

Our Finite World

Exploring how oil limits affect the economy

Where Energy Modeling Goes Wrong

Posted on [February 3, 2021](#) by [Gail Tverberg](#)

There are a huge number of people doing energy modeling. In my opinion, nearly all of them are going astray in their modeling because they don't understand how the economy really operates.

The modeling that comes closest to being correct is that which underlies the 1972 book, [The Limits to Growth](#) by Donella Meadows and others. This modeling was based on physical quantities of resources, with no financial system whatsoever. The base model, shown here, indicates that limits would be reached a few years later than we actually seem to be reaching them. The dotted black line in Figure 1 indicates where I saw the world economy to be in January 2019, based on the limits we already seemed to be reaching at that time.

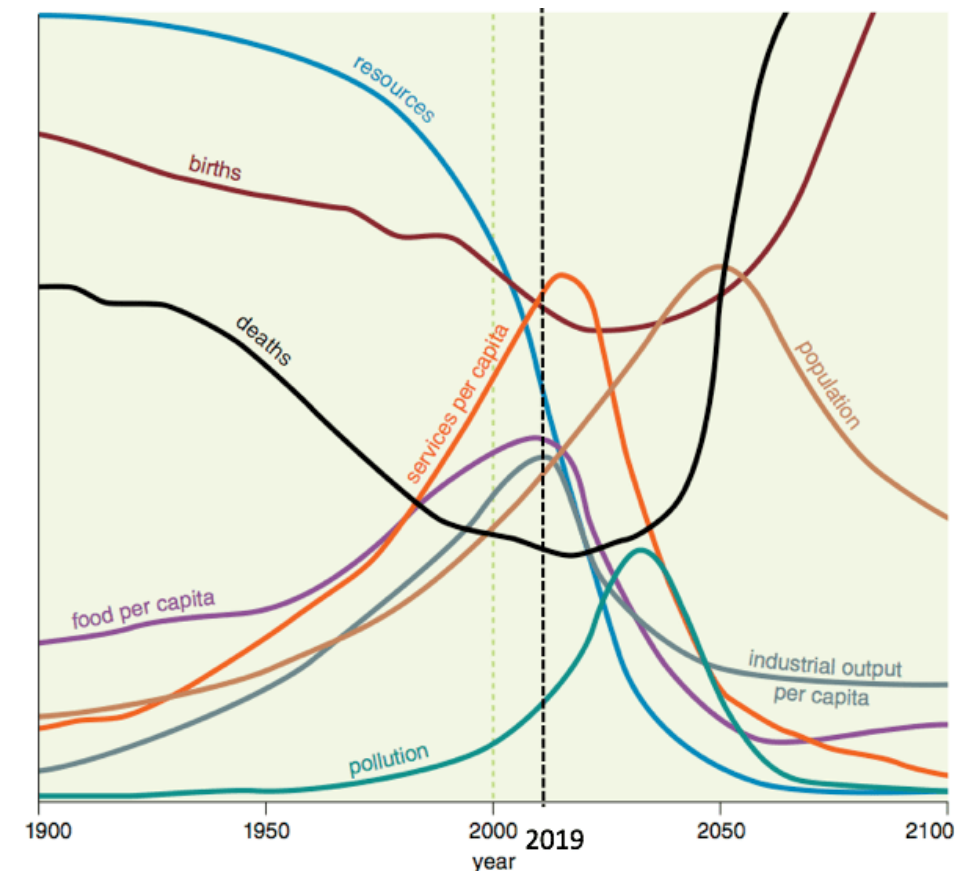


Figure 1. Base scenario from 1972 *Limits to Growth*, printed using today's graphics by Charles Hall and John Day in "[Revisiting Limits to Growth After Peak Oil.](#)" with dotted line added corresponding to where I saw the world economy to be in January 2019, based on how the economy was operating at that time.

The authors of *The Limits to Growth* have said that their model cannot be expected to be correct after limits hit

(which is about now), so even this model is less than perfect. Thus, this model cannot be relied upon to show that population will continue to rise until after 2050.

Many readers are familiar with Energy Return on Energy Invested (EROEI) calculations. These are favorites of many people following the Peak Oil problem. A high ratio of Energy Returned to Energy Invested is considered favorable, while a low ratio is considered unfavorable. Energy sources with similar EROEIs are supposedly equivalent. Even these similarities can be misleading. They make intermittent wind and solar appear far more helpful than they really are.

Other modeling, such as that by oil companies, is equally wrong. Their modeling tends to make future fossil fuel supplies look far more available than they really are.

This is all related to a talk I plan to give to energy researchers later in February. So far, all that is pinned down is the Summary, which I reproduce here as Section [1], below.

[1] Summary: The economy is approaching near-term collapse, not peak oil. The result is quite different.

The way a person views the world economy makes a huge difference in how one models it. A big issue is how connected the various parts of the economy are. Early researchers assumed that oil was the key energy product; if it were possible to find suitable substitutes for oil, the danger of exhaustion of oil resources could be delayed almost indefinitely.

In fact, the operation of the world economy is controlled by the laws of physics. All parts are tightly linked. The problem of diminishing returns affects far more than oil supply; it affects coal, natural gas, mineral extraction in general, fresh water production and food production. Based on the work of Joseph Tainter, we also know that added complexity is also subject to diminishing returns.

When a person models how the system works, it becomes apparent that as increasing complexity is added to the system, the portion of the economic output that can be returned to non-elite workers as goods and services drops dramatically. This leads to rising wage disparity as increasing complexity is added to the economy. As the economy approaches limits, rising wage disparity indirectly leads to a tendency toward low prices for oil and other commodities because a growing number of non-elite workers are unable to afford homes, cars and even proper nutrition.

