

LIVING IN THE FUTURE'S PAST

WHAT KIND OF FUTURE WOULD YOU LIKE TO SEE?

Introduction

This is an interdisciplinary film containing branches of study that include but are not limited to, philosophy, evolutionary biology, physics, ecology, cultural anthropology, psychology, chemistry, sociology, metaphysics, spirituality, natural resources, history, mindfulness, political theory, and economics.

Film Synopsis

Academy Award winner Jeff Bridges shares the screen with scientists, profound thinkers and a dazzling array of Earth's living creatures to reveal eye-opening concepts about ourselves and our past, providing fresh insights into our subconscious motivations and their unintended consequences.

Living in the Future's Past shows how no one can predict how major changes might emerge from the spontaneous actions of the many. How energy takes many forms as it moves through and animates everything. How, as we come to understand our true connection to all there is, we will need to redefine our expectations, not as what we will lose, but what we might gain by preparing for something different.

For Teachers - how to use this guide

The guide below can be used to suit various classroom situations and discussions depending on the age of students and length of time devoted to discussing the concepts in the movie.

Part 1 For Discussion Starters we have two (2) reviews of the film. Ask students to read the reviews and watch the film.

- 1) After you watch the film ask students if they agree with the assessment in the review or ask students to write their own reviews.
- 2) What was something they thought was important, interesting, unique or surprising in the movie?
- 3) Why do you think the movie is called 'Living in the Futures Past'?
- 4) We have provided a glossary of terms in the film. Which parts would students most like to explore further?

Part 2 of the guide provides a summary background on the main themes from the movie.

Part 3 is a glossary of vocabulary terms that are either new or are used in a new context in the film.

Part 4 is a list of questions to discuss and consider – we have provided too many to fit into a single class session - individual instructors can select a few to focus on that fit their class.

Part 5 the movie weaves together many scientists and other experts who sequentially explain aspects of human behavior, energy and environmental issues. Since so much was packed into a 90-minute movie, many of the statements in the film require longer explanations and context. **Several of the people involved in the film have provided additional information as a summation of their role in the movie and their respective expertise. Where possible we have provided hyperlinks in BLUE to their work.**

Part 6 provides a bibliography for further reading, links and a list of additional materials that can be used to delve deeper in these interrelated topics.

Part 7 Special Projects idea suggestions

*All quotes from the film are in GREEN

Part 1 - Film Reviews and Class Discussion

Review 1 - Excerpt from 'Lolo Loves Films' by Josh and Lauren Rains lololovesfilms.com

A documentary that examines the nature of man and the environment as told in terms of energy in its forms. By now, we should all be aware of the environmental issues facing our world today. So why is it that we have such a hard time accepting the facts and looking for solutions? "Living in the Future's Past" tries to break down



"The internal and external are always entwined."

these complex problems for us. It is an environmentally-conscious film that hopes to help people understand our surroundings and existence in terms of energy. Every single thing, from life to the economy, even down to our desires, all stems from the production and consumption of energy, whether it be from sunlight or fossil fuels, food or labor. Despite our belief that we are many individuals, this movie tries to teach us how mankind as a whole is actually part of one super-organism

that lives in a symbiotic relationship with each other. The film includes interviews with countless experts on philosophy, science, psychology, and sociology to discuss how our actions affect the future and why mankind has such a hard time changing its ways.

The goal of this film is to help us truly understand the core issues we face as an interconnected world on the brink of something massively devastating. At the most basic level, that core issue is the consumption of energy.

Humans need energy to live. Their fuel is food, and it takes energy to grow food, whether it be from more food to feed the animals we eat, fossil fuels to run the tractors and other machinery needed to grow plants, or the very manpower and calorie expenditure it takes for a laborer to produce goods. Everything is energy. Our economy, our currency, microwaves, and penguins, everything can be broken down to surpluses and deficits of energy.



"Our problems can no longer be pushed into the backyards of the less powerful, the less fortunate."

This movie also delves into our basic instincts as animals, including the way we think, and why those processes contribute to the ongoing crisis related to climate change. It also investigates how we have a psychological tendency towards tribalism, and how we look for ways to place blame on others to alleviate our own guilt about these issues. It looks at how we have a tendency to search for information that confirms our personal preexisting biases and how we often ignore any alternate ways of thinking that challenge those inclinations.

"Living in the Future's Past" is a lot to take in. It is a very dense subject matter presented in a very intellectual



"The way we live is an anomaly."

way. Watching this movie was almost like attending a stimulating lecture at a university from a professor who knows how to engage the audience and create a desire to want to learn more about the subject. It's not trying to scare the viewers. It isn't relying on our empathy. It is all about scientific data and what that data points to. It presents the facts in a way we haven't seen before and allows us to think critically about the interconnected nature of all things.

Review 2 - David Fergeson appearing in The International Policy Digest [International Policy Digest](#)

Director Susan Kucera and producer/narrator Jeff Bridges are smart enough to avoid cramming another preachy, guilt-laden, ‘destroying the world’ documentary down our movie-going throats (which is where popcorn belongs). Instead, they deliver a thought-provoking look at who we are, where we have come from, and where are we headed based on our actions and decisions of today.

Breath-taking photography is on display throughout the film – much of it in the beautiful National Geographic style we have become spoiled with over the years. Some of it is even more dramatic and impactful. There are images of oceans, Earth and of space. When Bridges’ familiar and warm voice tells us “The sky itself is not the limit,” we realize this movie is something different than expected.

Many experts are paraded out, and they come from various segments of society: Ecological writer and researcher Timothy Morton, former NATO Supreme Allied Commander General Wesley Clark, Ethno-botanist Mark Plotkin, astronaut Piers Sellers (since deceased), Physicist Leonard Mlodinow, as well as other scientists, politicians, and professors. The conceptual links between evolution and energy are a bit esoteric at first, but explanations and examples bring clarification.

Perhaps the most interesting aspect of the presentation is the blend of the scientific with the philosophical. The theory that what we “need” or “desire” drives our motivation on decisions and actions seems more than plausible. It is explained that we are “cultural beings” and our inherent need for group identity leads to the mass consumerism of society.

The difference between adapting to our environment versus controlling it is made clear by the comparison of bees and ants to our own mega-growth cities. Mr. Bridges’ home was recently destroyed by the Montecito mudslides, but that fact is not part of the film. Ms. Kucera’s film is not a lecture about climate change or how humans are ruining the planet, although it is certainly intimated. Instead, this is more about humanity – what makes us tick and what environmental challenges do we face now and in the future? How do we shift our decision-making from our own comfort and convenience to long term sustainability of our species (and others)? The film is presented well, thought-provoking, and yes, quite beautiful to look at.

Film Viewing, Review and Discussion

To get the discussion going have students watch the film and then read the reviews.

Questions:

- 1) Did you think that the reviews presented an accurate assessment of the content of the film? Were there areas the reviewers overlooked?
- 2) What parts of the film did you find most interesting, surprising or confusing?
- 3) Ask students to read the glossary to see if they would like to add some other terms.
- 4) What subjects in the film are you interesting in learning more about? What subjects did you disagree with?
- 5) What do you think the title, “Living in the Future’s Past” means?

Part 2 - Summary For Teachers

There are 5 themes overlapping throughout the movie and #6 is for the Bonus Material

1. Evolution/Behavior/Brain

- Humans ability to transform our environment in clever and creative ways has enabled 7.6 billion of us to spread to virtually all corners of Earth, with among the highest standard of living in our species history
- Despite all our uniqueness, we - *Homo sapiens* - are part of the animal kingdom, subject to the constraints and requirements that nature has shaped for biological species
- Evolution is a process by which organisms become more efficient at extracting resources from their environment
- Humans are unique. What makes us so different from all other animals is our mastery of technology that allows us to transform our environment in significant ways
- We are fundamentally a cultural species and this allows us to cushion ourselves against the harsh realities of the environment and to redefine our ecology
- We can trace human ancestors back over four million years, and anatomically modern humans for more than 200,000 years and we have inherited their successful survival traits
- For 99.9% of our evolutionary history, we were hunter gatherers, living in small kin groups where everybody was related and had a vested interest in taking care of each other
- Before agriculture, humans lived off of the land in such a way that we did not live beyond the carrying capacity of the environment
- Before the invention of agriculture, there was no surplus of resources creating a very egalitarian social system where women had autonomy and there was no rigid dominance hierarchy among men
- The Neolithic Revolution started around 12,000 years when we domesticated plants and animals. That's a blink of an eye in evolutionary terms. Controlling the production and distribution of surplus resources led to a change in human cultural and social organization
- Agriculture led to a rapid increase in population growth followed by migration to cities. People spent less time producing food resulting in innovation, complex problem solving and intellectual pursuits such as art, music and increasingly complex technologies
- The human brain is a complex and highly evolved organ. The emotional impulse areas of the midbrain drive desire for things that gave our ancestors a survival and reproductive advantage
- Our evolved urges and desires can have harmful effects in modern times of plenty. (e.g. cravings for fat and sugar - In past environments, it gave an advantage: now leads to obesity, diabetes, high blood pressure)

- Our brains are easily hijacked by technology, novelty and excess available in modern society thus potentially leading to habituation, addiction, and overuse of consumed objects
- We are incredibly social animals
- Our culture - via information exchange - can manifest emergent behaviors (both positive and negative)
- Emergent behaviors develop much more quickly than natural selection can evolve physiological adaptations in rapidly changing environments
- Emergent behavior is complex and often detrimental to the planet, ourselves, and many other species

2. Energy/Economy

- Energy underpins both nature and human societies
- Animals that consume significantly more calories from their prey than they expended in obtaining it have advantages in survival and reproduction
- Human societies lived as hunter gatherers for 290,000 of our 300,000 year history in modern anatomical form
- Only in the past 10,000 years did we stay in one place, develop infrastructure, acquire capital and store surplus
- Modern humans and modern economies both eat ‘energy’ in the same way animals eat food
- Every object and service in human economies first requires an energy input to convert it into something useful
- The majority of the energy used in human systems is fossil carbon and hydrocarbons that do not renew on human time scales
- There is plenty of fossil fuel left but we’ve used up the cleanest and easiest to access
- Technological alternatives to fossil energy are now available and getting cheaper but are unlikely to maintain our current levels of societal complexity and consumption
- Energy, other than perhaps its cost in dollars, is invisible to our society. We are energy blind.
- We live in a world of material abundance and inexpensive energy, this is not the normal human condition
- Until the modern era, 90% of human economies were devoted to the production of energy (food)
- Life is based on solar flows. Photosynthesis, rain and soil use energy from the sun to grow plants, animals eat the plants, and we eat the animals. Energy transforms from one state to another.

- The chemical composition of 50% of the protein and 80% of the nitrogen in our bodies indirectly comes from the chemical signature of fossil fuel.
- In hunting and gathering societies, solar energy provides enough food to support one person per square mile. Basic subsistence agriculture supports more people, but nowhere near modern population densities. The way we live is an anomaly.
- Our net energy is declining which means that it is costing us more in energy to grow food/extract fossil fuels than the energy it provides in return. This is highly inefficient. The benefits to society are outweighed by the collective cost to the environment

3) Environment/Ecology

- The word environment technically means ‘environs’ ie: everything encompassing the surroundings or conditions in which a person, animal, or plant lives or operates
- Ecology originates from the Greek word Oikos, and is the study of the relationship that interlinks all the members of the Earth's household.
- We can't think of ecology as only existing over there, beyond, because it has no boundaries and is in a state of constant flux.
- Ecology is intimate, coming right up to our skin and through it, it is permeable and borderless and chaotic. The internal and the external are always entwined

4) Human Impacts on the Environment

- We all ‘pay’ the cost of energy in all its forms like food and fuel in some way or another.
- Our current economic system only pays for the cost to extract, process, and deliver (fossil) energy to the consumer not the by-product of CO₂ which is building up in the atmosphere and oceans and as a consequence
- 17 Terawatts of energy is continuously being used by our global society (the coal, oil, natural gas, nuclear, hydro-electric etc. we consume, is equivalent to 18 trillion watts of power (180 billion 100 watt light bulbs turned on all the time)
- We are experiencing an increase in the acidity of the oceans, a warming of the air and oceans
- These rapid changes in earth’s environment are resulting in an increase in extreme weather events and other factors such as deforestation, loss of animal populations and biological diversity and an increase in plastics/ toxic pollution
- Most of these problems are considered ‘externalities’ as their loss is not considered in our daily economic prices and decisions.

- These externalities are occurring across the globe and in the future
- Though we see events in our backyard or local rivers and forests, we are largely '*earth blind*' when it comes to our impacts on planetary climate ecosystems like the deforestation in the Rainforest and elsewhere.
- This is starting to change as more people become aware - and care about - the larger world we are a part of
- Doubling of carbon dioxide will lead to about 2.5-3 degrees of global warming, resulting in massive climatic disruption - rainfall belts will move, hundreds of millions of people, will have difficulty accessing fresh water and food
- In Earth history, things change gradually. 100 million years ago there was a similar increase in CO2 as we see now - BUT the climate change happened over about 40,000 years
- The faster the climate changes, the less time organisms and ecosystems have to adapt
- Climate change is going to put huge stress on societies that are already under internal political stress, and stress induced by lack of resources
- Availability of food and water and other weather events associated with climate change will exacerbate divisions in society
- Access to wealth creates divisions. Access to basic resources such as food and water makes these divisions more pronounced
- The impact of climate change will result in people migrating, increased conflicts over resources and the destabilization of governments
- Countries must work together at the global level to address issues that effect our planet. We are all dependent on the earth for survival, what one does effects us all
- Plastic is made of fossil fuel and it never really goes away. It gets recycled and broken down into smaller and smaller pieces, and now it's detectable in our food and even our blood stream

5) Philosophy, Mindfulness and Conscious Awareness

- We don't often think about our human traits or the explanations of how they evolved.
- Thinking about how we think (a.k.a. metacognition) is an important step towards wisdom, and cultural change
- Science has revealed that humans are just another animal and that, as individuals, we are not as independent and in control of our actions and behaviors as we think we are

- Humans have an impressive ability to process information and to discover things, which is what brought us to the amazing state of organization and wealth we experience today
- Humans are psychologically adapted to pay attention to immediate threats but have a tendency to ignore or avoid information about long term threats or information that makes us feel uncomfortable
- Borders and boundaries between humans and nature are said to have evaporated so nothing is really ever externalized
- We (mostly) respond to facts and data only if they fit with our existing beliefs, emotions, and what prominent people in our 'tribe' are saying
- We prefer simple stories (and solutions). Complex problems and their solutions, however accurate, are difficult to get our minds around, and require us to use slower more analytical thought processes instead of the faster, emotional, motivation centers that lead to behavioral response
- We like to compare ourselves to others
- We are chock-full of cognitive biases: loss aversion, denial, authority bias, groupthink, cognitive dissonance, confirmation bias etc. These biases allow us to rationalize our current behavior but we also have the capacity for adaptability and change
- Every \$1 of electricity has significantly more value to our system than \$1 worth of pencils, paperclips or pastries. But since we spend dollars - (or euros, or yen, etc.) to pay for things, and because energy has been very cheap, our current culture tends to be unaware of the critical importance of energy to our economies
- An individual starting their car is statistically meaningless, but billions and billions of car ignition turnings has a meaning, and that's the paradox. We are enmeshed in systems of production, systems of manufacture, systems of consumption
- The concept of "the balcony of the mind" refers to the act of consciously examining an issue from the perspective of rational logic, where both short and long term consequences are considered and examined before action is taken
- We cannot know what every consequence of every action has and everyone's perception of reality often comes from the value judgments one places on 'things' that exist which can include thoughts, ideas, the future and the past, people, animals as well as all of the objects we interact with on a daily basis.
- It is important to understand that we should not feel guilty but try to embrace our desire and abilities to know ourselves better, see how the movement of goods and energy function and harness our flexibility and ability for ingenuity and capacity for compassion.

6) Bonus Material Discussion

In the 10 minutes of Bonus Material some of the participants in the film including the Producer and Director

express their personal thoughts. Buckminster Fuller “Bucky” and some of his ideas and philosophies are discussed.

