept of growing systems to explain a 150 year-old idea that explains how more efficient energy consumption in cars, homes, and other types of capital and machines leads to more energy consumption within the overall economy, not less. The chapter ends with explaining research and data on growth cycles (e.g., of population) of pre-industrial civilizations and societies such that we can consider analogies to our present fossil-fueled industrial civilization.

#### **6 Macromodel on the Wall, How Does Growth Occur, After All?**

There are many recognized problems with neoclassical macroeconomic growth modeling. This chapter explores a small number of core criticisms that relate to how the theory does and does not consider the role of energy, or power more precisely. The chapter discusses key economic theories and assumptions that, unbeknownst to the vast majority of people, guide policies. The chapter focuses on (i) the concept of total factor productivity, which is an assumption input that dominates results of neoclassical growth models, and is a major flaw, and (ii) the lack of consideration of debt. The chapter discusses implications of using current macroeconomic theory to investigate the cost-benefit tradeoffs of a low-carbon energy transition. In essence models based on neoclassical theory are incapable, economically speaking, of distinguishing a 100% fossil from a 100% renewable energy future. The chapter introduces research findings that more accurately describe economic growth with respect to energy consumption. This shows how by modeling economic growth from both a biophysical perspective (e.g., tracking material flows as well as energy flows and conversions, using the concept of useful work as energy times its efficiency of use) and a stock-flow consistent economic approach, we can much more accurately match flows of energy to flows of money, such as GDP and wages, and stocks of money such as debt. These are the modeling ideas that are needed to guide energy and economic policies, such as those that inform a low-carbon energy transition.

## **7 Summary of U.S. Energy and Economic Trends**

This chapter summarizes many of the U.S. data discussed in the previous chapters into one location. Because the U.S. has good data and has been the dominant world economy for much of the past 100 years, a look into its energy, economic, and political trends provides insight into what other countries might aspire to attain and avoid, yet be challenged to avoid the same growth cycle that peaks in structural complexity. The U.S. economy went through three growth phases since World War II. Phase 1 runs from just after World War II until the late 1960s and early 1970s. Phase 2 runs until a time period around the turn of the Twenty-first Century, and Phase 3 continues since then. This book emphasizes the need to consider economic size and structure, and each phase is characterized by different trajectory of structural change that relates to the rate of energy consumption (in total and per capita) and the cost of energy (including food).

## **8 A Narrative that Works for Both Energy and Economics**

This chapter houses the concept behind the title of the book: a coherent combined energy and economic narrative is that the economy operates as a superorganism in a similar manner as the biological organisms, such as animals and ant colonies, as described in Chapter 5. By considering the economy as a superorganism, one can dismiss the dichotomous competing energy and economic narratives as avoiding the real question about whether we can know the purpose of the economy or direct its growth and structure. The economy, just like biological organisms, exists within an environment from which it must extract energy and resources that are consumed for the purpose of growth and organization. This narrative is consistent with the natural laws of physics, information, ecology, and evolution. While the economy as a superorganism does not necessarily relegate us to complete bystanders, it does force us to think about why we make the decisions that we do and why certain types of economic organization are more replicable than others.

## 9 Delusions of Control

This chapter discusses several ideas and explanations provided by economists and political scientists for economic growth, distribution and consumer choice, but that ignore the important biophysical constraints discussed in the previous chapters in the book. These are consumer confidence, political will, decoupling (of economic growth from material consumption via a service economy,) and better finance. Thus, while these narrative statements do have merit, they typically ignore critical physical principles. These supposed explanations of economic fundamentals and drivers are often associated with either energy narrative, per the needs of the author, with the implication that with a little tweak of policies and energy system design, the economic system can continue to grow in a similar manner as the past century, but these are largely delusions that must be grounded in physical principles. While exploring these ideas, the chapter briefly introduces the contrasts between several of the “-isms” about which people pundits debate: capitalism, socialism, and communism, as well as concepts such as neoliberalism, lobbying, and economic cost-benefit analysis. The chapter discusses how these “-isms” might philosophically link to the concept of the economy as an evolving superorganism. The chapter also discusses how we can interpret our social options, hierarchies, and choices in the context of our ability to extract energy from the environment. Even lobbying and

## 10 Scenarios and Trends of The Future

Are we humans freely choosing our future societal and economic organization, or does our organization emerge in response to physical laws as we interact with the natural world around us? We don't have to explain the human economy in the context of only social rules or natural laws independently from each other. Not only can we use both social rules and physical laws to assess the constraints and possibilities for future energy and economic scenarios, we absolutely must. In assessing the current state of society and possible future trajectories, we can and should update our assessments and narratives to be consistent with observations.

There are many ways to think about what the future might hold, and many ways to be wrong. This chapter summarizes a set of four different broad trajectories for the future, ranging from continuous growth and technological advancement to collapse. In this chapter the reader is asked to contemplate and continue a discussion whether we can understand why certain policies and forms of economic organization endure more than others. Can we control, or should we kill the economic superorganism that seems to pursue economic growth and increasing energy consumption?

We are caught in a conundrum. On one hand the individualistic and profit-seeking structure of the economic superorganism is what drives innovation, creativity, and the ability to both create and solve energy and environmental problems. We seem to want this feature. On the other hand, the biophysical nature of the superorganism means that physical limits and natural laws constrain its space of solutions such that we might not be able to solve all social and environmental problems simultaneously. We might not want these physical constraints, but we have to deal with them.

The chapter includes thinking of this conundrum via a few tradeoffs: between increasing labor productivity and meaningful employment; between economic growth (and increasing consumption) and

competing approaches (e.g., carbon prices, federal plans, divestment from fossil fuels) to decrease greenhouse gas emissions. It is these tradeoff conversations that can best prepare us for the future such that we are not as surprised or confused as we otherwise might be.