A second effect of added complexity is growing use of long-lasting goods available through technology. Many of these long-lasting goods are only affordable with financial time-shifting devices such as loans or the sale of shares of stock. As non-elite workers become increasingly unable to afford the output of the economy, these time-shifting devices provide a way to raise demand (and thus prices) for commodities of all types, including oil. These time-shifting devices are subject to manipulation by central banks, within limits.

Standard calculations of Energy Returned on Energy Invested (EROEI) ignore the fact that added complexity tends to have a very detrimental impact on the economy because of the diminishing returns it produces. To correct for this, today's EROEI calculations should only be used to compare energy systems with similar

complexity. The least complex energy systems are based on burned biomass and power from animals. Fossil fuels represent a step upward in complexity, but they still can be stored until their use is required. Intermittent renewables are far ahead of fossil fuels in terms complexity: they require sophisticated systems of storage and distribution and therefore cannot be considered equivalent to oil or dispatchable electricity.

The lack of understanding of how the economy really works has led to the failure to understand several important points:

(i) Low oil prices rather than high are to be expected as the economy reaches limits,

(ii) Most fossil fuel reserves will be left in the ground because of low prices,

(iii) The economy is experiencing the historical phenomenon of collapse, rather than peak oil, and

(iv) If the economy is not to collapse, we need energy sources providing a larger quantity of net energy per capita to offset diminishing returns.

[2] The world's energy problem, as commonly understood by researchers today

It is my observation that many researchers believe that we humans are in charge of what happens with future fossil fuel extraction, or with choosing to substitute intermittent renewables for fossil fuels. They generally do not see any problem with “running out” in the near future. If running out were imminent, the problem would likely be announced by spiking prices.

In the predominant view, the amount of future fossil fuels available depends upon the quantity of energy resources that can be extracted with available technology. Thus, a proper estimate of the resources that can be extracted is needed. Oil seems to be in shortest supply based on its reserve estimates and the vast benefits it provides to society. Thus, it is commonly believed that oil production will “peak” and begin to decline first, before coal and natural gas.

In this view, demand is something that we never need to worry about because energy, and especially oil, is a necessity. People will choose energy over other products because they will pay whatever is necessary to have adequate energy supplies. As a result, oil and other energy prices will rise almost endlessly, allowing much more to be extracted. These higher prices will also enable higher cost intermittent electricity to be substituted for today's fossil fuels.

A huge amount of additional fossil fuels can be extracted, according to those who are primarily concerned about loss of biodiversity and climate change. Those who analyze EROEI tend to believe that falling EROEI will limit the quantity of future fossil fuels extracted to a smaller total extracted amount. Because of this, energy from additional sources, such as intermittent wind and solar, will be required to meet the total energy demand of society.

The focus of EROEI studies is on whether the EROEI of a given proposed substitution is, in some sense, high enough to add energy to the economy. The calculation of EROEI makes no distinction between energy available

only through highly complex systems and energy available from less complex systems.

EROEI researchers, or perhaps those who rely on the indications of EROEI researchers, seem to believe that the energy needs of economies are flexible within a very wide range. Thus, an economy can shrink its energy consumption without a particularly dire impact.

[3] The real story seems to be that the adverse outcome we are reaching is collapse, not peak oil. The economy is a self-organizing system powered by energy. This makes it behave in very unexpected ways.

[3a] The economy is tightly connected by the laws of physics.

Energy consumption (dissipation) is necessary for every aspect of the economy. People often understand that making goods and services requires energy dissipation. What they don't realize is that almost all of today's jobs require energy dissipation, as well. Without supplemental energy, humans could only gather wild fruits and vegetables and hunt using the simplest of tools. Or, they could attempt simple horticulture by using a stick to dig a place in the ground to plant a seed.

In physics terms, the economy is a dissipative structure, which is a self-organizing structure that grows over time. Other examples of dissipative structures include hurricanes, plants and animals of all types, ecosystems, and star systems. Without a supply of energy to dissipate (that is, food to eat, in the case of humans), these dissipative structures would collapse.

We know that the human body has many different systems, such as a cardiovascular system, digestive system and nervous system. The economy has many different systems, too, and is just as tightly connected. For example, the economy cannot get along without a transportation system any more than a human can get along without a cardiovascular system.

This self-organizing system acts without our direction, just as our brain or circulatory system acts without our direction. In fact, we have very little control over these systems.

The self-organizing economy allows common belief systems to arise that seem to be right but are really based on models with many incorrect assumptions. People desperately need and want a "happily ever after" solution. The strong need for a desirable outcome favors the selection of models that lead to the conclusion that if there is a problem, it is many years away. Conflicting political views seem to be based on different, equally wrong, models of how world leaders can solve the energy predicament that the world is facing.

The real story is that the world's self-organizing economy will determine for us what is ahead, and there is virtually nothing we can do to change the result. Strangely enough, if we look at the long term pattern, there almost seems to be a guiding hand behind the result. According to Peter Ward and Donald Brownlee in [Rare Earth](#), there have been a huge number of seeming coincidences that have allowed life on Earth to take hold and flourish for four billion years. Perhaps this "luck" will continue.

[3b] As the economy reaches limits, commodities of many types reach diminishing returns

simultaneously.

It is indeed true that the economy reaches diminishing returns in oil supply as it reaches limits. Oil is very valuable because it is energy dense and easily transported. The oil that can be extracted, refined, and delivered to needed markets using the least amount of resources (including human labor) tends to be extracted first. It is later that deeper wells are built that are farther from markets. Because of these issues, oil extraction does tend to reach diminishing returns, as more is extracted.

If this were the only aspect of the economy that was experiencing diminishing returns, then the models coming from a peak oil perspective would make sense. We could move away from oil, simply by transferring oil use to appropriately chosen substitutes.

It becomes clear when a person looks at the situation that commodities of all kinds reach diminishing returns. Fresh water reaches diminishing returns. We can add more by using desalination and pumping water to where it is required, but this approach is hugely expensive. As population and industrialization grows, the need for fresh water grows, making diminishing returns for fresh water a real issue.