Richard Buckminster Fuller (12 July 1895 – 1 July 1983) was an American [philosopher](#), [systems theorist](#), [architect](#), and [inventor](#).

“The Things to do are: the things that need doing, that *you* see need to be done, and that no one else seems to see need to be done.” Buckminster Fuller’s metaphor of the Trim Tab comes up in the context of how all our small actions accumulate to move the larger ship that is the greater human endeavor.

“Something hit me very hard once, thinking about what one little man could do. Think of the Queen Mary—the whole ship goes by and then comes the rudder. And there's a tiny thing at the edge of the rudder called a trim tab.

It's a miniature rudder. Just moving the little trim tab builds a low pressure that pulls the rudder around. Takes almost no effort at all. So I said that the little individual can be a trim tab. Society thinks it's going right by you, that it's left you altogether. But if you're doing dynamic things mentally, the fact is that you can just put your foot out like that and the whole big ship of state is going to go.

So I said, call me Trim Tab.” — Buckminster Fuller

External links to video material that may be worth having students watch and discuss:

[Jeff Bridges and Bill Maher discussion](#)

Possible Questions to bring up:

- Is sustainability possible?
- What do we hope to sustain?
- Roll of Government and Personal Responsibility
- Is it possible to do more with less on a planet with finite resources?

Part 3 - Glossary of Selected Terms for *Living in the Future's Past*

Adaptations: Traits in an organism that were historically beneficial to the fitness of that organism’s ancestors in the environment in which they evolved.

Amygdala: The part of the human brain responsible for detecting fear and preparing for emergency events. Also related to fears and scary memories.



Anthropocentrism: regarding humankind as the central or most important element of existence, especially as opposed to God or animals.

Authority Bias: the tendency to attribute greater accuracy to the opinion of an authority figure (unrelated to its content) and be more influenced by that opinion.

Prefrontal Cortex: the part of the brain that learns from experience, weighs consequences and inhibits emotional impulses.

Biodiversity: The rich variety of life in the world. The extent and sum of all life on Earth.

Carrying Capacity: The number of organisms that a region can support without environmental degradation.

Cognitive Dissonance: the state of having inconsistent thoughts, beliefs, or attitudes, especially as relating to behavioral decisions and attitude change.

Confirmation Bias: An evolved cognitive bias that predisposes humans to interpret new evidence as confirmation of one's existing beliefs or theories and primarily seek out information that will support pre-existing beliefs.

Consumerism: the preoccupation of society with the acquisition of consumer goods.

Consumption: The use or “using up” of a particular resource.

(In economic relationships, consumption may refer to the purchase of services not directly linked to physical resources. However, considered ecologically, consumption is equated with the use and *waste* of a resource. That is to say, its useful potential is expended so that it cannot be used the same way twice).

Cultural Evolution: The process by which information is socially transmitted among individuals that leads to a change in beliefs, morals, institutions or behavior.

Divestment: A social movement seeking to have institutions (mostly universities) sell their investments in companies that develop coal, oil and natural gas. By ‘divesting,’ they are aligning their financial investments with a pro-future value set. (However, divesting from fossil fuel stocks is a separate issue than divesting from fossil fuels)

Dynamic Obsolescence: The policy of designing a product with a limited useful life, so it will become obsolete (either unfashionable or no longer functional) after a certain period of time so a new one needs to be purchased.

Ecocentrism: A point of view that recognizes the ecosphere as central in importance and attempts to redress the imbalance created by anthropocentrism.

Ecology: The branch of biology that deals with the relations of organisms to one another and to their physical surroundings.

Egalitarian/Equality: The state of being equal, especially in status, rights, and consumption.

Emergent Behavior: Behavior of a system that arises from the interactions and relationships among its many parts. Emergent behavior cannot be predicted from observing the parts individually.

Energy Flows: The movement of energy through a system. Sunlight and wind are energy flows in nature. Oil extraction, refining and burning is an energy flow in an economy.

Energy Footprint: The total energy consumed (directly or indirectly) by an organism, event, process, organization, or product. (Americans energy footprint is about 4 times the world average).

Energy Potential: The amount of useful work that can be extracted from a particular energy source.

EROEI (Energy Returned on Energy Invested): A ratio of the amount of usable energy delivered from a particular energy source relative to how much energy it took to harness it.

Energy Sink: A product or process that uses more energy to produce than it delivers. (A losing proposition in energy terms)

Entropy: “Disorder.” According to The Second Law of Thermodynamics, entropy is always increasing as heat is lost in every use of low entropy energy. Entropy is what makes the universe irreversible.

Externalities: a side effect or consequence of an industrial or commercial activity that affects other parties without this being reflected in the cost of the goods or services involved, such as the pollination of surrounding crops by bees kept for honey.

Evolution: The process by which organisms change over time as a result of changes in gene frequencies of heritable traits in a population.

Fossil Slaves: Collectively oil, natural gas and coal used in machines and factories underpinning the vast infrastructure and living standards of the modern world. Term invented by Buckminster Fuller to indicate the power of this unseen (and under appreciated) workforce.

Group Identity: A person's sense of belonging to a particular group and the specific traits and behaviors that arise while participating as a member of that group. (Dallas Cowboys fan, Catholic, student, Democrat, American, high school debate team, etc.).

Groupthink: the practice of thinking or making decisions as a group in a way that discourages creativity or individual responsibility.

Limits (to growth): The natural limits imposed upon the growth of any biological entity (as it is reliant on the environment to support itself).

Loss Aversion: people’s tendency to prefer avoiding **losses** to acquiring equivalent gains: it is better to not lose \$5 than to find \$5.

Metacognition: awareness and understanding of one's own thought processes

Morphological Adaptations: (Morphology) The branch of biology that deals with the form and structure of organisms without consideration of function.

Natural Selection: The process by which organisms better suited to their environment tend to survive and produce more offspring. The main process by which evolution occurs.

Neolithic: Relating to the later part of “the Stone Age,” when stone weapons were used heavily by early humans.

Net Energy: The total amount of energy “produced” by a process (available to be converted into work) after other energy costs associated with its production/extraction have been accounted for. (In the same way we pay taxes on our gross income, our society pays an ‘energy tax’ on the gross amount of energy there is.)¹³¹³

Ocean Acidification: The process by which carbon dioxide is absorbed into the oceans and the associated significant physical changes in the chemistry of the ocean.

Optimal Foraging: A field of biology that helps predict how organisms behave when searching for food, positing that the most economically advantageous foraging pattern (or least time spent) will be selected for in a species through natural selection.

Paradox: A seemingly absurd or self-contradictory statement or proposition that when investigated or explained may prove to be well founded or true

Planned Obsolescence: a method of stimulating consumer demand by designing products that wear out or become outmoded after limited use.

Sentient: Able to perceive or feel things.

Social Contract: An agreement among the members of a society to cooperate for social benefits.

Stimulus: Any sort of information the brain receives (this might evoke a specific evolved reaction in an organism). Certain stimuli are given preferential treatment by our brains due to our evolved biases and preferences.

Subsistence vs. Industrial Agriculture: The cultivation of food for personal consumption and survival vs. the mass-production of food, fueled by an excess in cheap energy, for worldwide consumption.

Superorganism: A superorganism is a collection of social organisms that functions like a larger entity, where labor is specialized and individuals are not able to survive by themselves for extended periods. Ants and termites are examples often given. In LIFP, aggregate human society is described as a superorganism because of the social nature of humans and homeostasis of global energy consumption.

Surplus/Abundance: An excess of production. The extra resources “left over” after all basic needs have been met. For most times in history this meant grain or food. Today it often means money or capital.

Symbiosis: An ecological relationship/interaction between two organisms that is mutually beneficial.

Web of Life: The many interconnected relationships that link organisms within and between ecological communities.

Xenophobia: Intense or irrational dislike or fear of people from other countries.

Part 4 - Potential Questions for discussion

1. “Because we see it, we think we stand above it.”
 - a. What is meant by this quote?
 - b. What are examples of humans behaving this way?
2. “All money is a claim on some energy service.”
 - a. Discuss how you perceive the relationship between energy and money after watching the movie- can you brainstorm some examples on how this relationship might change?
3. “Culture is our life support system.”
 - a. In what ways is our reliance on culture a detriment to us/our relationship with the environment? Are there ways in which it can be a benefit?
4. “Do we confuse what we need with what we desire and what we desire with what we need?”
 - a. What do you think of this quote?
 - b. Is this true?
5. “When we think about sustainability, what is it that we hope to sustain?”
 - a. After watching this film, what parts of our society do you think we should work to sustain? What parts do you think we should work to change?
6. In your experience have you found obtaining certain objects very exciting in their novelty only to be discarded because they are no longer in fashion or the excitement of interaction with them diminishes?
7. How often do the objects we use, such as phones, computers or cars wear out or break down and lose value over time. Can you name some objects you feel have ‘planned obsolescence’ built into them?
8. How do you interpret the following statement: “A state of plenty can have unintended consequences. It is the paradox of our times.”
9. “There's much more energy in the system,” was used to describe the current state of the earth’s climate due to the increased levels of Carbon Dioxide. Can you think of any examples in recent memory of this? *(This is a good question to give for a research paper or presentation project. Students can research a topic (e.g. increasing strength of severe weather, rising sea levels, melting ice caps, release of methane from melting permafrost, droughts, fires etc.).*

10. “If there's a big change coming, and we want to know what it might do in the future, what do we do? We look at what's happened in the past.” Explain this quote and why it is so important to look to the past when planning for the future.
11. What is meant by “Energy is the currency of life?”
12. “The treadmill is getting smaller, and smaller, and smaller, and smaller. And, the number of people who want to be on the treadmill is getting bigger and bigger and bigger and bigger. And eventually, there's going to be no room to run, and so, people will fall off. Many people will fall off.” What is being referred to in this analogy. What does the treadmill represent? Who do you think will fall off first and why?
13. What is meant by the statement: “Our food system is an Energy Sink”?
14. What is meant by the question, “Are we eating our seed corn?” What is seed corn in reference to How does it apply to modern human behavior?
 - a. Need to preserve resources to have something to plant for future harvest
 - b. If you use it all now, everyone starves later
 - c. Are we using more than our share of the earth’s resources/energy?
 - d. Are we wasting energy that we will need in the future?
 - e. Are the decisions we are making today harming the future of our species and the planet?
15. What is meant by “Where you sit is where you stand”?
 - a. your situation influences your biases and opinions
16. What companies, inventions, leaders, countries are engaging in practices that make sense ie: not outstripping the earth's resources?
17. Discuss the Onondaga Nation’s concept of “Swyonisu”. What does it mean?
 - a. He who looks far into the future
 - b. A leader has to think about the future and make decisions that will take into consideration the short-term benefits vs. the long-term costs
18. Can one purposefully/consciously engage in emergent behavior? How can this be accomplished? Can it be done?

More General Discussion Questions

Introduction: Some students may find this information unsettling, to others it may seem overblown or unrealistic, and to some it will be perfectly plausible etc. The important thing is that we can all participate in conversations about what we learned and our perception of that information.

1. Think of 1 or 2 words that describe your reaction to the movie/information/material.
 - a. What are the main messages from this movie?
2. What are some ways we can increase how we begin discussing these ideas from this video?

- a. What is one way we can talk about this film and the ideas presented with people who haven't seen it or are unaware of human behavioral traits?
3. Being here, in the most industrialized part of the industrialized world, our tentacles reach everywhere." Do you think the U.S. and other highly industrialized nations have a responsibility to lead the way towards a future in which society is less dependent on fossil fuels? Less dependent on consumption?
4. Grab a piece of recycled paper and write out some of your activities that used energy so far today - from when you woke up to now. How much exosomatic energy (calories that you used but didn't eat) have you taken in/used? Did you do anything that didn't require energy?
5. What's the *real* cost? Think of your last order from Amazon. What costs were incurred getting that product to your doorstep, other than the e.g. \$12.68 that came out of your bank account?
6. Xenophobia and consumerism are two phenomena that have evolutionary roots in our past in the animal kingdom. What other phenomena observed today trace their roots back to our ancestors on the plains of Africa?
7. You learned in the documentary that the rise of fossil fuels as "cheap energy" allows for the innumerable freedoms and wealth we enjoy in human society today. Can there be too much freedom for us humans? Can or should our freedoms be limited and why? What is the role of government? What role does individual choice have?
8. How might individuals, groups, countries and systems use less energy or use energy in a different way?
9. The movie states that we have to change how we see the world to be able to solve the problems we are facing and will face.
 - a. What are some different ways we could imagine the world to function?
 - i. If we took away states, countries and territories- what are alternative ways of organizing that may help prevent climate change?
10. Can we change how we see ourselves as humans? Culturally and in the media?
11. If you were King or Queen of the world right now, how would you respond to our environmental challenges?
12. Is the sum of our modern, technological developments ultimately a curse or a blessing to humanity and the world? Is it both? Discuss.
13. What are some of the "unintended consequences" of abundance of material goods and food for an increasing population?
14. Think about, then discuss, a favorite memory of an experience you have had in nature. What is it about this experience or instance that makes it so special?

15. Efficacy is defined as “the ability to produce a desired result.” What are some desired results you have for human beings now and in the coming decades, why and what path can we take to get there?
16. How can each of us, in our daily lives, as indigenous leader Oren Lyons states, be “one who looks far into the future?” How might that take shape in your everyday decision-making, belief systems, relationships, etc.?
17. The film brings in some philosophical mind exercises. Try to imagine, as Jeff Bridges says, a theoretical world where everything has equal value, from skyscrapers and trees, to humans and cola, suitcases and Orangutans, water, diamonds, dragonflies and even time itself”. This can be difficult to do but in doing so one can discover in ones daily life what our value systems are. On a daily basis we decide what is valuable to us and what is not. What are the ways we apply this value system? If something we are using that we value is destroying another part of the planet that we also value how do we reconcile this?
18. As Jeff Bridges brings up in the final moments of the film, what is one action you can fit into your life, that comes naturally to you, that will help to create a better, more sustainable future?
19. It's nearly impossible for individuals to function independently in modern society. What are some of the functions that individuals are dependent on the superorganism for?
- Feed us
 - Clothe us
 - Power our communications
 - Protect via organized conflict
20. Give examples of things you might consider emergent behaviors both positive and negative
- The internet
 - The smart phone
 - The disappearance of phone booths
 - The rise of server farms
 - The overall decrease in smoking cigarettes
21. Can you think of examples of adaptation in nature?
22. What is horsepower? How is it measured? How many horses would it take to do the work of one Semi truck?
- A measurement unit for energy
 - 1 horse = the work of 10 men
 - 450
23. What do you think is meant by the term “fossil slave”? What is an example of a fossil slave? What are the benefits of fossil slaves? What are the costs - both short and long term?
24. While renewable energy is better for the environment, why is it not practical to think that we can flip a switch and instantly convert our entire infrastructure to run on solar and wind power?
- Can't change overnight – not practical, too expensive
 - \$100 trillion worth of machinery on the planet that uses gasoline or diesel fuel.

- c. 250, 270 million cars and light trucks on the road
 - d. More wealth than the gross domestic product in a year to replace it
25. Do we have an obligation to leave a sustainable planet for future generations? Should this be a priority of governments and human endeavors? What would have to change to make this happen? What are some of the things we could do as individuals, and countries to improve the outcome for humanity?
26. Our current global Infrastructure is built around cheap transportation and global connectivity of supply chains. What do you predict will happen in 10-20 years when fossil fuels are no longer inexpensive because the cost of extracting them make them unprofitable? What will happen to the cities?
27. Have humans evolved to take a short or long view in life? Why?
- a. Short term best bet
 - b. Rational
 - c. Bird in the hand worth 2 in the bush
 - d. In our evolutionary past those focused on immediate threats survived better
28. Should modern emotional desires be considered an evolutionary mismatch? Do these evolved behaviors serve the same function in modern urban environments that they did in the environment that selected for them in our ancient past when they became adaptive?
- a. Status seeking
 - b. Designer handbags
 - c. Need for new things
 - d. Seeking out food high in fats and sugar (good then, bad now)
29. Attracting a mate in animals often involves males displaying their genetic quality in terms of their ability to obtain surplus resources that they show off as colorful feathers or huge antlers. How does this phenomenon translate in humans in western civilizations?
- a. Fancy cars
 - b. Preoccupation with what others think/have
 - c. Need to compete with other males for attention of females
 - d. Social status striving
30. Can you think of an example where the concept of Group Identity has created conflict in society?
- a. Racism
 - b. LGBTQ
 - c. Sexism
 - d. Religion
 - e. Xenophobia
31. Discuss optimal foraging. What does it mean? Give some examples from animals and modern humans.
- a. Maximizing payoff
 - i. Investing as little as possible for the biggest payoff
 - 1. Examples
 - a. Hunting an elk as a pack of wolves
 - b. Getting 20% off a pair of shoes

c. Two for one happy hour

32. Define Entropy. Give two examples.

- a. Energy running down to 0
- b. Examples
 - i. Time only goes in one direction
 - ii. A shattered glass can not put itself back together
 - iii. Where does fossil fuel energy go when we've used it?

33. What causes the morphological differences that we see between different populations on the planet?

- a. The different environmental conditions they adapted to
- b. Sun exposure/ latitude skin color
- c. Amount of oxygen in the air/altitude

34. What did you learn from this film and how do you think it will change the way you behave and interact with the world around you? Has it changed the way you think about the future? Has it changed the way you interact with objects or energy?

35. What are you willing to do to ensure a sustainable future for future generations?

Personal Reflection

1. What future do I want to see?
2. What am I willing to do for it?
3. Write down 2-3 hobbies that you enjoy most... How can these be used or adapted to help others/ to work toward a more sustainable future?

Part 5 - Further Perspectives from several of the Film's Participants to discuss

Rich Pancost: Rich Pancost, PhD, was Director of the University of Bristol Cabot Institute and is now Head of Bristol's School of Earth Sciences. He studies organic molecules in organisms, mud, and rocks to understand the flow of chemical energy through the Earth's coupled biological and geological system. He uses those same molecules to reconstruct how Earth's climate has changed over millions of years, in order to put into context the impact humans have had on our planet.

“The geological past contains other lessons for us. It is particularly useful for exploring the deep unknowns in the Earth system, those consequences of global warming that are complex and difficult to predict. For example, ancient global warming events are not only associated with extinctions but also dramatic changes in rainfall, the erosion of soil, eutrophication of lakes and seas, the spread of anoxic dead zones, and the unleashing of positive feedbacks that amplify warming. Some of these observations confirm our worst concerns about current climate change; others remain too difficult to predict and instead serve as cautionary tales about the dangerous experiment we are performing on our planet. It has been 3 million years since the Earth had 400 ppm CO₂ [Ancient climate records 'back predictions'](#). [Plio-Pleistocene climate sensitivity evaluated using high-](#)

[resolution CO2 records](#) The unprecedented rate of modern pCO₂ change (the following refer directly to what I discuss in the movie).” [Aptian Oceanic Anoxic Event](#) [Aptian mystery solved](#)

Quote from the film “It's not so much the change itself, but it's how fast it's happening. The faster the change comes, the less time we have to adapt. The faster the change comes, the less time the trees have to adapt, or plankton living in the ocean. The faster the change comes, the less time ecosystems have to adapt. And the more complex these are, the harder it is to actually predict what the consequences of that change will be.”

Through our fossil-fueled economies, we are emitting CO₂ far faster than it was sequestered into the Earth (by dying organisms, sinking and being buried in ancient sediments). Current emissions are small in total quantity compared to the changes that happened in the geological past, through the past billions of years of Earth history ever since life colonised our planet. Those changes occurred gradually over tens of millions of years and are related to the slow movement of the continents, with carbon buried in sediments, subducting deeper into the Earth and eventually being released via volcanism. Those long term tectonic changes brought about periods of extended warmth when there were no ice sheets on Antarctic or Greenland and our current climate of cyclical ice ages. Due to human activity, and our incredible feats of engineering, we have accelerated those slow geological processes, and CO₂ is now higher than its been in at least [800,000 years](#) and probably the past 3 million years (<https://www.nature.com/articles/nature14145>). But it's the speed at which it rises that most concerns geologists. As far as we can tell, the current sharp increase in a geologic blink of an eye (~150 years) is the [fastest in the last 66 million years](#) – and that ancient event was due to an extremely unusual external force, the asteroid impact that killed the dinosaurs.

In the film, Professor Pancost discusses an even older ‘rapid’ event from 120 million years ago, but observes that it also occurred far more slowly than the modern rate of change. The consequences of such a rapid rate of climate change is unknown, but it is quite concerning, given that most of the [Earth's prior mass extinctions were linked to CO₂](#). It is also concerning because the faster we change our climate, the faster we will have to adapt - moving our cities, relocating our populations, rebuilding our infrastructure and ensuring we can produce the food we need.

***See Bibliography for further suggested reading**

Stephan Lewandowsky: Stephan Lewandowsky, PhD, is a cognitive scientist. He has worked in both the United States and Australia, and is currently Chair of Cognitive Psychology at the University of Bristol and a member of the university's Cabot Institute. His research examines people's memory and decision making, with particular emphasis on how people respond to corrections of misinformation. He also researches the public's understanding of science and why people often embrace beliefs that are sharply at odds with the scientific evidence, and he is particularly interested in the difference between skepticism and denial when it comes to climate change.

“The Earth is changing around us at an increasing pace. Fueled by greenhouse gas emissions, the climate is inexorably changing, triggering a cascade of socio-political trends ranging from large-scale migration to potential economic disruption. Humans have triggered those processes, but will we be able to manage them? The limitations, simplifications, and biases of human cognition are legendary, and those limitations are amplified by global change. For example, whereas scientific uncertainty about future climate change should make us worry more, not less, people often consider uncertainty to be a signal for dismissal of a problem.

Fortunately, however, we are capable of understanding ourselves and our own limitations. For example, we know that people never put aside enough money for retirement—and because we know that, we legislate mandatory retirement contributions from employers and employees to get around our own cognitive limitations. Similarly, the problems posed by global change, however daunting they may appear, can be solved despite our cognitive limitations, provided we examine ourselves carefully and then cleverly devise policies that take into account our biases and limitations.”

***See Bibliography for further suggested reading**

Ugo Bardi: Ugo Bardi, PhD, is a lecturer in physical chemistry at the University of Florence, in Italy. He is engaged in research on sustainability and energy, with a special view on the concept of circular economy and on the depletion of mineral resources. He is also a member of the Club of Rome, an international think tank dedicated to sustainability.

“People often ask if solar energy can replace fossil fuels, but the question is ill posed: if we mean whether solar energy can power our society exactly as it is today, then the answer is no. It is not possible. But if you ask whether it is possible to build a prosperous, vibrant, and sustainable society using the renewable technologies we have today, then the answer is **yes: we can**. But it will not be the same society: it will have to be leaner, more efficient, producing less waste, and way less prone to extravagances such as long-distance tourism or eating in the US eggplants produced in New Zealand. In addition, in order to arrive there, we'll have to make sacrifices: the transition to renewables doesn't come cheap and it is not just a question of money, the energy transition must be paid in energy. And, today, this energy can only come in large part from fossil fuels: we have to use them in order to pay for their own replacement. It is the "Sower's Strategy:" we have to save some of our seed corn (the energy we produce today) in order to produce the new corn harvest (the energy we'll produce tomorrow). It is possible, our ancestors used this strategy to survive and we, their descendants, are here because they used it successfully. But we have to start now, or soon it will be too late to stop global warming and resource depletion.”

<http://iopscience.iop.org/article/10.1088/1748-9326/11/9/094009/meta>

“So, if you ask, ‘Can solar energy power our society as it is today?’ then you already have the answer. It is no. It is not possible. If you want to switch from oil and gas and coal and to move to solar energy, then you have to change a lot of things.”

Excerpt from **Turning electricity into food: the role of renewable energy in the future of agriculture**

<https://www.sciencedirect.com/science/article/pii/S0959652613002291?via%3Dihub>

“Modern agriculture is heavily based on the energy supply obtained mainly from fossil fuels. In this sense, it can be defined as a technology that transforms fossil fuels into food. However, the available amount of fossil hydrocarbons is not infinite and climate change is creating a critical necessity of reducing their use. Therefore, it is not too early to start considering how agriculture could be adapted to sustainable sources of energy which do not cause climate change. In the present paper, we discuss how agriculture could be restructured in order to utilize the electric power provided by renewable energy technologies such as wind and photovoltaics. In this sense, the problem can be stated as the need of developing technologies able to turn electricity into food.”

***See Bibliography for further suggested reading**

Bruce Hood: Bruce Hood, PhD, is Professor of Developmental Psychology in Society at the University of Bristol. He spends most of his time engaging with the public in one way or another. His written popular science books broadly based on this research interests including the origins of supernatural thinking, the illusion of self, the social domestication of humans, and his new book on the psychology of ownership.

“One of the reasons that we face such a crisis in energy consumption is relentless consumerism to satisfy psychological needs. Just like the peacock who evolved an energy-hungry tail to signal prowess, humans accumulate the trappings of wealth to signal their success to others. Our sense of self including how we feel about where we are in the pecking order of society is largely shaped by what we can claim ownership over and what we have in terms of material wealth. However, comparing ourselves to others generates a constant pursuit of happiness on a hedonic treadmill where we never achieve satisfaction as there is always someone ahead of us. Our preoccupation with where we are in the group is also the second problem of changing human behaviour. We reason that the consequences of our consumption are insignificant compared to the multitude of other humans on the planet which creates the tragedy of the commons – everyone thinks they don’t make a difference but the cumulative effect of everyone thinking that way is collective disaster. We need to harness the power of social comparison to create new markers of esteem and success – those that generate the least environment impact through their consumption.”

***See Bibliography for further suggested reading**

Mark Plotkin: Ethnobotanist, Conservationist and President, Amazon Conservation Team

“Much of the attention on reducing climate change focuses on fossil fuels. However, the second major source of climate-changing gases is deforestation, particularly in the tropics. Much of the current discussion centers on new technologies that can extract carbon from the atmosphere. Nonetheless, better protection for standing forests is an urgent necessity.”

<https://data.mongabay.com/brazil.html>

***See Bibliography for further suggested reading**

**Amy Jacobson: Evolutionary Anthropologist, Rutgers, Department of Anthropology
Human Behavioral Ecologist Research Director, Biosocial Research Foundation, New Jersey**

“In thinking about the future of the human race on this planet from the perspective of evolutionary biology, the vision forward is clear. We need public policy based on comprehensive investigations into human behavior. We need to know where we have been in order to comprehend where we are. Once we understand the ecological conditions that select for a desired outcome we can plan accordingly. Acknowledging that humans are under the same selective pressures as all other creatures on the planet, allows us to use basic ecological principles to decode human behaviors and understand the principles of human existence and how and what we can do to promote a future that is sustainable for all life on earth. I think of evolutionary logic as the rosetta stone for interpreting behavior. Knowledge is power and the information in this film lays out a very complex and fact-based reality in which we find ourselves. Science literacy is key.”

***See Bibliography for further suggested reading**

Ian Robertson: Dr Ian Robertson Cognitive Neuroscientist Co-Director, Global Brain Health Institute Professor Emeritus, and Trinity College Institute of Neuroscience University of Dublin

“We are a social species and our ability to work together in groups has been the key to our amazing success as a species. Our sense of self develops through our interactions with others and our self-image is in part the internalization of other peoples’ responses to us. You don’t remember anything from your earliest years in part because there is no coherent “self” onto which the mind can attach autobiographical memories and the emergence of a personal, narrative autobiographical memory roughly corresponds to the emergence of a sense of self.

Groups inevitably form hierarchies and being accepted in the group entails knowing your place in the hierarchy – “status” – in order to navigate complex interpersonal relationships of the group and not be expelled from it. In our early evolution, expulsion from the group would mean a high risk of death; this explains the fact that the evidence is clear that on average the greatest fear that people have is the negative evaluation of other people.

Different cultures have different bases for awarding status to their members. For example, I lived in Fiji in the 1970’s and in their tribal culture at that time, status accrued to leaders who were most generous and gave most away, rather than to those who accumulated goods or wealth. But in Western culture, status is heavily related to wealth and the communication of status depends on conspicuous status symbols like cars and jewellery. It is through these symbols of our particular value system that we try to fend off the greatest of our fears – the negative evaluation of other people and the deeply primal fear of expulsion from the group that lies behind it.

As the child gradually develops a self in our culture, she learns to seek status by the values she picks up from those around her. Unfortunately for the globe, our dominant human tribe these days makes heavy demands of energy and resources in order to maintain status and secure acceptance – that will have to change if we are going to survive.”

Anna Kirsch: A writer and narrative consultant for *Living in the Future’s Past*. Anna specializes in narrative theory and holds a Masters in English Studies from Durham University in the UK. She is currently undertaking a PhD on environmental ethics of violence and consumption in crime fiction and is the Book Reviews Editor for the International Crime Fiction Association.

“The Philosophy spoken by both Jeff Bridges, the narrator and Dr. Timothy Morton is a branch of Philosophy called Object Oriented Ontology. There are some interesting thinking experiments that arise out of this way of looking at the world especially when evaluating our value - judgements.

Object-Oriented Ontology is a 21st-century Heidegger-influenced school of thought that rejects the privileging of human existence over the existence of nonhuman objects. OOO was presented to the world by Graham Harman in 1999, and to date, the core practitioners of object-oriented ontology are, Graham Harman, Ian Bogost, and Timothy Morton. Other writers loosely affiliated to the school are Jane Bennett and Tristan Garcia.

Living in the Future’s Past uses one of the thought experiments from OOO which is to imagine a world where everything is equal. This experiment gives the viewer an exercise which exposes the hierarchal value system we

apply to, and participate in, throughout our daily lives. The experiment aims to make us think about those values and relationships and hopefully reevaluate our relationship to the environment and think about the ways we think giving us a way to overcome our evolutionary programming and engage with our higher reasoning.

Living in the Future's Past also uses Timothy Morton's visualization of the mesh from his book *The Ecological Thought*. Building on the idea of the mesh as the interconnection between humans and everything else the film explores the enmeshed nature of natural systems of energy exchange in the biosphere and the human cultural relationships to things.

For more on OOO Graham Harman's book *Object-Oriented Ontology: A New Theory of Everything* makes an excellent introduction to the philosophy as a whole and Timothy Morton's *Being Ecological* is a must read and his most accessible work on the connection between object-oriented ontology and the environment to date. Morton's idea of the mesh is similar to Stacy Alaimo's, who does not expressly work in the field of OOO, imagery of transcorporeality which she expresses as the expression where the human is always intermeshed with the more than human world to the extent that the substance of the human is ultimately inseparable from the environment.

For further reading Timothy Clark's *Ecocriticism on the Edge: The Anthropocene as a Threshold Concept* makes an excellent introduction to the Anthropocene from a literary perspective as well as a systematic analysis of the various philosophical approaches, including OOO, to the environment. Those seeking OOO philosophy applied to the environment should begin with any of Timothy Morton's work."

***See Bibliography for further suggested reading and links to OOO**

Joseph Tainter: Joseph Tainter is an anthropologist and historian who has studied collapse in numerous ancient civilizations. He worked on issues of sustainability before the term became common, including his highly-acclaimed book *The Collapse of Complex Societies* (Cambridge University Press, 1988). He has also conducted research on land-use conflict and human responses to climate change. Tainter's sustainability research, with emphases on energy and innovation, has been used in more than 40 countries, and in many scientific and applied fields.

"Sustainability requires that people have the ability and the inclination to think broadly in terms of time and space. In other words, to think broadly in a geographical sense about the world around them, as well as the state of the world as a whole. And also, to think broadly in time in terms of the near and distant future and what resources will be available to our children and our grandchildren and our great grandchildren.