Minerals of all kinds reach diminishing returns, including uranium, lithium, copper and phosphate rock (used for fertilizer). The reason this occurs is because we tend to extract these minerals faster than they are replaced by the weathering of rocks, including bedrock. In fact, useable topsoil tends to reach diminishing returns because of erosion. Also, with increasing population, the amount of food required keeps increasing, putting further pressure on farmland and making it harder to retain an acceptable level of topsoil.

[3c] Increased complexity leads to diminishing returns as well.

In his book, [The Collapse of Complex Societies](#), Joseph Tainter points out that complexity reaches diminishing returns, just as commodities do.

As an example, it is easy to see that added spending on healthcare reaches diminishing returns. The [discovery of antibiotics](#) clearly had a huge impact on healthcare, at relatively little cost. Now, a recent article is entitled, [The hunt for antibiotics grows harder as resistance builds](#). The dollar payback on other drugs tends to fall as well, as solutions to the most common diseases are found, and researchers must turn their attention to diseases affecting only, perhaps, 500 people globally.

Similarly, spending on advanced education reaches diminishing returns. Continuing the medical example above, educating an increasing number of researchers, all looking for new antibiotics, may eventually lead to success in discovering more antibiotics. But the payback with respect to the education of these researchers will not be nearly as great as the payback for educating the early researchers who found the first antibiotics.

[3d] Wages do not rise sufficiently so that all of the higher costs associated with the many types of diminishing returns can be recouped simultaneously.

The healthcare system (at least in the United States) tends to let its higher costs flow through to consumers. We can see this by looking at how much higher the Medical Care Consumer Price Index (CPI) rises compared to the

All Items CPI in Figure 2.

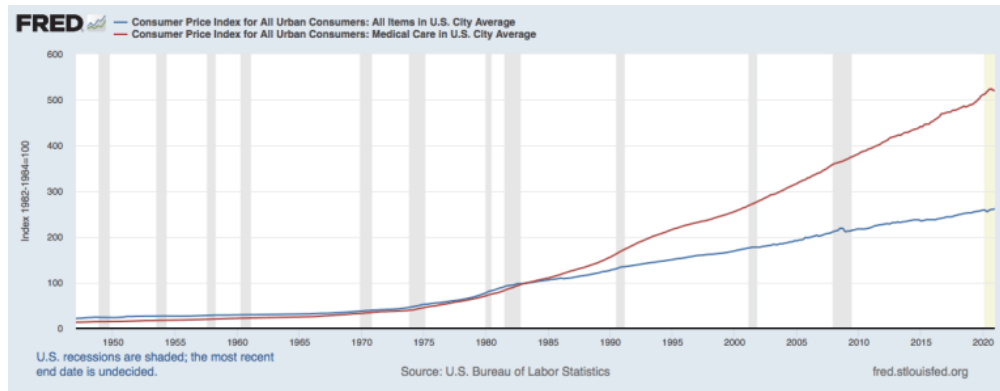


Figure 2. Consumer price index for Medical Care versus for All Items, in chart made by the Federal Reserve of St. Louis.

The high (and rapidly rising) cost of advanced education is another cost that is being passed on to consumers—the students and their parents. In this case, loans are used to make the high cost look less problematic.

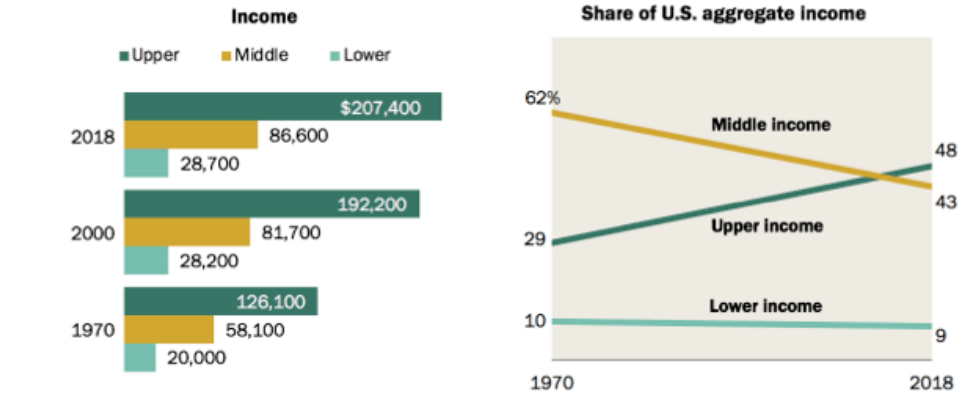
Of course, if consumers are burdened with higher medical and educational costs, it makes it difficult to afford the higher cost of energy products, as well. With these higher costs, young people tend to live with their parents longer, saving on the energy products needed to have their own homes and vehicles. Needless to say, the lower net income for many people, after healthcare costs and student loan repayments are deducted, acts to reduce the demand for oil and energy products, and thus contributes to the problem of continued low oil prices.

[3e] Added complexity tends to increase wage disparities. The reduced spending by lower income workers tends to hold down fossil fuel prices, similar to the impact identified in Section [3d].

As the economy becomes more complex, companies tend to become larger and more hierarchical. Elite workers (ones with more training or with more supervisory responsibility) earn more than non-elite workers. Globalization adds to this effect, as workers in high wage countries increasingly compete with workers in lower wage countries. Even computer programmers can encounter this difficulty, as programming is increasingly moved to China and India.

The gaps in income between upper-income and middle- and lower-income households are rising, and the share held by middle-income households is falling

Median household income, in 2018 dollars, and share of U.S. aggregate household income, by income tier



Note: Households are assigned to income tiers based on their size-adjusted income. Incomes are scaled to reflect a three-person household. Revisions to the Current Population Survey affect the comparison of income data from 2014 onwards. See Methodology for details. Source: Pew Research Center analysis of the Current Population Survey, Annual Social and Economic Supplements (IPUMS). "Most Americans Say There Is Too Much Economic Inequality in the U.S., but Fewer Than Half Call It a Top Priority"

PEW RESEARCH CENTER

Figure 3. Figure by Pew Research Center in *Trends in Income and Wealth Inequality*, published January 9, 2020. <https://www.pewsocialtrends.org/2020/01/09/trends-in-income-and-wealth-inequality/>

Individuals with low incomes spend a disproportionately large share of their incomes on commodities because everyone needs to eat approximately 2,000 calories of food per day. In addition, everyone needs some kind of shelter, clothing and basic transportation. All of these types of consumption are commodity intensive. People with very high incomes tend to buy disproportionately more goods and services that are not very resource intensive, such as education for their children at elite universities. They may also use part of their income to buy shares of stock, hoping their value will rise.

With a shift in the distribution of incomes toward those with high earnings, the demand for commodities of all types tends to stagnate or even fall. Fewer people are able to buy new cars, and fewer people can afford vacations involving travel. Thus, as more complexity is added, there tends to be downward pressure on the price of oil and other energy products.

[4] Oil prices have been falling behind those needed by oil producers since 2012.

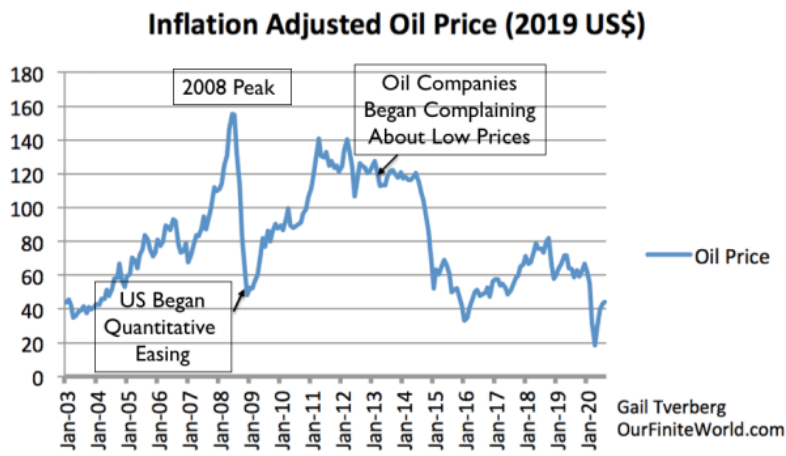


Figure 4. Figure created by Gail Tverberg using EIA average monthly Brent oil price data, adjusted for inflation using the CPI Index for All Items for Urban Consumers.

Back in February 2014, Steven Kopits [gave a presentation](#) at Columbia University explaining the state of the oil industry. I wrote a post describing this presentation called, [Beginning of the End? Oil Companies Cut Back on Spending](#). Oil companies were reporting that prices had been too low for them to make an adequate profit for reinvestment, back as early as 2012. In inflation-adjusted terms, this was when oil prices were about \$120 per barrel.

Even Middle Eastern oil exporting countries need surprisingly high oil prices because their economies depend on the profits of oil companies to provide the vast majority of their tax revenue. If oil prices are too low, adequate taxes cannot be collected. Without funds for jobs programs and food subsidies, there are likely to be uprisings by unhappy citizens who cannot maintain an adequate standard of living.

Looking at Figure 4, we see that there has been very little time that Brent oil prices have been above \$120 per barrel. Even with all of the recent central bank stimulus and deficit spending by economies around the world, Brent oil prices remain below \$60 per barrel.

[5] Interest rates and the amount of debt make a huge difference in oil prices, too.

Based on Figure 4, oil prices are highly irregular. Much of this irregularity seems to be associated with interest rate and debt level changes. In fact, in July 2008, what I would call the debt bubble associated with subprime housing and credit cards collapsed, bringing oil prices down from their peak abruptly. In late 2008, Quantitative Easing (QE) (aimed at bringing interest rates down) was added just prior to an upturn on prices in 2009 and 2010. Prices fell again, when the United States discontinued QE in late 2014.

If we think about it, increased debt makes purchases such as cars, homes and new factories more affordable. In fact, the lower the interest rate, the more affordable these items become. The number of purchases of any of these items can be expected to rise with more debt and lower interest rates. Thus, we would expect oil prices to rise as debt is added and fall as it is taken away. Now, there are many questions: Why haven't oil prices risen more, with all of the stimulus that has been added? Are we reaching the limits of stimulus? Are interest rates as low as they can go, and the amount of debt outstanding as high as it can go?

[6] The growing complexity of the economy is contributing to the huge amount of debt outstanding.

In a very complex economy, a huge number of durable goods and services are produced. Examples of durable goods would include machines used in factories and pipelines of all kinds. Durable goods would also include vehicles of all types, including both vehicles used for businesses and vehicles used by consumers for their own benefit. As broadly defined here, durable goods would include buildings of all types, including factories, schools, offices and homes. It would also include wind turbines and solar panels.

There would also be durable services produced. For example, a college degree would have lasting benefit, it is hoped. A computer program would have value after it is completed. Thus, a consulting service is able to sell its programs to prospective buyers.

Somehow, there is a need to pay for all of these durable goods. We can see this most easily for the consumer. A loan that allows durable goods to be paid for over their expected life will make these goods more affordable.

Similarly, a manufacturer needs to pay the many workers making all of the durable goods. Their labor is adding value to the finished products, but this value will not be realized until the finished products are put into operation.

Other financing approaches can also be used, including the sale of bonds or shares of stock. The underlying intent is to provide financial time-shifting services. Interest rates associated with these financial time-shifting services are now being manipulated downward by central banks to make these services more affordable. This is part of what keeps stock prices high and commodity prices from falling lower than their current levels.