One of the major problems in sustainability and in this whole question of resources and collapse is that **we did not evolve as a species to have this ability to think broadly in time and space**. Instead, our ancestors who lived as hunter-gatherers never confronted any challenges that required them to think beyond their locality and the near term(...)

We have developed the **most complex** society humanity has ever known. And we have maintained it up to this point. I have argued that technological innovation and other kinds of innovation evolve like any other aspect of complexity. The investments in research and development grow increasingly complex and reach diminishing returns. **We cannot forever continue to spend more and more on technological innovation when we've reached the point of diminishing returns, which I argue we have reached.**

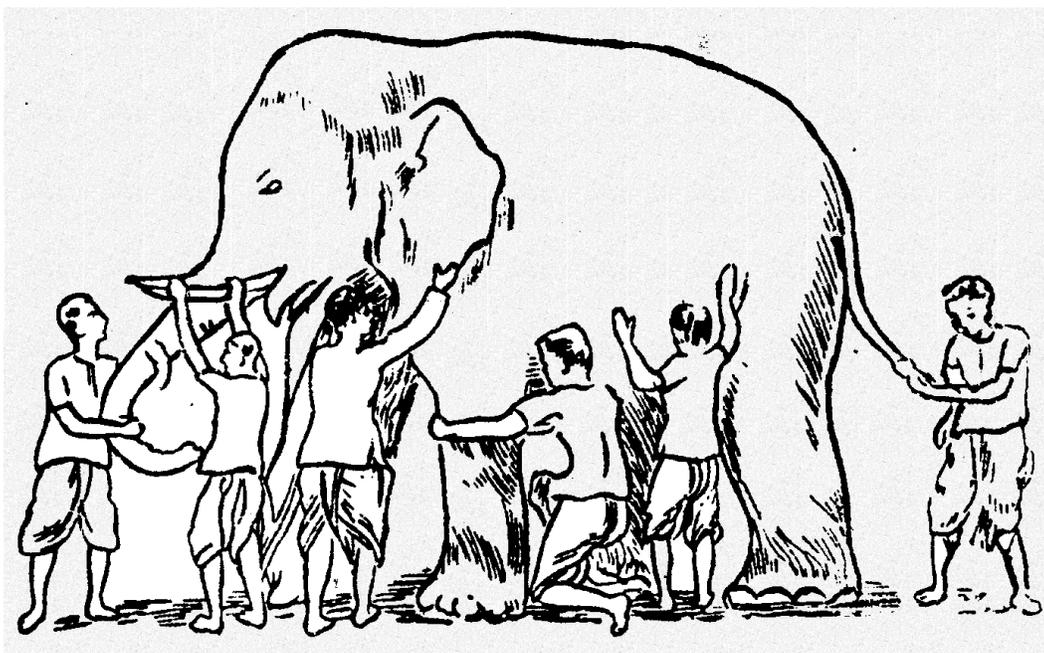
Our system of innovation is going to change very significantly over the next twenty to thirty to fifty years or so. By the end of the century, our system of innovation will not be anything like what we know today. It will have to be very different. And it's likely that **innovation is not going to be able to solve our problems as readily as it has done** to this point.

The technological optimists have assumed that the productivity of innovation is either constant or increasing. And in fact, what I think my colleagues and I can show is that the productivity of innovation is actually decreasing. What that means is that **we will not forever be able to solve resource problems through innovation(...)**

And so **individuals need to take responsibility** for their own ignorance. As I said, our species did not evolve to think broadly in terms of time and space and if we're going to maintain our way of life, people have to learn to do so. **People have to take responsibility for knowing and understanding the predicament that we're facing.** I have argued over the last few years that we need to start teaching early school age children in K to 12 to think differently, to think broadly in terms of time and space – to think historically, to think long-term about the future, to think broadly about what's going on in the world around us instead of the narrow way – the narrow, local way – that most people live and think. So I put responsibility on individuals to broaden their knowledge.”

Nate Hagens: Nate Hagens, PhD, is a well-known speaker on the big picture issues facing human society and currently teaches a systems synthesis course at the University of Minnesota ‘Reality 101 – A Survey of the Human Predicament.’ Nate has embedded his suggested reading links within his contribution to this guide.

“This film has considerable overlap with the class I teach at the University of Minnesota about energy, human behavior and ecology. Called “Reality 101 – A Survey of the Human Predicament” the course revolves around modern humans being: 1) *Self-blind* (mostly unaware of most of our evolved drives and biases), 2) *Energy blind* (viewing our wealth and productivity as a function of technology, human cleverness and money, as opposed to being predicated on low entropy (high quality) non-renewable resources) and 3) *Earth-blind* (only seeing the environmental impacts locally in our own backyard, not in the distance, or in the future, or on other species).



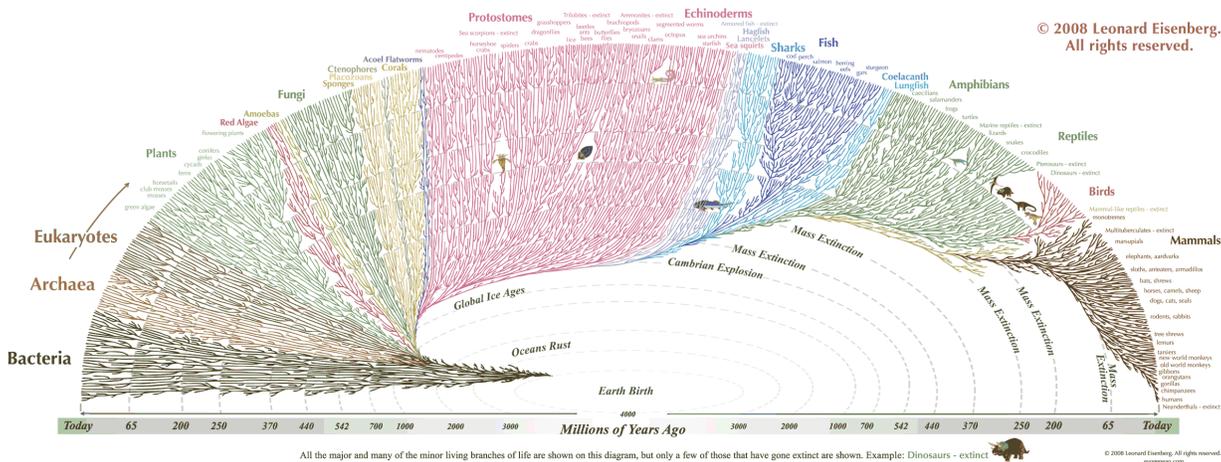
Nowhere in the general public discourse today do we hear these concerns mentioned much less recognized as the major existential problems of our time. The single biggest takeaway from this class is also a main inference emerging from the movie – that we're at a cultural point where *we need a holistic view of the whole elephant to understand our situation*, as opposed to a composite

of isolated contributions from traditionally narrow and reductionist academic disciplines. A meta-synthesis of energy, ecology and human behavior paints a clear picture of what is possible for humans this century - and what is not.”

Below are some perspectives from the Reality 101 class materials on selected quotes and topics from the movie which are not typically covered in high school or college classes:

NH - Evolution/Brain/Behavior

Quote from the film: *“Natural selection has evolved different lineages of organisms, and we are at the top of one of those lineages.”*



Yes, humans are special, but we are → part of the animal kingdom → part of the mammal and → ape lineage. The tree of life is amazingly beautiful and complex (as shown above with image and explanation from Evogeneao.com). We are not the pinnacle of creation, but one of approximately 10 million species extant today that each arrived here through a long series of successfully surviving past environments long enough to produce offspring. From perspective of biology, humans are unique and amazing, *but not special and not immune to natural laws.*

Here is a good timeline of [human evolution](#)

Here is an excellent resource on [natural selection, evolution and humans](#).

Quote from the film: *“This Earth was here before us and will be here long after we're gone. Every living thing on it has evolved together, over eons of time.”*

The Earth is 4.5 billion years old. The age of animals and plants is already 500 million years long and will have conditions for life for [about another 500 million years](#) until plant respiration exceeds oxygen photosynthesis. Humans – in our present form have only been here for 300,000 years or so – which is a tiny fraction of deep time. We are [related to every single living creature on Earth](#). We share 99.99% of our genes with other humans, 98.8% with chimpanzees, 90% with *mice*, 84% with dogs, 65% with chickens and even 40% of our DNA with mushrooms. Of course we are related to all living things because we all originated from the same primitive life, which began on Earth approximately [3.8 billion years ago](#).

Quote from the film: *“Our evolutionary impulses can be easily hijacked.”*



Modern human skulls house stone age minds. Humans alive today are ‘adaptation executors’, i.e. we don’t go through our days thinking about getting our genes to next generation – instead we try to seek the same (evolved) daily emotional state as our successful ancestors. Playing today’s video games like ‘Overwatch’ or ‘Fortnite’ is fun and addictive. When you are playing, your emotional brain center doesn’t know you’re sitting at a desk using electricity from coal or natural gas on a computer – it thinks you are competing in a tribal conflict where the winner gets real spoils of life. Similarly, checking your Facebook post every 10 minutes to see how many likes you got is akin to getting respect and admiration which were all important in our ancient tribal setting. Facebook and other social media/technology access the same reward system of the brain as do cocaine and alcohol – yet in our culture we promote computers and iPhones to 14 year-olds. The average teenager today stares at a screen (TV, computer, phone) for over [9 hours per day](#). The activities of our modern world are easily 10x or even 100x as powerful as the experiences our ancestors had available to them daily. So, we can become addicted, even though in today’s world they don’t necessarily add to our success, health or happiness.

See: [The psychological roots of resource over-consumption](#)

Books: *American Mania* – Peter Whybrow, *The Shallows: What the Internet is Doing to Our Brains* – Nicolas Carr

Quote from the film: *“We have a very quick system that is dealing with gut reactions, with reflex responses, with an instant response to danger. And on the other hand, we have a slower, more deliberative system which takes time to engage, and which is slow and ponderous, that we should keep engaged when we’re looking at complex issues in the world around us.”*

Organisms brains evolved upwards and forwards on top of existing structures. Humans have old brain regions – called the reptilian and limbic systems – that lie under the ‘new brain’ or neo-cortex. All our brain regions work together to give us a seamless perception of reality. But the older brain regions prepare us for fight or flight or emotional/survival issues. These systems give us quick gut reactions and are very fast. They shout loudly!! Psychologists call this [System 1 thinking in contrast to System 2](#) thinking which is methodical, analytical, more

accurate, but much slower¹. We spend most of the time using System 1 thinking – but our modern problems require intelligent foresight, which can only come from the newer brain – using System 2 thinking.

Books: Thinking Fast and Slow – Kahneman and Tversky

Quote from the film: *“You know the famous study, if I offer you 20 dollars now, or I can give you 50 dollars in a week's time, people just kind of are almost, kind of, compelled to go for the short term.”*

In economics there is a concept called a discount rate. It is a number from zero to one representing how much we focus on the present vs. the future. Economists determine this from various financial games measuring the subject preference of receiving say \$400 today or \$800 in 1 year. The vast majority of people significantly prefer immediate consumption vs even higher amounts in the future. A discount rate of 1 means you only care about the present – even tomorrow holds no value to you. If you leave your goldfish 3 days of food because you're gone for the weekend, it will eat all of it at once – because it doesn't have a concept of the future -a goldfish has a discount rate of 1. In contrast, imagine a robot with an infinite lifespan – to that robot (assuming it had energy ;), the year 2219 would be the same as the year 2019. It wouldn't differentiate between the two – hence a discount rate of zero.

We have [steep discount rates](#) because we are biological organisms with finite lifespans. Caring more about the present than the future was adaptive to our ancestors. Organisms in our past that didn't consume available food immediately were outcompeted. Such 'time bias' is important because most of the global challenges we face today have the perceived 'danger' well into the future. The longer we get away from today, or this weekend, the smaller that 'danger' seems to our emotional centers, and the less we tend to do about it. Former Secretary of Energy James Schlesinger aptly said: *“[Americans have only two modes: complacency and panic.](#)”* Like everything about our evolved behavior tendencies, being aware of this phenomenon is the first step towards counteracting it.

Quote from the film: *“One of the important qualities that we developed that helped us survive was group identity. And today, group identity still plays an important role in our life. It has an important unconscious effect on our attitudes and our actions.”*

In addition to natural selection and sexual selection, [group selection](#) played a major role in our ancestral past. Being competitive for resources and mating opportunities within our tribe was adaptive, but - at times - we had to compete with other tribes - either via direct warfare or via trials and challenges where group cohesion and cooperation within a tribe meant survival - or perishing - for the entire tribe.

Each of us has these two dynamics working at all times, depending on the context -we are competitive looking out for ourselves, and we are cooperative within our 'tribe.' Me vs Us. Us vs Them. This backdrop explains why we are not only extremely social but extremely tribal. We routinely exhibit ingroup bias, which means we look for ways to both support our ingroup (whether it's a religion or sports team, or [political affiliation](#), or college fraternity) while at the same time ostracizing outgroups.

¹ Kahneman and Tversky, Thinking Fast and Slow, another good summary here: <https://medium.com/leadership-motivation-and-impact/what-i-learned-from-thinking-fast-and-slow-a4a47cf8b5d5>

Books: Jonathan Haidt, *The Righteous Mind*, esp Chapter 9, [Why are We So Groupish?](#)

Quote from the film: *“So, we have this very positive spin on ourselves, and we try to maintain that characterization to the extent that we will only pay attention to information which confirms that bias. We'll deliberately reframe things that we've done in order to keep the coherence of who we are.”*

This refers to the cognitive bias known as ‘confirmation bias,’ where we only seek out information that confirms what we already believe and supports our lifestyles and behaviors. If solving our resource and climate issues means consuming less, it’s no wonder most people don’t seek out more information and understanding about this issue – because it might not ‘confirm’ their current lifestyle and may increase their discomfort.

Cartoon: [Believe](#)

[Ignorance is Bliss - Why People Avoid Complex Social Issues](#)

[The Post Truth Species](#) - Yuval Harara

Books: Newman, Andrew, ‘Why We Believe What We Believe’

Quote from the film: *“Our brains are always creating these distortions. We have no direct contact with reality.”*

Science is a relatively new invention for our species. Even language is not that old an invention in our evolutionary past. Which is why we are more likely to be moved by stories, or images, or imagination than by scientific facts and data.

Imagine a black panther, with iridescent green dragon-fly wings swooping in an azure ocean bay grabbing a barracuda with its large panther talons. If you’re like most people you never have heard this particular word combination before, but instantly upon reading it there was a colorful detailed image in your brain of such an imaginary panther. Communicating in this way to others, and anticipating their visualizations and reactions, is central to human experience. But it is a distortion, not related to reality.

When we use our imaginations, information flows from the old brain region to the new; something different occurs when we watch video or read scientific facts. Using our imagination is an evolutionary downhill roll compared to facts, logic and science. We can each only ever experience our own virtual world and universe; in which meaning, love, satisfaction, music, poetry, challenge, exhilaration, pain, magic stories, contentment and everything else we value plays out. Yet those virtual worlds are critically dependent on the physical world, which obeys entirely different rules.

Quote from the film: *“We humans aren't just like animals, we are animals. And as animals, we compete for mates. Organisms in the wild that have extra resources to display like flashy tails, or large antlers are advertising to their mates that, “My genes are so good, I don't need to skimp and save, because, I'm so strong, I have these amazing attributes.” The same phenomenon happens in human societies to impress members of the opposite sex. A lot of these displays require spending extra energy and natural resources that*

we don't really need to be genetically fit. But we respond to those cultural signals, as if those things really do matter.”



Charles Darwin had a lifelong dislike for peacocks – because their large, showy tails made no sense under this theory of evolution – it would take more food and minerals to grow such a tail, it would make the peacock more obvious to predators and it would make it less likely to escape if spotted. However, all these ‘negative fitness hits’ were overcome by the increased female preference for males with fantastic tail displays. Natural selection (survival) was ‘outcompeted’ by sexual selection (mate preference).