These loans, bonds and shares of stock are providing a promise of future value. This value will exist only if there are enough fossil fuels and other resources to create physical goods and services to fulfill these promises. Central banks can print money, but they cannot print actual goods and services. If I am right about collapse being ahead, the whole debt system seems certain to collapse. Shares of stock seem certain to lose their value. This is concerning. The end point of all of the added complexity seems to be financial collapse, unless the system can truly add the promised goods and services.

[7] Intermittent electricity fits very poorly into just-in-time supply lines.

A complex economy requires long supply lines. Usually, these supply lines are operated on a just-in-time basis. If one part of a supply line encounters problems, then manufacturing needs to stop. For example, automobile manufacturers in many parts of the world are [finding that they need to suspend production](#) because it is impossible to source the necessary semiconductor chips. If electricity is temporarily unavailable, this is another way of disrupting the supply chain.

The standard way to work around temporary breaks in supply chains is to build greater inventory, but this is expensive. Additional inventory needs to be stored and watched over. It likely needs financing, as well.

[8] The world economy today seems to be near collapse.

The self-organizing economy is now pushing the economy in many strange ways that indirectly lead to less energy consumption and eventually collapse. Even prior to COVID-19, the world economy appeared to be reaching growth limits, as indicated in Figure 1, which was published in January 2019. For example, recycling of many renewables was no longer profitable at lower oil prices after 2014. This led China to discontinue most of its recycling efforts, effective January 1, 2018, even though this change resulted in the loss of jobs. China's [car sales fell](#) in 2018, 2019, and 2020, a strange pattern for a supposedly rapidly growing country.

The response of world leaders to COVID-19 has pushed the world economy further in the direction of contraction. Businesses that were already weak are the ones having the most difficulty in being able to operate profitably.

Furthermore, debt problems are growing around the world. For example, it is unclear whether the world will require as many shopping malls or office buildings in the future. A person would logically expect the value of the unneeded buildings to drop, reducing the value of many of these properties below their outstanding debt level.

When these issues are combined, it looks likely that the world economy may not be far from collapse, which is one of my contentions from Section [1]. It also looks like my other contentions from Section [1] are true:

- (i) Low oil prices rather than high are to be expected as the economy reaches limits,
- (ii) Most fossil fuel reserves will be left in the ground because of low prices, and
- (iv) If the economy is not to collapse, we need energy sources providing a larger quantity of net energy per capita to offset diminishing returns.

Regarding (iv), the available energy supply from wind and solar (net or otherwise) is tiny relative to the total energy required to operate the world economy. This issue, alone, would disqualify a Great Reset using wind and solar from truly being a solution for today's problems. Instead, plans for a Great Reset tend to act as a temporary cover-up for collapse.

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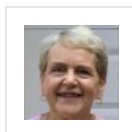


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About Gail Tverberg

My name is Gail Tverberg. I am an actuary interested in finite world issues - oil depletion, natural gas depletion, water shortages, and climate change. Oil limits look very different from what most expect, with high prices leading to recession, and low prices leading to financial problems for oil producers and for oil exporting countries. We are really dealing with a physics problem that affects many parts of the economy at once, including wages and the financial system. I try to look at the overall problem.

884 Responses to *Where Energy Modeling Goes Wrong*

[Michael L'Merchant](#) says:

February 8, 2021 at 11:13 am

Reaction of Human Monoclonal Antibodies to SARS-CoV-2 Proteins With Tissue Antigens: Implications for Autoimmune Diseases

<https://www.frontiersin.org/articles/10.3389/fimmu.2020.617089/full>

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[Gail Tverberg](#) says:

February 8, 2021 at 4:01 pm

A section from the discussion section:

Another concern from molecular mimicry is the potential role it may play in vaccine safety. Several incidences of viral infection and vaccine-induced autoimmunity specific to cross-reactivity have been reported in the literature (8). In 2009, the vaccines developed to treat the H1N1 pandemic lead to narcolepsy specifically due to cross-reactivity. The inactivated split-virion particles (ASO3) shared cross-reactive homology with hypocretins found in the hypothalamus, leading to selective destruction of that substance after vaccination in a subgroup of susceptible individuals (13). Vaccination with ASO3 lead to a three-fold increase in the onset of narcolepsy compared to individuals who were not vaccinated (61).

During the swine flu outbreak in the late 1970s in the United States, the use of influenza vaccination was found to induce a four- to eight-fold increased risk of developing Guillain-Barré syndrome due to cross-reactivity (14). Cross-reactive relationships between viral infections and vaccinations have also been found with hepatitis B and myelin proteins leading to multiple sclerosis, human papillomavirus and nuclear proteins leading to systemic lupus erythematosus (SLE), coxsackievirus and islet cells proteins leading to type 1 diabetes, etc (15–18). Razim et al (62), in designing a vaccine against Clostridium difficile, concluded that before considering a protein as a vaccine antigen, special care should be taken to analyze and remove the sequences of tissue cross-reactive epitopes in order to avoid possible future side effects.

But the article moves toward the conclusion where it says,

But while the possibility of future autoimmune disease is daunting and very real, it must be remembered that without vaccinations the SARS-CoV-2 pandemic will spread unchecked, bringing with it a slew of multiple system disorders including autoimmunities both in the present and the future.

So we should move ahead with vaccines, despite these concerns.

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Ed says:

February 8, 2021 at 11:15 am

Alberta Conservative premier Jason Kenney says interesting things in an article at humansarefree dot com. I have tried three times to post but it just disappears.

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[Reply](#)

Ed says:

February 8, 2021 at 11:18 am

Kenney said he would describe Schwab's "great reset" plan as a "grab bag of left-wing ideas for less freedom and more government, for more government intervention, for policies that would, I think, create massive poverty, particularly [regarding] energy policies that he is advocating."

The premier called Schwab's annual Davos summit the "biggest gathering of global hypocrites in history."


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[Reply](#)

Kowalainen says:

February 8, 2021 at 12:00 pm

"biggest gathering of global hypocrites in history"

+++++++ -> 



Aren't we all more or less hypocrites, however, that jolly bunch of musca domestica surely must be the fattest flies on top of the rapidly decomposing IC turd.



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Bei Dawei says:

February 8, 2021 at 5:14 pm

If history had been a little different, c-theorists might be pointing to Burning Man instead of Davos as the center of the c.

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[Reply](#)



Gail Tverberg says:

I am suspicious that WordPress is deleting some things. I get a few things marked as spam that are really things that Facebook would likely reject. I expect some things are never shown to me, they are deleted by WordPress first.

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[Reply](#)

dauidinamonthorayearoradecade says:

February 8, 2021 at 5:23 pm

I replied to Ed with his link attached.

I think my reply is imprisoned in moderation because the link contains the word con.spir.acy. 😊

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[Reply](#)

dauidinamonthorayearoradecade says:

February 8, 2021 at 5:13 pm

Ed yes I see your links back one page of comments:

<https://humansarefree.com/2021/02/alberta-canada-premier-great-reset-not-a-conspiracy-theory-has-no-place-in-our-province.html>

good fight in that man.

just because some TPTB blowhards are spouting their GR nonsense, doesn't mean govts must bow down to their somewhat laffable ideas.

thanks for the link.

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[Reply](#)

Gerard d'Olivat says:

February 8, 2021 at 11:55 am

Hello Gail. You were referring to the near "blackout" in Austria on January 8. Here's what was going on in detail.

1. In Austria, electricity generation from renewables such as water and solar reduces in winter. This is offset by imports of electricity from coal and nuclear power.

In addition, national hydropower production leaves much to be desired.

Solar power is effectively "non existent" in the winter months and at the beginning and end of fall and spring. The approximately 1.3 gigawatts of solar panels installed in Austria are then effectively on winter vacation.

2. Things really get more problematic when the wind fails. For example, the wind turbines in Austria, with a total capacity of more than 3.1 gigawatts, contributed to electricity production on only about 10 December days. And in January it wasn't much better. Most of the time, wind power was low or absent.

3. Wind also played a role in the European near-blackout on January 8. At wind energy champion Germany, renewable energy generation fell by a whopping 7.8 gigawatts in the four hours leading up to the massive drop in grid frequency. That matches the average total demand in Austria.

4. The big problem, however, was the low rainfall since November. And December and January were not much better. So Austria's hydropower plants – with a possible peak capacity of eight gigawatts, provided little electricity. The domestic green power balance stands and falls with the hydropower plants. The turbines in the dams could generate at least barely a quarter and at most not even half of the maximum power.

5. So what is left to keep the power grid functioning properly is Import!

Except for a few days, Austria has been a net electricity importer since November. Sometimes up to a third of its electricity demand has to be met from foreign sources, especially from Germany, the Czech Republic, Hungary and Slovenia. In total, up to three gigawatts of power flowed in that period, And it came mainly from coal and nuclear power plants from abroad. Austria has no coal-fired power plants itself. The last one was closed in April 2020.

6. The imported “gray power” is hedged with the purchase of green power certificates. Thus, on paper, the green power is from somewhere and someday is ours – and the “gray power” for those who do not buy certificates for it.

7. The last day so far that Austria produced an electricity surplus was (as of January 28) December 8. Since then, about 30 to 70 gigawatt hours of energy have been imported per day. For comparison, the Czech nuclear power plant Temelín generates about 48 GWh per day.

8. The aforementioned January 8 was an interesting day, the day of the near-crash on the grid: at 10:00 a.m., Germany produced a total of 81.2 gigawatts and exported 8.5 GW of it. Austria produced 7.2 GW and imported 2.5 GW. At 2 p.m., German power generation was down to 75.3 and there were only 4.7 left for export – so within four hours, ‘renewables’ dropped from 32.4 to 24.6 gigawatts of power output.

The ‘mega deficit’ was only partially offset by pumping 1 GW of coal and 0.5 GW of natural gas into the grid. At that time, Austria was producing 6.4 GW and importing 2.8 GW at 2 p.m.

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Ed says:

February 8, 2021 at 1:50 pm

Will Austria build more natural gas peaker plants?

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Gerard d'Olivat says:

February 8, 2021 at 2:54 pm

The Eu is going for a 0% CO2 bij 2050... 😊

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Ed says:

February 8, 2021 at 4:07 pm

I would hope if 400 million people are making plans for drastic change they will put down in writing the details. How much money year by year for the next 30 years, how much human labor, how much cement, copper, rare earth materials, glass, miles of transmission lines, etc....

Why is nothing in writing?

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Kowalainen says:

February 8, 2021 at 4:54 pm

Then what's that brand spanking new gas pipeline from Russia good for? 🤔

Exactly how will Stuttgart busy itself? Perhaps produce bicycles out of exactly what? Bicycles typically doesn't wear out like a car. They don't get obsolete either. Just a frame, two wheels, a seat, steerer, cranks and chain. The carbon ones doesn't rust either. I'll bet my carbon fiber bicycle will last a lifetime if properly cared for. The frames are repairable if they get damaged. Once everyone got a couple of bicycles, that's all she wrote.

It's timeless stuff. Like a proper electrified loco. The engine of those two vehicle types keeps on huffing and puffing close to a century.

Nah, it's a crazy idea and they got absolutely no idea what to do, how to sequence it, all while cheap FF's are depleting at an alarming rate. And the idea that electric cars won't require FF's to manufacture is absurd. The roads and rail for sure require FF's, with rail requiring much less of it. Mostly coal and some concrete.

And now, oh yes, there's no semiconductors to make either of them functional. The rather stringent EU regulations on emissions makes advanced engine control units a complicated affair. The same for just about anything inside a computerized vehicle.