It’s easy to see this in the human sphere. Tiger Woods’ ex-wife Ellen Nordegren has a new boyfriend, billionaire Chris Cline – the above image shows how Chris’ yacht is slightly longer than Tigers. We can laugh about this example, but this dynamic underpins much of our resource consumption issue. We not only can be hijacked by novelty, but in a world of massive technology, fashion, travel and living choices, we often make decisions not primarily on our own preferences, but to buy what makes a statement to others, i.e. conspicuous consumption. Subconsciously we are competing for acceptance and status within the tribe to improve our mating prospects.

[Sexual Selection and Evolution](#) - 8 min video

[Natural Selection and Sexual Selection](#) - 8 min video (some overlap)

Judson, Olivia, **Dr Tatianas sex advice to all creation** (pages 1-20)

A Review of Sexual Selection and Human Evolution - How Mate Choice shaped Human Behavior -

Geoffrey Miller Pages 1-25

[The Evolution of Human Mating](#) - David Puts - 15 min video

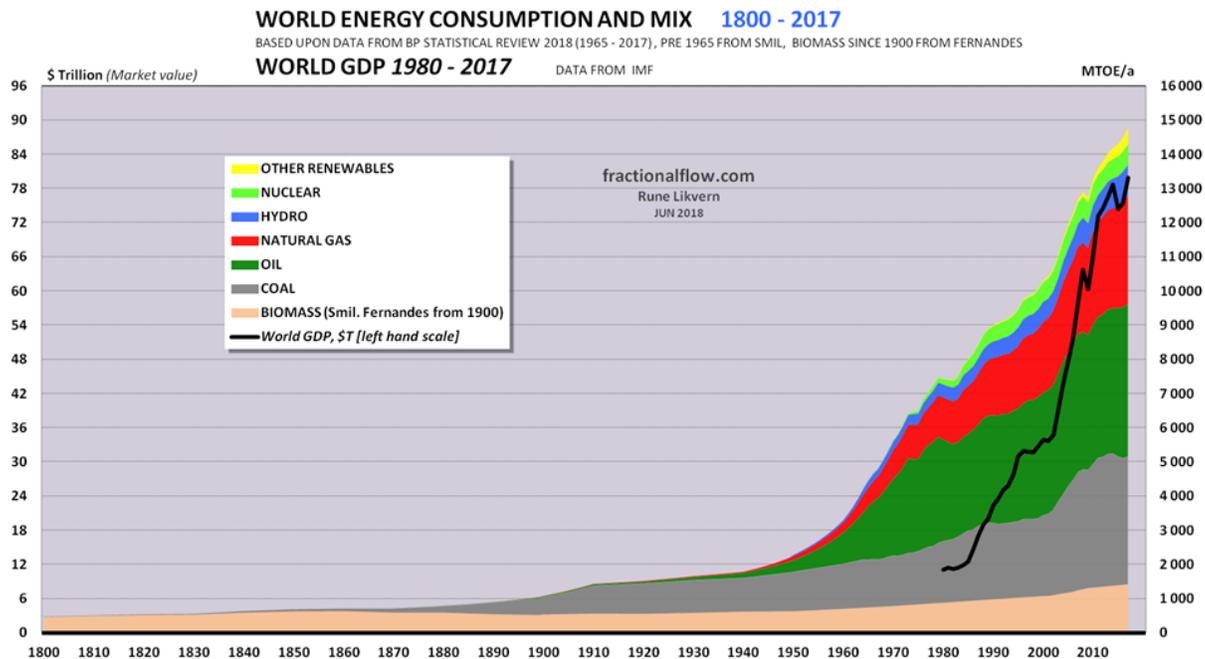
[Waste is Good](#) – Geoffrey Miller

NH – Energy/Economy

Quote from the film: *“Today we live in a world of material abundance and inexpensive energy. And this leads us to think that this is normal for humans, that it's the normal human condition. Early societies, even through the middle ages, and up until almost the modern era had 90% of their economies devoted to the production of energy, primarily in the form of food. That meant that 90% of what people did involved producing energy.”*

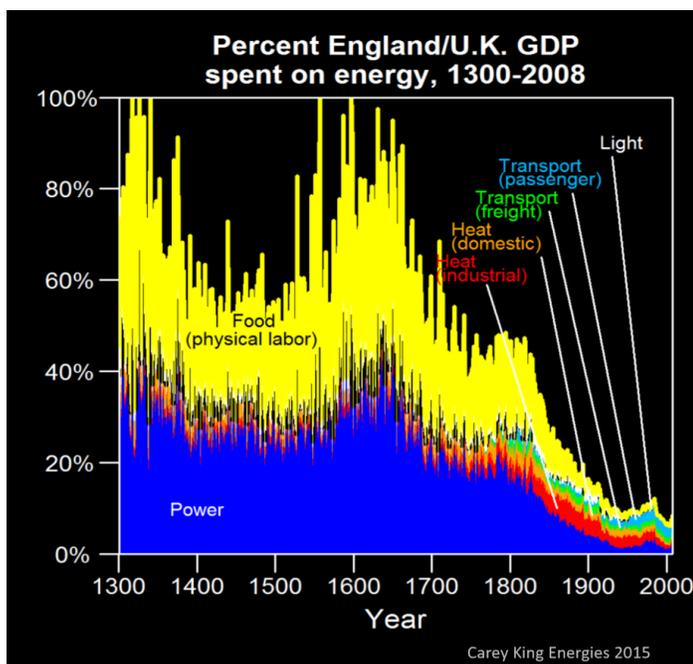
For most of our history as a species we did not use substantial calories above our food and shelter requirements. Today – even though the average American consumes about 2,000 calories via food, we consume over 200,000

calories of ‘exosomatic’ energy (energy used outside of the body.) The below graph shows how the size of the human access to energy has skyrocketed – and mostly in the past 100 years. The grey, dark green and red areas collectively are comprised of ‘fossil fuels’. (the scale on left is ‘millions of tons of oil equivalent’)



Currently, we only use around 8-10% of our societies’ GDP to obtain the energy that underpins all of society, which frees up the other 90%+ for hospitals, universities, airplanes, shopping centers, environmental NGOs, etc. About 20 years ago, this statistic was as low as 4-5%. But in the past 500-700 years, we spent significantly higher % of our economic budgets on energy – exceeding 90% in the dark times of the 1300s. In fact, before the 1700s (when we discovered fossil carbon compounds), almost all of society was agriculturally or energetically

employed. If most of the population is required to work to grow food, there is no surplus left to fund scientists, painters, and explorers.



Quote from the film: *“Fossil sunlight is so powerful it's indistinguishable from magic. And we're mining this ancient sunlight in a very brief period of human history.”*

One might define magic as the ability to do seemingly impossible things. Though coal, oil and natural gas are obviously not really ‘magic’, because of their incredible energy density, they can do enormous amounts of work – for very little cost. 1 barrel of oil (42 gallons) contains 5,700,000 BTUs worth of energy, which if you translate it to work, is 1,700 kWh of work. The average adult human performs 0.6 kWh of work per day – which means it takes us over 4 years to generate the same work as in a barrel of oil – which

costs us around \$65. Fossil fuels are not magic, but their existence does explain most of our industrial and technological progress – because we effectively have the work of hundreds of billions of human workers, for next to nothing.

Despite the above (easy to verify) facts, modern economic theory underpinning our business schools and national policies treat energy the same as every other input. Capital (money and machines/infrastructure) plus human labor describe the entire wealth machine. Economic textbooks assert that firms create products that households want – and pay for – and the money then cycles back to the firms as profits and supporting investment for the next round. Nowhere in this theory is the origin of most of the physical work (fossil energy) nor the impact on environment (CO₂, acidification, mass animal loss, toxics, pollution, etc) included. Only the cost of extraction is included. Technology and labor are very important inputs to our economies, but both are dependent on energy inputs.. Macroeconomic theory will eventually have to incorporate the primacy of energy.

[5 Carbon Pools](#) - Wes Jackson

[Gasoline and Fertility](#)

See: Vaclav Smil – Energy and Civilization 2018

See: Ayres et al, The Underestimated Contribution of Energy to Economic Growth

Quote from the film: *“A chemical composition of 50% of the protein in our bodies, and 80% of the nitrogen in our bodies indirectly comes from the chemical signature of this fossil sunlight that we're mining. So, we are different than our ancestors. They were made of sunlight, we are made of fossil fuels.”*

Instead of the soil fixing nitrogen from the air (which has limits), we now artificially create nitrogen by an industrial process called Haber Bosch, where we effectively turn natural gas into ammonia fertilizer, thus enabling a vast increase in crop production over the past 40-50 years. Along with other natural gas based fertilizers and pesticides, we have quadrupled our agricultural productivity in the past 100 years, and especially in the past 40 years or so, termed the [Green Revolution](#). However, this is based in large part on fossils (natural gas) which are non-renewable on human times scales. Growing crops without fossil fuels is possible and still done in many parts of the world, but is much more labor intensive and costly.

Quote from the film: *“Eighty years ago, the oil in America was just under the surface. We would need very little machinery to get these gusher wells and we would get out over one-hundred times the energy that we put in.”*

The Earth does not have a creamy nougat center of crude oil. Oil is formed from [diatoms](#) –miniature ancient sea creatures that died and fell to the bottom of the ocean and were gradually covered by sediment. Over (very long periods of) time, the organic matter was pressurized and heated from geologic forces and turned into [pockets of liquid hydrocarbons](#) – oil – that are mostly in places that used to be ancient oceans and seas.

Just like it's easier for you to pick an apple right at your head level on a tree -and the apples at the top of the tree 30 feet in the air require more effort to pick, so it is with oil – (and natural gas – and coal -and copper – and most other non-renewable resources). We have found most of the easy (and cheap) oil and have now resorted to using complicated technology ([hydrofracturing](#)) to get at tough-to-access source rock deposits in the shale regions of USA and Canada. There are huge amounts of oil (and gas and coal) remaining, but we've used most

of the easy to get/cheap stuff. Moreover, most of what remains will be expensive to extract-and in view of climate change risks – can we afford to burn them anyway?

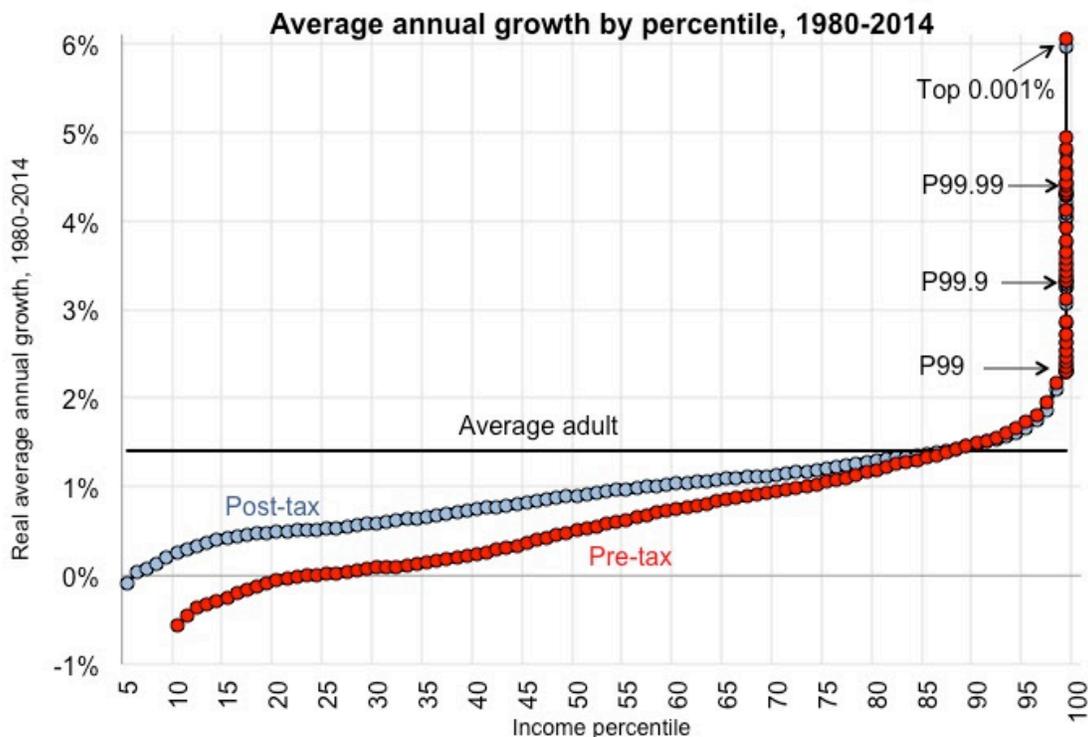
[Fossil fuel use graphically](#)

Quote from the film: *“When there's uncertainty, when there's a sense of precarity, when there's a feeling of vulnerability and confusion, that's exactly when we are most susceptible, obviously to adhering to a message, a voice, a person who comes along and is able to meet those anxieties and those uncertainties with such confidence and certainty. And so, that's what we've seen replaying over and over again in politics. I don't need to mention the obvious examples of what happens when the larger public's sense of fear is coopted.”*

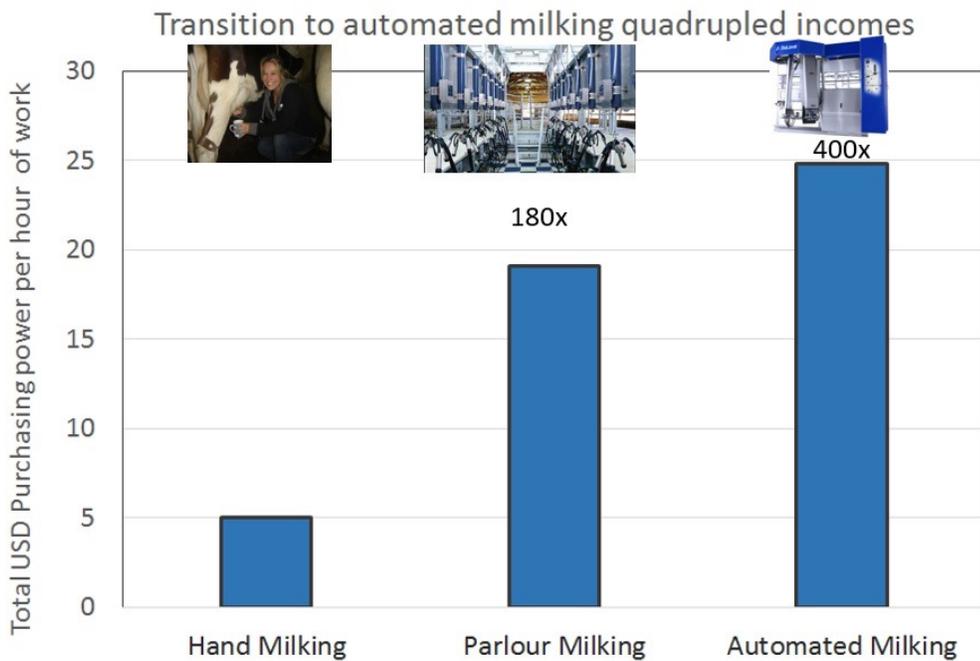
Much of the “populist” turn seen in Western politics recently is in response to decreasing opportunities due mostly to biophysical limitations. [1 in 3 US households](#) faces challenges meeting energy needs. Over half of Americans [don't have \\$500 in savings](#). The median household is 6% poorer today than their parents in the 1960s (while the top 1% have gained significantly). When our economy ‘recovered’ from the Great Recession, over 90% of the recovery in income went to the top 1% of Americans (meaning it wasn't a recovery for most).

When people are struggling economically relative to others and relative to their recent experience, they become anxious and stressed. When we are stressed about money, [people experience a reduction in cognitive function](#) and make poorer decisions. This often means being susceptible to following simple messages that promise a return to better times, irrespective of whether they are valid or possible.

Quote from the film: *“About half the wealth in the country is held by the top one-percent of the people”*



The above graph ([source](#)) shows that the average adult has experienced about a 1.3% growth in income over the past 35 years (horizontal line). The sharp spike on the far right that shows 3, 4 and 5%+ growth are all the top 1% of earners. Wealth inequality is at its highest levels since the 1920s as the [top 1%](#) own almost half of all



wealth. This is not healthy, as when increasing numbers of people have nearly nothing, they then have nothing to lose. This inequality can set the stage for social instability and upheaval.