Sure, those could be removed and carburetors installed, but then again, emissions would skyrocket as catalytic converters won't work well without a rather exact fuel to air mixture. That would fuck up the zero emissions goal. And good luck manufacturing an electric car without computers.

It is a predicament. That's how shit goes down when primates get herded around for nothing. It is total and utter chaos that awaits. But I got nothing against chaos as long as despotic/tyrannical guvmints/herds are not formed coming for my princess ass. If that would happen, well, I got some remedy for myself.

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Gail Tverberg says:

February 8, 2021 at 5:20 pm

This is how I come to a chart like this:

<https://ourfiniteworld.com/wp-content/uploads/2020/11/world-energy-consumption-to-2050-with-caption-1.png>

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[worldofhanumanotg](#) says:

February 8, 2021 at 2:10 pm

Yep, it was occasionally mentioned here over the years already. The neighboring countries with base load generation based grid are fed up to be always on the receiving edge:

- when the solar is in over supply it's rushing across borders (and crashing spot prices)
- when it's overcast and winds are down they demand imports (at barely sound pricing)

The predictive weather modelling is not always correct or helping in sort of cascading problem situation when there are other issues, maintenance schedule, .. etc.

Therefor the craziness continues and some of the countries are now building up large installations to block incoming current / voltage spikes on the borders – hence increasing chance of forced-localized blackout in Austria (or parts of Germany in that situation).

Perhaps it will be all just “solved” in upcoming econ depression for undershooting demand beyond existing grid capacity.

PS If I'm not mistaken AT is able to receive natgas from Russia via CZ/SK/HU? on that old link via Ukraine (but that's obviously very questionable backup now), or from Germany (new undersea connectors from Russia and likely the older NL & Norway network), or perhaps there is even some connector to ClubMed ports via Italy. So, AT should build up more peak demand natgas power-stations at home.. which they are not eager to do, because they have got enough idiots or vassals around them to keep working it as now on the cheap..

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Gerard d'Olivat says:

February 8, 2021 at 4:40 pm

The energy situation in Europe is complex.

By the way, the good news is that there was no blackout.

Houdini also did his trick for years until he overestimated himself. Europe has an interesting energy history. They have been shaping world history for five centuries.... based on energy and a few other skills.

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Gail Tverberg says:

February 8, 2021 at 5:16 pm

Thanks for your detailed explanation of what went wrong in Austria.

Each time, what goes wrong is a little different. As there gets to be an increased share of intermittent electricity, the chances of a widespread outrage increase.

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Marco Bruciati says:

February 8, 2021 at 12:46 pm

The economies of poor countries in Africa and Europe and South America will begin to collapse and collapse and as millions of refugees lend the western economies North America and Europe. So what happens will our economies in Europe and North America collapse as well?

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Ed says:

February 8, 2021 at 12:56 pm

We can not “build back better” until we have a collapse. I have not seen food nor electric fail yet in the U.S..

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Marco Bruciati says:

February 8, 2021 at 1:01 pm

Starting now in Nigeria. Algeria. Tunisia.

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Thierry says:

February 8, 2021 at 1:28 pm

can you give us more details?

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Marco Bruciati says:

February 8, 2021 at 2:01 pm

I read the news of Harry. About Nigeria i had read in Harry news are bolo haram and bands in North of country. North Nigeria Is out of control

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Gail Tverberg says:

February 8, 2021 at 7:52 pm

This is from November 20, 2020.

<https://energy.economictimes.indiatimes.com/news/power/electricity-grid-collapses-in-nigeria-africas-largest-economy/79484019>

Electricity grid collapses in Nigeria, Africa's largest economy

Power outages in Nigeria, the most-populous nation in Africa, are common, but a system collapse is unusual

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Robert Firth says:

February 8, 2021 at 1:26 pm

Yes, they will. In the long run, an economy cannot consume more than it produces. Countries that import "refugees" are importing people who will consume and not produce. The inevitable result is collapse.

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Marco Bruciati says:

February 8, 2021 at 1:59 pm

I agree. Look Libano....there was a lot of refugees from Syria. 2 millions

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Marco Bruciati says:

February 8, 2021 at 1:21 pm

The price of food increases the price of raw materials will surely start the problems in poor countries at the beginning.

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Z says:

February 8, 2021 at 2:23 pm

Hello Marco,

How is the situation in Italy today?

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Marco Bruciati says:

February 8, 2021 at 4:04 pm

In Italy Everything is quite calm, we have the Brazilian English variant, we have 13000 contacts a day there quite light lockdown throughout Italy 1 red zone only things are going quite well, but the data are not true, I

think there is a lot of unemployment the layoffs are blocked until March 31 and maybe even later.

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[Gail Tverberg](#) says:

February 8, 2021 at 7:55 pm

Governments will try to keep things going as best they can, by blocking layoffs from jobs and evictions from apartments. Businesses owing rent or mortgage payments may be allowed to skip payments.

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[Ed](#) says:

February 8, 2021 at 3:21 pm

The U.S. government made matters worse by only issuing emergency use authorization for in-hospital use and not for outpatient settings. Meanwhile, HCQ has been used for about 60 years in people with chronic conditions such as lupus and rheumatoid arthritis.

“So, the hypocrisy, the loss of common sense, the outright indoctrination killed a lot of people,” Zelenko says.

“The root cause of it is the way we educate people. It used to be that higher education was about teaching critical thought and deductive reasoning, analytical analysis.

“Now we indoctrinate people into responding to stimuli like dogs, like automatons, like robots. Common sense no longer matters. That’s my critique of higher education and why I think many physicians fell into the trap. Also, this country was traumatized. Even if a doctor was willing to give it, patients were afraid to take it.”

<https://humansarefree.com/2021/02/ny-doctor-claims-near-100-success-rate-treating-covid-19.html>

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Azure Kingfisher says:

February 8, 2021 at 8:04 pm

“Meanwhile, HCQ has been used for about 60 years in people with chronic conditions such as lupus and rheumatoid arthritis.”