If what fossil fuels can do for us is ‘indistinguishable from magic’ won’t they still provide massive benefits to our economies if oil rises to say \$200 per barrel? Or \$500 per barrel? Well, yes, they’ll still be able to do

things cheaper than human labor would, but we have organized our society around using LOTS of energy, but also CHEAP energy. The benefits we derive from fossil energy in terms of wages, profits, and cheap goods can be unwound easily if energy prices increase. This is because a unit of human labor is not replaced with just one or a few units of fossil labor, but with hundreds or thousands of units for each task, making the system very sensitive to small increases in energy input costs. Think of how much of your own time and labor is saved from using a chainsaw to get firewood instead of a handsaw, or driving a car to your high school reunion instead of walking. Lots of affordable fossil slaves save you time and raise your living standards.

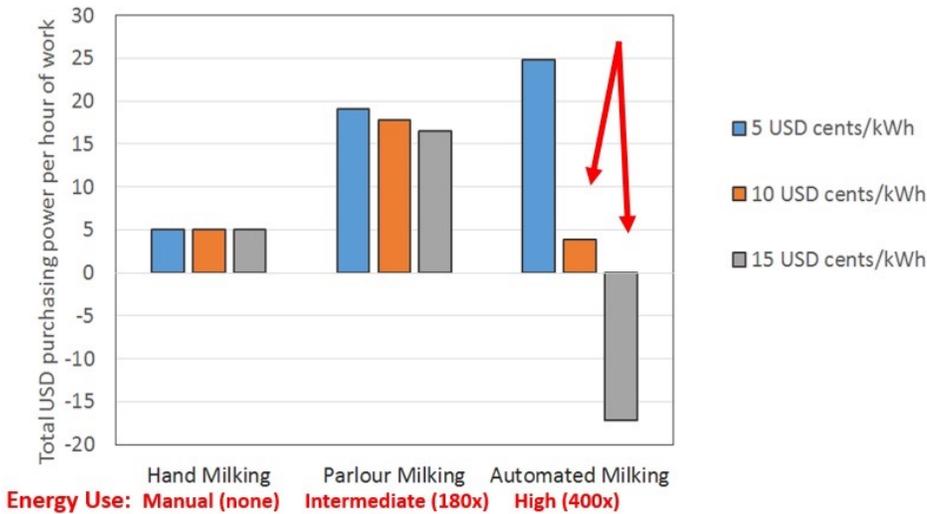
Consider milking a cow using three methods: manual (no energy other than the human labor), semi-automated electric milking machines (1,100 kWh per cow per year, or cow-year), and fully automated milking (3,000 kWh per cow-year). The manual milker, working alone, requires 120 hours of human labor per year per cow, but the semi-automated machines require only 27 hours of labor, and full automation only 12 hours.

Let’s assume that the human milker is paid \$5 an hour working alone. Using electric milkers that run on electricity at \$0.05 per kWh, output rises significantly *and*—because cheap electricity substitutes for so many human hours of labor—the wages for the milker increase to \$18 per hour with semi-automated milkers and to \$33 per hour with the fully automated technologies. (Note: this large economic benefit can go to the owner of the dairy farm, the employees, or to consumers in form of cheaper milk – or some combination). This same principle can be extrapolated to many or most modern industrial processes: we save human labor and time by adding large amounts of cheap fossil labor.

In other words, workers are paid according to their productivity, and using lots of cheap fossil energy raises productivity. If that fossil energy gets more expensive, workers’ productivity is not increased as much and so their labor is worth less. For example, if electricity prices rise to \$0.10 per kWh, the manual milker (still) makes \$5 per hour, but the semi-automated milking wage declines from \$18 to \$14 and the fully automated (energy-intensive) wage plunges from \$33 to \$8 per hour.² If electricity prices triple to \$0.15 per kWh, the previously

² IIER, *Low Carbon and Economic Growth – Key Challenges* (Meilen, Switzerland: July 2011).

Impacts of changing energy costs on total milking systems cost



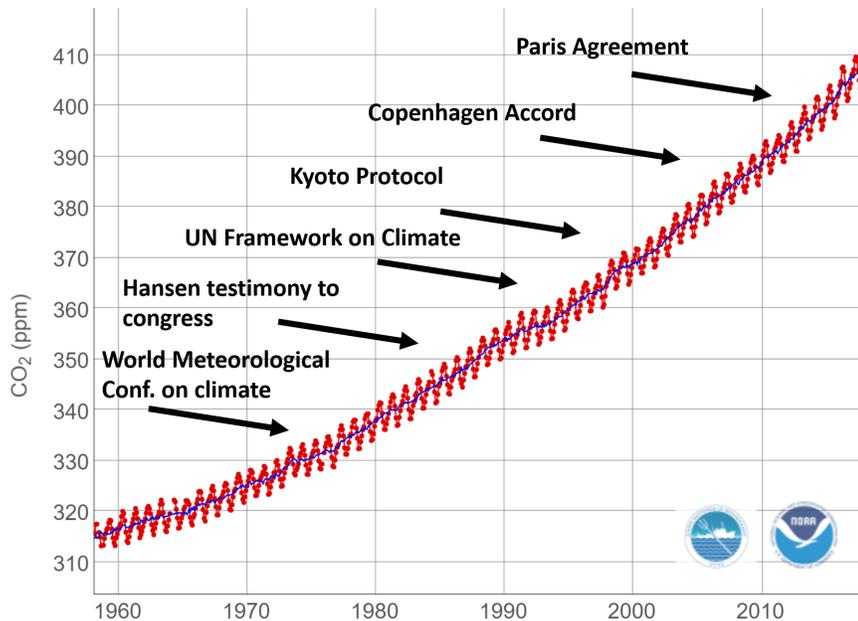
very profitable high energy technology now is a money loser! (see above graph)

The key point is that in an economic system that uses lots of non-human energy labor, as the price of energy doubles or triples, the economic benefits from this tradeoff recede quickly. This is especially true for air travel, aluminum smelting, cement manufacturing, and other energy-intensive processes. The reduction in wages that ensues from large energy price increases can be offset only partially by greater efficiency or lean

manufacturing measures, because the whole phenomenon was predicated on large amounts of very cheap energy. This experience of “reduced benefits” is occurring now around the world.³

Nathan Hagens: *“And so, to just get more facts about climate change or about oil depletion or about environmental destruction, people don't know what to do, because they're part of this organism trying to get more feel-good brain chemicals.”*

Mauna Loa Monthly Averages



We’ve been hearing disturbing facts about our environmental situation and climate change for decades, but the precautionary impact of all the science and warnings isn’t demonstrated on a graph of CO2 emissions (above) - because we haven’t stopped growing nor stopped emitting carbon at record levels. Most people want a healthy environment for themselves and their children. But most people don’t want to voluntarily use less energy to save the environment - unless everyone else does. Giving up meat or carrying around a water bottle instead of buying plastic are good environmental choices – but giving up something much more tightly correlated

³ IIER, “Green Growth: An Oxymoron?” 18; Max Kingsley-Jones, “Emirates Begins Parting Out Its A340-500s,” *Flight International*, September 23, 2013; EIA, “The Cement Industry Is the Most Energy Intensive of All Manufacturing Industries,” *Today in Energy*, July 1, 2013, www.eia.gov/todayinenergy/detail.cfm?id=11911.

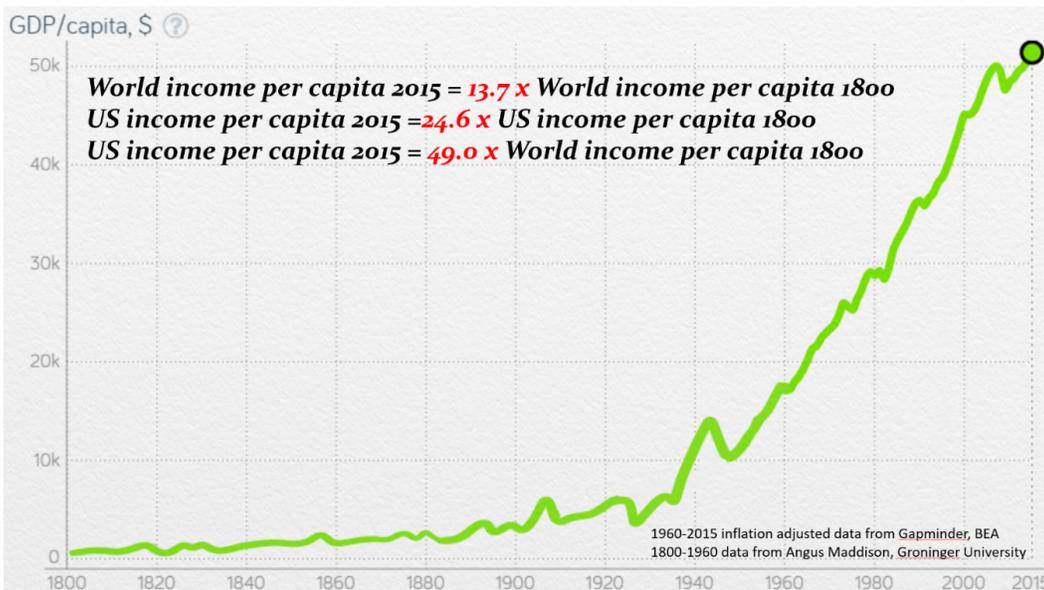
to human development (energy) cannot be easily handled by our current institutions, the political system, or the population at large.

We are animals -but we alone possess culture. Biology determines what we want and need – but culture dictates how we get it. Which opens up quite a few positive opportunities.

Quote from the film: *“The treadmill is getting smaller, and smaller, and smaller, and smaller. And, the number of people who want to be on the treadmill, is getting bigger and bigger and bigger. And eventually, there's going to be no room to run. And so, people will fall off. Many people will fall off.”*

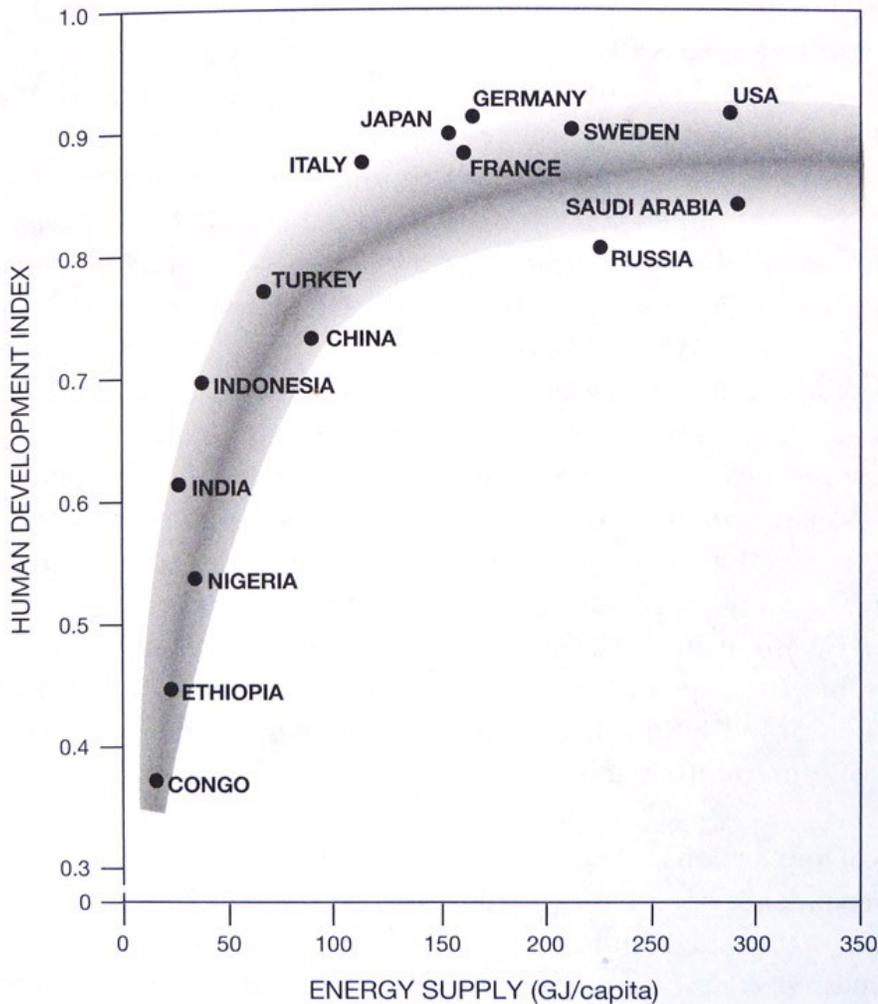
What this quote refers to is the fact that we've had a dramatic growth in human population – from only 500 million 300 years ago, to almost 8 billion today. In fact, the [world population](#) has quadrupled since when most of your grandparents were alive and doubled since 1970. (Here is a [timeline video](#) showing population for last 2000 years)

But the other critical aspect that is implied is the type of lifestyle that the 7.6 billion humans alive today aspire to. Concurrent with rapidly growing populations we also had rapidly growing levels of income -and consumption (based on new technological inventions and large amounts of primary energy (mostly fossil)). The average human today has almost 14 times the income that the average human living in 1800 did. The average American has almost 50 times the income of the average human in 1800.



So when we talk about population, and limits to natural resources, it is important to remember that we have populations of people – but also populations of the energy hungry devices that those people use. Our car population currently numbers in the billions – so too do cell phones, air conditioners, refrigerators, computers, washers/dryers, freezers, lawn-mowers, Xboxes and large amounts of energy-using products that require energy separate from our bodies. So the falling off may be in terms of our access to high energy lifestyles.

Finally, it is important to point out that there are declining benefits to ‘more’, but ‘more’ to someone who has very little dramatically improves their lives.



The above graph ([Source](#)) shows that above 100 gigajoules per capita, there is very little developmental benefit to ‘higher energy supply/ But at low levels – like 10-20 GJ/capita, there is significant improvement to human well-being to having more energy access.

Quote from the film: “...energy is the ability to do work. Work is force through distance. So, every time that you move something, from China to the United States, or from the floor to the ceiling, that takes energy. When you drive to work, obviously it takes energy. To boil one quart of water, it takes up the equivalent of 500 calories of food. Any kind of transformation requires energy.”

We (including the most prominent economists in the world) tend to look at money as what drives human economies and progress. But money is

just linen and paper (or electronic digits in your bank account). Unused energy is what is really valuable in our modern economies. No matter how a factory makes a cup – whether using plastic, or metal or fiberglass or paper or Styrofoam or even out of a coconut, energy is required in the process. Imagine everything you did today. Was there anything you experienced or bought or used that did not require energy to make?

(MTOE= Million Tons of Oil Equivalent)

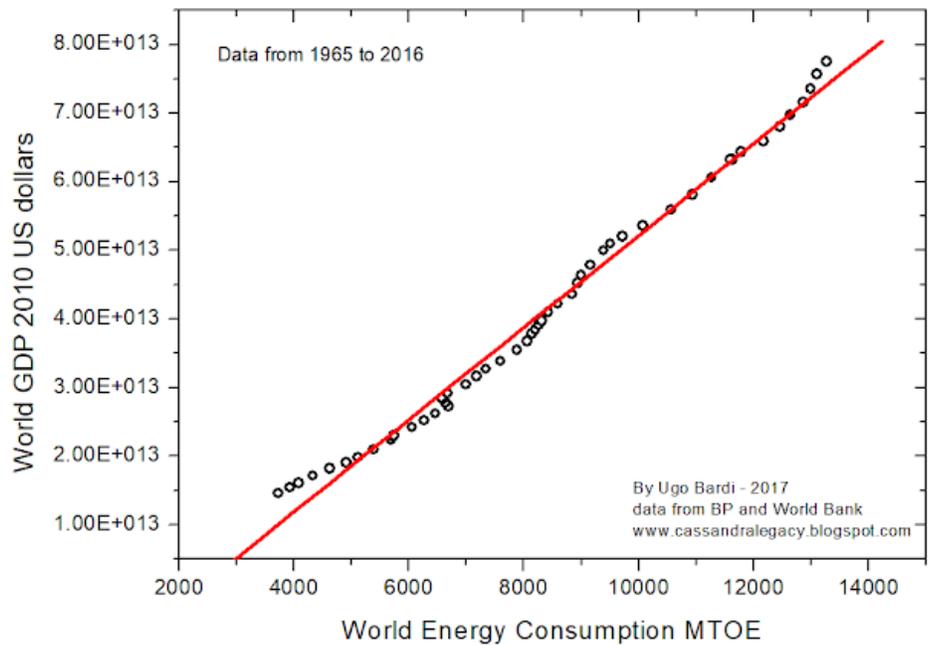
Because of this, it is no wonder that the size (and how we measure the success) of our economies has been growing for over 150 years – and is highly correlated to how much energy we use. The above chart shows the relationship between energy use (on bottom) and the size of global economy (on the left). It weaves in and out of alignment due to monetary additions and efficiency improvements, but effectively, our GDP is extremely correlated with energy. In certain developed countries (like UK or USA) we are getting more GDP per unit of energy suggesting a ‘decoupling’. But this is largely because we import energy in finished goods from other countries (e.g. China) that do the heavy manufacturing for us.

Quote from the film: “An energy transition must be paid in energy.”

What? Don’t we just need to find enough money to pay for an energy transition?

Well – an energy transition means that humans move into a different sort of economic system that consumes differently, is organized differently and uses largely a different type of energy. Much of our current energy is used for consumption – consumer goods, vacations, transportation etc. So if we keep Starbucks, WalMart, Disneyland and Delta Airlines supplied with energy, where will the excess energy needed to build and develop new energy come from? If we really want to invest in new energy types to power a future society, we need to set aside a (large) chunk of societal energy use

to invest in that new energy development. Just growing the total amount of energy (solar, wind, hydro, oil, gas, coal, etc.) doesn't create an energy transition – it just creates a larger energy infrastructure.



Cutler Cleveland – [Energy Transitions Past and Future](#)

Quote from the film: *“The flow of fossil fuel has turbo-charged our society.”*

Until very recently our economies were based on what our physical labor plus energy from the sun could combine to produce – mostly in the form of grains and crops from intensively working the land. Also, that physical (caloric) surplus in turn allowed for other occupations: e.g. builders and butchers and armies and artists. Today, compared to those times, humans have access to vastly larger amounts of energy than our muscles and diffuse sunlight hitting the earth could provide.

The average American employee (including CEOs) makes \$260 doing eight hours of work per day. Since U.S.A. is a rich nation, this is over five times higher than the world average earnings of \$57 per day. At the historical average cost of \$20 per barrel, oil could do the equivalent work of over 25,000 humans who generate 600 watt hours per work day! Even at today's oil price of \$75/barrel one can buy the work equivalent of over 7,000 human laborers⁴. If a human does 600 watt hours of work per day and 60% of the 7.7 billion of us are working, this totals about 2.8 TWh of work per day - merely 0.5% of total global primary energy consumption used by humans. *The vast majority of labor done in the global economy is not done by humans at all but by fossil coal, oil, and natural gas, and it's done thousands of times cheaper.* If we include non-fossil sources like hydropower, nuclear, solar and wind, fossil carbon compounds still do over 90% of the lifting, moving, excavating, cutting, and other difficult tasks that power our globalized economies.

⁴ [Green Growth- An Oxymoron?](#) Institute for Integrated Economic Research, For UK Department of Foreign Investment and Development 2009

Nathan Hagens: *“Ninety percent of the work done in human economies is done by fossil slaves.”*



Huh? Fossil energy slaves? What does that really mean? Well, imagine taking a road trip with three of your buddies. You pick them up, stop at a gas station and for ~\$40, fill up your 20-gallon tank and head for the countryside. You drive for hours, talking, watching the scenery roll by and having fun. After about 500 miles, your vehicle rolls to a stop, out of fuel. How many hours/days/weeks would it take the four of you to push your truck back to your starting point 500 miles away? Well, let's say the road was reasonably flat and you had reasonably good weather and you were reasonably strong. You might push the truck two miles per hour. *Doing that ten hours per day it would take you almost a month to push it back to where you started!* How much would you have to pay your friends to do such a boring, difficult and unpleasant task? Even at minimum wage of \$8 per hour it would cost you over \$6000 and a month of time (and probably several friendships). Ergo, though we don't often think of it, that condensed, liquid pixie dust you put in your gasoline tank for \$40 is mighty special.

[Fossil slaves](#) (comic) is a term invented by scientist and systems thinker [Bucky Fuller](#) to describe this massive amount of work done for us by coal, oil and natural gas. These modern energy helpers obviously aren't 'slaves' in the conventional sense, but they do follow our bidding (or rather, the machines that use them to run do our bidding). Compact, transportable, not needing sleep or medical care, and with no feelings or way to voice them, our army of fossil slaves has a huge advantage over human labor: their extremely low cost relative to human labor. And they don't complain or need health insurance!

Although in our current culture the term 'fossil slaves' has a pejorative connotation, it is appropriate under a wide boundary perspective. Just like our society is still dealing with the repercussions from human slavery 150 years ago, humans 150 years in the future not only won't have access to this many 'energy slaves' in fossil fuels, but will also have to deal with the consequences of their use. The term 'slave' may not be as misplaced as it first sounds.

Essay: [GDP, Jobs and Fossil Largesse](#)

Quote from the film: *“The average American consumes 220,000 kilocalories, every day. We don't think about that, we only think about the 3,000 or 3,500 of food that we eat. But our energy footprint is almost one hundred times more than that, if you consider our buses, and our airplanes, and all the hospitals, and the*

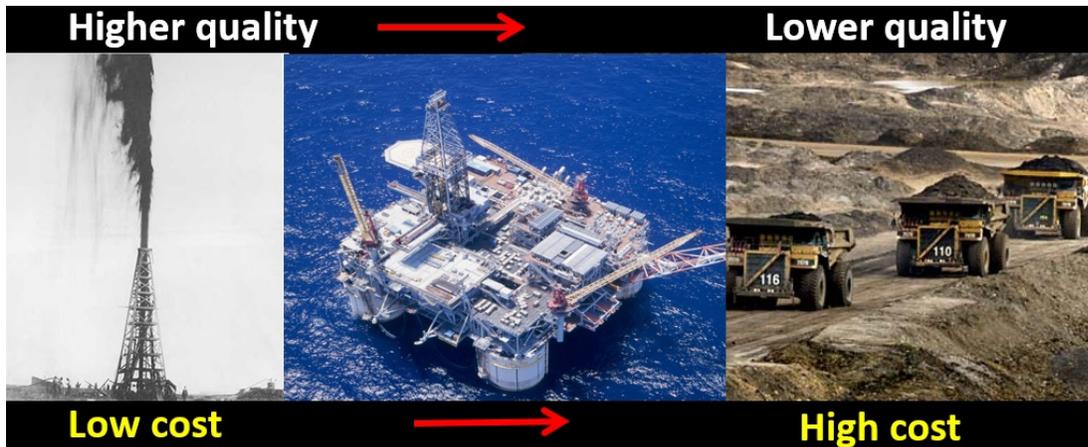


Disney Lands, and the NASCARs, and in all the various things that we buy that are imported around the world”.

Simply put, our ‘energy footprint’ is not the calories we eat, but the calories we burn in all the energy using activities we experience during the day. The average American uses over 200,000 kilocalories of energy ‘exosomatically’ (outside the body) while we only eat about 2000 calories (the rest being waste). So, if you’re an American you ‘consume’ the equivalent of 407 Big Macs, every day, in terms of the calories you use: driving, turning on the lights, flying, growing and delivering our food, etc. (Or for college

students, 585 packages of ramen noodles.)

Nathan Hagens: *“So, it's not like we're running out of oil, or coal or gas, it's that it's getting more costly, in energy terms, to get it. Because it's more costly, it has less benefits to the rest of society.”*



There have been cries of ‘running out of oil’ for a long time. But technology and globalization (and debt) have allowed us to continue to grow our oil extraction. But oil, formed over geologic time, is not infinite, and cannot be replaced on human time scales. While technically there are vast amounts of hydrocarbons remaining, we have found the best and easiest and cheapest and now are moving into the ‘unconventional sources’ like shale oil, bitumen, tar sands, etc.

The USA recently hit an all-time [peak in extraction](#), piercing the high made back in 1970. But we have done this by [drilling more holes](#) than the rest of the world combined. A new shale oil well requires [100 train cars of sand](#) and over 1200 truckloads of water. Technology has enabled us to access the source rock where petroleum resides, but for how long and at what cost? These are open questions.

[A Net Energy Parable](#) – Nate Hagens

[Resource Transitions and Energy Gain](#) - Joseph Tainter

Quote from the film: *“When we take on debt, we are promising to repay it with future energy. The fossil fuels will not last forever, they cannot last forever.”*

Most economists and financial analysts misunderstand the relationship between money and energy. Energy is what powers societies. Money is a marker for energy and other physical wealth. Since the 1970s the global economy has grown its debt in every single year more than it has grown its economy. In USA, in the 12 months prior to August 31, 2018, we grew our economy by \$515 billion, but our government had to borrow a whopping \$1.2 trillion to do so. IN the future, all the debts that we (and other countries) have accrued, will come due - eventually that money will be spent -and every good and service in our economies requires energy. Growing our obligations faster than our economies is not a sustainable practice.

Nathan Hagens: *“Renewable energy, although it's mature and it's getting very cheap, it's not going to replace this infrastructure, and this civilization.”*

Renewable energy is kind of a misnomer. An oak tree is renewable. A raccoon is renewable – solar panels and inverters are repeatable, if we have complex global supply chains and industries. Solar and wind based technology has gotten substantially cheaper in recent years -cheap enough that a society based on it would have reasonable energy surplus and emit less CO2 to boot.

But all joules (a measure of energy) are not equal in what they provide to human society. Here are some brief reasons why e.g. solar and wind can't replace fossil carbon AND continue our current developed world lifestyle and throughput:

Intermittence - Wind and solar are stochastic sources, meaning there is some variability as to when they are available (it's not always sunny or windy, and the sun definitely is not out at night time!) Coal and natural gas plants can be turned on with the flick of a switch. So with industries that require 24/7 access to electricity, solar and wind are not a perfect match, and it costs more money (and energy) to build back-up capacity, battery storage or overbuild.

Energy quality - Almost all renewable energy produces electricity. Electricity has many advantages over other fuels because it can be used for so many things and has lower energy losses than e.g. burning gasoline to power a vehicle. However, currently only around 20% of energy use in USA is electricity - the other 80% is mostly direct consumption of fossil fuels for transportation and heat.

Fossil surplus - The vast power in global economic systems provided by the over 100 billion human laborer equivalents from coal, oil and natural gas allows for many benefits to human societies (and many costs). One benefit is they enable the factories, surplus and education for us to develop alternative tech like solar panels and inverters. Without fossil fuels we would have to create industrial infrastructure using only renewable energy, which is very difficult for e.g. blast furnaces to make steel requiring 2000+ degree heat. It is technically possible but right now the renewable energy industry is enabled by the fossil industry.

Growth - We have a lot of oil left. We have maybe 30-40 million barrels per day of the cheap stuff - ~\$20 per barrel. We could get 100 million barrels a day of oil that cost over \$100 per barrel. But continued growth in our economies from these levels requires two things: 1) sufficiently cheap energy in 2) sufficiently large size. We are in a situation where we have cheap energy in small amounts or more costly energy in large amounts. If any

combination of cheaper renewable energy plus more costly fossil fuels cannot continue growth, then we have an issue with all the debt we've amassed. The result of that reset will be a smaller economy, where the renewable energy calculus takes on a different texture.

Superorganism (see below) - As long our cultural goal is GDP, powered by free markets, scaling up renewables can only grow the human energy footprint. For environmental reasons, we need subtraction not addition. So whether or not solar/wind are better or worse than fossil fuels is mostly moot. There is not a plan for how stochastic sources can replace fossil fuels, only add to them. Unless we change our objectives and aspirations away from just growth.

Quote from the film: *“Oil's the biggest industry on the planet. So, it sets the pace, in terms of inflation. So, if you raise the price of oil, all the other prices go up.”*

The story of industrialization is one of replacing tasks humans used to do manually with machines powered by fossil energy. Because oil (and coal and natural gas) are so incredibly energy dense, and because we don't pay for their creation (or pollution) but only their extraction, they are unbelievably cheap relative to what they do for us. So we replace one unit of human labor energy with thousands of units of fossil energy. This 'trade' has caused enormous boost to wages, profits, and lower priced stuff in our stores.

The problem is that we have built an enormous and complex system that depends on continued low-cost energy. If oil would say double or triple in price, this wouldn't only impact Americans at the gas pump, but throughout all products due to embedded use of petroleum in the system. Because we don't just replace human labor 1 for 1 with fossil energy, but thousands of units, our wages, profits and the price of goods is quite sensitive to higher energy costs.

Quote from the film: *“So, if you ask, ‘Can solar energy power our society as it is today?’ then you already have the answer. It is no. It is not possible. If you want to switch from oil and gas and coal and to move to solar energy, then you have to change a lot of things.”*

The energy picture circa 2020 is very complicated. There are fervent believers that solar and wind can completely replace fossil fuels and we can continue to grow. We are likely growth constrained, not energy constrained per se. We can power a wonderful civilization using solar and wind and some % fossil energy— just not the one we are currently attempting to power. To switch to largely/all renewables will require many things. It will most of all mean using less energy, which means less gadgets and comfort, or a lower population, but perhaps more excitement and meaning. It will mean switching a large portion of our energy use to electricity, which is possible but has many challenges. It will mean overbuilding wind and solar and when its real windy and sunny using the excess to create 'hydrocarbons' via chemical processes – we can actually make transportation fuels with solar and wind – but our economies couldn't function real well on \$10 per gallon gasoline.

We will eventually go to 100% renewable energy someday in the future, by definition as the carbon pulse has run its course. What will that look like and how do we get there? Do we need 427 Big Mac equivalents per person to be happy and healthy?

[Green Growth - An Oxymoron?](#) - Institute for Integrated Economic Research

[Steady-State Economics](#), Herman Daly, University of Maryland, (1977, 1991); also: *For the Common Good*, (1989); *Ecological Economics: Principles and Applications* (2003); and this essay: [From a Failed Growth Economy to a Steady-State Economy](#), Solutions Journal, v. 1, March 2010

Nathan Hagens: *“Our food system right now is an energy sink. We use 10 to 12 fossil-calories to produce one food-calorie.”*

In past eras, our food system was an energy source – we would toil and work in the fields – along with draft animals to produce a crop. The food crops that we grew contained more calories than all the calories that went into the agricultural work to procure them. Today, with a vast, fossil fuel based ag system, we now use 2 calories of oil and natural gas to grow one calorie of food globally – an energy sink – but because the food isn’t in our backyards ready to eat, we also use another 8-10 calories to process, refine, package, deliver and cook the food, making our agricultural/retail system a pretty big energy sink ([10:1 good rule of thumb](#))

Books: D. Pimentel. Food, Energy, and Society.

Quote from the film: *“You see, there is a parameter that is very basic in evaluating these kinds of things, which is called energy return on energy invested.”*

Ecologists study the behavior of animals and fish. They’ve discovered that those organisms who expend (a lot) less energy than they receive in terms of calories have survival advantages. A classic way to measure this is called EROEI or ‘Energy Return on Energy Invested.’ We are used to the dollar return on dollars invested, but dollars can be created or printed with no relationship to how many high quality natural resources – (like oil, or copper) remain. This is why how much money a certain energy technology makes is not the most important question – because that might depend on subsidies or taxes or government support etc. A better way to understand how sustainable and beneficial an energy technology might be is how much energy it produces divided by how much energy it took to get it going. Just like measuring how many calories a lion used chasing down a zebra vs how many it will get to eat, we can measure how many calories of profit a solar panel, or oil well, might have during its lifetime.

NH – Humans/Environment/Future

Piers Sellers: *“If we don't stop emitting carbon dioxide at these rates, pretty soon we're going to be in trouble. We're going to have massive climatic disruption. The rainfall belts will move. People in the hundreds of millions, maybe a billion and a half people have problems getting access to fresh water and food.”*

Many of the worlds past mass extinctions had to do with CO2 pulses. Though it’s just a tiny molecule which is only around 400 out of every million molecules in the air, it has a powerful heating effect on the planet. Many historic extinctions were due to large volcanoes – the size of whole countries, spewing lava (and CO2) for thousands of years. Humans, with our cars, our factories and our cutting down of rainforests are currently ‘acting like volcanoes’ in how we are emitting CO2 which enters the atmosphere, much of which gets absorbed by the oceans.

There are many variables that relate to how climate will change in the future – no one really knows. But we are already at 1C above the period before our economic system started to burn fossil carbon compounds. And – at least voluntarily – there seems to be no real plan in sight to change that.

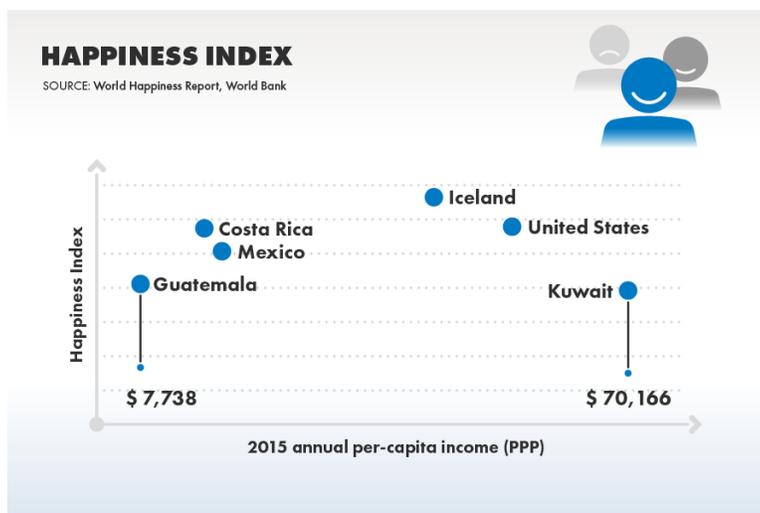
Quote from the film: *“There is a very complex metric that can be obtained for any material object in terms of what it actually does to the planet at every point from the beginning of making it, through the end of its life-cycle.”*

[Life cycle assessment](#) studies the impact and cost of a product from cradle to grave. But the conclusions of heavily polluting industries or products have rarely changed our policy and pricing. Coal – which costs around 5 cents per kWh, would cost over [8 times that amount](#) if all the environmental and health costs were included in the price. But if we did that we would crash the economies. It is possible over time that we could again tax natural resources instead of human labor, and have prices more reflective of their true costs.

Quote from the film: *“We like to drink out of bottles that we can throw away. We like styrofoam containers for our fast food. Plastic itself is something that is persistent through time. It gets recycled, it gets recycled, it gets smaller, it gets smaller, and now it's right back to us and detectable, in our blood stream.”*

There are many macro pollution events currently occurring – ocean acidification and global heating to name two. But in the same way that we are blind to bad things that will (possibly) happen well into the future, we also tend to miss pollution and impacts that are too small to see. It is expected that [by 2050 there will be more plastic \(by weight\) than fish in the oceans](#). There is now a global epidemic of [plastic waste](#). Many toxic chemicals are used in such small concentrations that they fall below EPA thresholds, but increasing research shows that *small* concentrations might be enough to [impact our endocrine system](#). Another concerning development on pollution in the micro world is the sharp [decline in sperm counts in the developed world](#), possibly due to pesticides.

Quote from the film: *“Wise farmers know that if they eat their seed corn, there will be nothing left to plant for future harvest. Will future generations look back at today and view much of the energy we're burning to have been wasted? Are we eating our seed corn? So many of us have come to expect the level of comfort and convenience unprecedented in our biological past. We need to redefine our expectations. Not as what we will lose, but what we might gain, by preparing for something different.”*



Money, above a certain threshold, does not make us happy. Happiness is more related to community, friendship, lack of stress, access to healthcare, nature and meaningful work and hobbies. Despite a significantly larger economy, Americans are no happier than we were 50 years ago. Kuwait, as one example of many, has almost 10x the income per person as Guatemala (as one example of many) yet their citizens are equally happy.

We are often afraid of the unknown. To imagine a world with less physical wealth than we are used to naturally causes anxiety. Loss aversion – where we feel worse about losses than we feel good about equivalent gains is a very real emotion. But we still live in a society with a 100: 1 energy surplus vs. what our bodies really need, meaning there are enormous possibilities of imagining and constructing a future that is exciting, fulfilling and more aligned with longer term co-existence with the rest of life on Earth. Change is scary to many people, but can also be exciting, especially when so many possibilities lie before us.

Quote from the film: *“Of course, humans are not social insects, but if you were able to watch a village or a city from a distance over time, it looks a lot like a growing interdependent super-organism. A reorganization of material existence with far reaching implications.”*

Humans are one of the few organisms on Earth that biologists consider ‘eusocial,’ which means, generally speaking, “very social.” Eusociality is often characterized by the use of several generations to help raise offspring, division of labor, and specialization of tasks to produce food/surplus. A new term ‘ultrasocial’ has been added to describe humans because of our ability to cooperate with millions/billions of non-familial related others towards a collective cultural goal (currently: profits measured in dollars, but historically, agriculture and physical surplus). It is this quality that has enabled us to build nation/states and civilization. (Ants, another eusocial species also build ‘[cities](#)’)

Collectively, as individuals, as employees of small businesses, as part of a corporation, as part of a nation-state, we follow biological adaptations that steer us towards maximizing our investments of time and money. In seeking the same emotional state of our ancestors, but in a globalized economy with a smorgasbord of options and huge amount of very low cost fossil energy, our economy looks very much like a lurching energy dissipating structure – a Superorganism. If you look at CO2 from Mauna Loa at any time in history, you can approximate the [size of the human economy and energy consumption](#).

Ultimately, we evolved, and *we figured out that we evolved*. And we are functioning like an energy eating supeorganism, a kind of giant mindless amoeba. *Figuring out we function as a superorganism* can inform our future policies, goals and decisions. The far-reaching implications are: on a finite (source and sink) planet, we’ll soon need to reduce per capita consumption (or population), and culturally decouple our ‘emotional state’ from expecting more and more energy and material goods each year.

[The Economic Origins of Ultrasociality](#)

Book: E.O. Wilson: The Social Conquest of Earth

Quote from the film: *“And, the pre-frontal cortex has the ability to inhibit emotional impulse. And once we understand the true cost of the things we use and the things we do to the environment, the very same mechanism applies, and lets us pull back to the balcony of the mind, where we see everything is going on. Then we can make a better decision. This is the first step in changing our habits because without*

mindfulness, we don't even notice the choice points. We just blindly, spontaneously, automatically do that thing we've always done."

It is not an immediate panacea to understand the quiver of evolutionary arrows our mind carries around with us, but it is a first step towards mindfully engaging on the road to *sapience*. In the words of Aristotle, "knowing our weakness is our strength." [Mindfulness](#) leads to better choices, but takes practice. If we can culturally make the same choice with respect to energy and the environment as an individual does when they eschew the donut with sprinkles or chocolate cheesecake, then we will, as Jeff says 'have rediscovered fire' culturally.

Quote from the film: *"There isn't transparent accountable pricing for all the impacts of the burning of fossil fuels. The markets aren't working right."*

This gets at the heart of the issues regarding the environment. The markets ARE working right – we as a culture just haven't chosen to limit/reduce our access to energy and the scale of our economies by incorporating the costs of pollution to ecosystems and other species into our prices. If it cost \$8 a gallon for gasoline instead of \$3, we would drive (significantly) less but also pollute a lot less. We just haven't yet socially put meaningful value on ecosystems, other species or generations to have the political will to tax 'the bads.'

Quote from the film: *"How will we shape the future, towards a better outcome? What defines our identity? Are we our urges? Are we our principles? Who are we?"*

Let's all think about this.

Part 6 - Bibliography, Links and Further Recommended Readings

Amy Jacobson recommends:

Evolution and Social Psychology. Mark Schaller, Jeff A. Simpson & Douglas T. Kenrick. (Eds.) 2006. New York: Psychology Press.

Death from a Distance and the Birth of a Humane Universe. Paul M. Bingham, P. M. and Joanne Souza. 2009. Lexington KY: BookSurge Press.

Homicide. Martin Daly & Margo Wilson 1988. New York: Aldine de Gruyter

Evolutionary Psychology: The New Science of the Mind (4th Edition) David Buss. 2015. New York: Routledge.

The Better Angels of our Nature: Why Violence has Declined. Steven Pinker, 2011. London: Viking Penguin.

The Moral Animal. Why we are the way we are: the New Science of Evolutionary Psychology. Robert Wright. 1994. New York: Vintage Books.

Evolution for Everyone: How Darwin's Theory Can Change the Way We Think About Our Lives. David Sloan Wilson. 2007. New York: Bantam Dell.

The Evolution of Desire: Strategies of Human Mating. David Buss. 2016. New York: Basic Books.

The Blank Slate: The Modern Denial of Human Nature. Steven Pinker. 2002. New York: Penguin Books.

Anna Kirsch recommends:

Alaimo, Stacy. Bodily Natures: Science, Environment, and the Material Self. Indiana University Press, 2010).

Bogost, Ian, Alien Phenomenology or What It's Like to Be a Thing, (Minneapolis: University of Minnesota Press, 2012).

Bennett, Jane, Vibrant Matter: A Political Ecology of Things, (Durham NC: Duke University Press, 2010).

Clark, Timothy Ecocriticism on the Edge: The Anthropocene as a Threshold Concept. (London: Bloomsbury Academic. 2015).

Garcia, Tristan, Form and Object: A Treatise on Things, trans. by Mark Allan Ohm and Jon Cogburn (Edinburgh: Edinburgh University Press, 2014).

Harman, Graham. Immaterialism: Objects and Social Theory(Cambridge: Polity, 2016).

-- Object-Oriented Ontology: A New Theory of Everything (Pelican, 2018).

-- The Quadruple Object (Winchester: Zero Books, 2011).

Morton, Timothy, Being Ecological (Penguin Books, 2018).

--Dark Ecology: For a Logic of Future Coexistence, (New York: Columbia University Press, 2016).

-- The Ecological Thought, (Cambridge Massachusetts: Harvard University Press, 2010).

-- Ecology Without Nature: Rethinking Environmental Aesthetics (Cambridge Massachusetts: Harvard University Press, 2007).

-- Humankind: Solidarity with Non-Human People (London: Verso Books, 2017).

-- Hyperobjects: Philosophy and Ecology after the End of the World, (Minneapolis: University of Minnesota Press, 2013).

Blogs:

Bogost [What is Object Oriented Ontology](#)

Harman <https://doctorzamalek2.wordpress.com/>

Morton <http://ecologywithoutnature.blogspot.com/>

Bruce Hood recommends:

-“The Self Illusion: How the Social Brain Creates Identity” OUP 2012

[The Self Illusion](#)

-“Possessed: Why We Want More than We Need” OUP Due 2019

<https://global.oup.com/academic/product/possessed-9780190699918?cc=gb&lang=en&>

Mark Plotkin recommends:

-On climate change: J. Roman. 2016. “Climate Change: What Everyone Needs to Know.” Oxford Press.

-On the role of forests: F. Seymour. 2016. “Why Forests?” Center for Global Development.

-On biocultural diversity and forest protection : M. Plotkin. 1994. “Tales of a Shaman's Apprentice.” Penguin Press.

Stephan Lewandowsky recommends:

-Lewandowsky, S.; Risbey, J. S.; Smithson, M.; Newell, B. R. & Hunter, J.

Scientific uncertainty and climate change: Part I. Uncertainty and unabated emissions
Climatic Change, **2014**, *124*, 21-37

-Benartzi, S. & Thaler, R. H.

Heuristics and Biases in Retirement Savings Behavior

Journal of Economic Perspectives, **2007**, *21*, 81-104

Ugo Bardi recommends:

-“The Sower's Way: quantifying the narrowing net-energy pathways to a global energy transition" Sgouris Sgouridis, Denes Csala and Ugo Bardi, Environmental Research Letters, 11, 9, 2016 <http://iopscience.iop.org/article/10.1088/1748-9326/11/9/094009/meta>

7) Special projects idea suggestions:

Students can create their own special project. These could be video essays, debates or written presentations that could be filmed and the Films Producer and Director *may* feature on the film’s website.

Sample #1 Calculate how much energy it takes to move a shipping container full of goods to a store near you. What kind of energy was used? What were the goods inside? Food, Cars, bulk or raw materials?

Sample #2 Film yourself interacting in the world for a month. Is it possible to get through a day or a week without the use of any single- use plastic? Is it possible to buy food in a way that there is no need for recycling of packaging or throwing away? If not, how could this be accomplished? How much of what we use is actually recycled once it leaves the house.

Sample #3 Calculate the time you are using energy. What form does this energy take in food? In fuel? How much of the energy used would be repeatable if the flow of fossil fuels stopped today?

Sample #4 Research and write an essay on mis-match theory. All the ways our evolved nature helps us to survive but that may have become an evolutionary mis-match given today's global environmental problems.

Sample #5 Do research on how many solar panels it may take in a given geographical area to power society. How many solar panels to power large farm equipment, pump water or power factories. How much of society could be powered by solar and wind and how would we power the rest. What would we have to change?

Sample #6 Research how your local area is predicted to change over the next 40 years. What did your area look like the last time CO₂ was over 450 ppm? What plants and animals are likely to adapt and which ones may or are already having a hard time? What other stresses or pressures are there besides climate change.

Sample #7 Research the contradictions in society. Certain countries are committed to renewable energy but are opening more coal fired power facilities. Some places are committed to renewable energy but rely on tourism, and as a consequence jet fuel to keep the economy going. Explore your own contradictions.

Sample #8 Research and interview architects. How might architects help in designing the places we work and live to use less energy and be more adaptable to the environment in their function and creation. What can we learn from indigenous architecture for building. I.e; Certain tribes built on stilts in areas that routinely flooded etc.

Sample #9 Research what traits we have in common with animals - optimal foraging? Hierarchical groups, 'peacocking' etc. Can being aware of some of our sub-conscious behavior help us?

Sample #10 Research companies in your area. Which ones are trying to do something different either in energy use, packaging etc. Are they volunteering or are there new laws that precipitated this change or are people's habits changing and therefore there is a demand for their 'green' products. For example plastic straws have been banned in several cities and some companies have come up with pasta straws. Or, for example some food stores sell heavily packaged foods but also offer reusable bags in their bulk food section.

Sample #11 If the 'Super-Organism' that humans are creating were peaceful and not fighting one another how much energy could be put to other uses. I.e: how much energy goes into weaponry of varying kinds in different countries and how much energy does it take to run those parts of society? How much of the economy, jobs etc. relies on national defense. How much of the military can be fueled or is currently fueled by renewable resources.

Sample #12 research the idea of a carbon tax, what things or activities would become more expensive? How would a carbon tax work? Could it be border adjustable and begin in one country, or state? How would it change people's habits? Where would this tax be collected and how would it be used? Which states are doing this now?

Sample #13 Research example of emergent behavior for example many cities are banning plastic bags in grocery stores. How did this come about? Many cities are banning plastic straws. Some cities are banning

vehicles and investing in alternative transit systems. Examine the process from individual ideas to collective action to change the way the 'superorganism' functions.

Sample #14 Research the practice of Mindfulness. How can this process be helpful in our decision-making process.

Sample #15 Hold a debate on contentious issues where you take the opposite side of what you currently believe. Include Debates among people who may disagree about Climate Change.

Sample #16 Design a concept for a community which you think would be sustainable

Sample #17 Explore the concept of the digital "Cloud" What is it? What keeps it running?