But, you see, the people in charge aren’t interested in the results of HCQ. They’re running a massive experiment on the global population and want to try out their new plaything – mRNA technology.

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Pekoe says:

Hi Gail. I have been reading your articles for many years and will continue to do so as your site seems to have an element of calm and common sense that is increasingly rare as 'doomer porn' gains traction.

I have become increasingly frustrated with politicians, MSM, academics and economists pushing the mantra of 'net zero emissions by 2050', but not one of them will give a detailed account of what the path to this goal will actually look like, and what sort of lives we will be living in this zero carbon world. I have an engineering background and am fully aware of what is and isn't achievable from a practical point of view, but politics and a good story get far more media time than reality.

Would it be possible for you to examine this aspirational transition to zero carbon in more detail in an article (series of articles) so that we can get a better understanding of what would really be required to get there by 2050, what may be possible in reality, and what our world would look like in 2050 with those scenarios?

I understand that you may be reluctant to project too far forward with your thoughts and predictions but surely this projection is just a natural outcome of what your work has been up to this point. If we are at the 'point of no return' (and I agree we are) – then what?

I have two daughters in their late teens and I have been reluctant to tell them what I truly believe will be their place in a world we here at OFW imagine as our collective future (they get enough gloom and doom just watching the tv news). Your clear and concise writings on what the coming decades might hold for us would be of immense value and would help me to broach this subject with them.

Kind regards.

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[Gail Tverberg](#) says:

February 8, 2021 at 9:02 pm

Thanks for the suggestion. I did put up a couple of charts, showing what the path might look like, back in this post.

[Energy Is the Economy; Shrinkage in Energy Supply Leads to Conflict](#)

I am always afraid to put in too specific predictions of what might happen, partly because I don't really know. I would never have thought about this "shutdown" idea, and the willingness of quite a lot of people to go along with it.

Partly, too, is the fact that I am not sure readers, especially young readers, are ready for this kind of thing. The issue is not that most people will be poor; it is that the vast majority will be dead. I would expect epidemics, poor diet, lack of antibiotics, and war to play a role in the high death rate.

We will have the things that we currently have for a little while, but these things will break and will not be able to be replaced. Solar panels without the rest of the economy are of limited value. We may be able to keep our cell phones charged, but we really need transmission towers and new cell phones when the old ones wear out. Solar panels are of little value in providing food and water.

Ultimately, I am afraid the few remaining people may not end up at much higher a level than the hunter-gatherers. Perhaps, it is best just not to think about these things. Perhaps I am wrong, and one (or more) of the religions is right.

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Azure Kingfisher says:

From “31 Reasons Why I Won’t Take the Vaccine, ” by Israeli rabbi Chananya Weissman:

1. It’s not a vaccine. A vaccine by definition provides immunity to a disease. This does not provide immunity to anything. In a best-case scenario, it merely reduces the chance of getting a severe case of a virus if one catches it. Hence, it is a medical treatment, not a vaccine. I do not want to take a medical treatment for an illness I do not have.
2. The drug companies, politicians, medical establishment, and media have joined forces to universally refer to this as a vaccine when it is not one, with the intention of manipulating people into feeling safer about undergoing a medical treatment. Because they are being deceitful, I do not trust them, and want nothing to do with their medical treatment.
3. The presumed benefits of this medical treatment are minimal and would not last long in any case. The establishment acknowledges this, and is already talking about additional shots and ever-increasing numbers of new “vaccines” that would be required on a regular basis. I refuse to turn myself into a chronic patient who receives injections of new pharmaceutical products on a regular basis simply to reduce my chances of getting a severe case of a virus that these injections do not even prevent.

<https://gatesofvienna.net/2021/02/31-reasons-why-i-wont-take-the-vaccine/>

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Gail Tverberg says:

February 8, 2021 at 8:32 pm

This is an article by Dr. Joseph Mercola dated February 5, 2021 on Humans are Free.

<https://humansarefree.com/2021/02/scientists-more-virulent-and-lethal-versions-of-sars-cov-2.html>

Scientists Just Created A More Virulent And Lethal Version Of SARS-CoV-2 — It Escapes Antibodies And Jumps Species

There are a lot of different topics covered in the article. One is a twitter feed, claiming Italian virologists have made a more dangerous SARS3. <https://twitter.com/ydeigin/status/1352674201526788097>

One section is called “**Investigative Committees Are Severely Compromised**”

...while the WHO has assembled a committee to investigate, China was granted veto power to decide who would be on that committee, and the primary investigation is to be carried out by Chinese representatives. The WHO’s committee will then simply review their findings.

Another section is “**Daszak Is The Fox Guarding The Hen House**”

... Daszak played a central role in the plot to obscure the lab origin of SARS-CoV-2 from the very beginning by crafting a scientific statement condemning such inquiries as “conspiracy theory.” This manufactured “consensus” was then relied on by the media to counter anyone presenting theories and evidence to the contrary.

Daszak is also heading up a second commission to investigate the origin of the virus, The Lancet COVID-19 commission, thereby ensuring that the “consensus” will be maintained.

Ironically, in 2015, Daszak actually warned a global pandemic might occur from a laboratory incident and that “the risks were greater with the sort of virus manipulation research being carried out in Wuhan.”

Another section is “**Fauci, Daszak And The WIV [Wuhan Institute of Virology] Appear To Be Key Culprits**”

When the US changed the law on gain-of-function research, Fauci didn’t drop it. He contracted it out to the EcoHealthAlliance, where Daszak was the project leader. Daszak, in turn, subcontracted out a key piece of the research — the gain-of-function part — to the WIV.

Steve Hilton has been investigating the situation. He says,

“Fauci Must Step Aside Until We Get To The Bottom Of His Role In Creating — Unintentionally, Of Course — This Catastrophic Global Pandemic.”

Steve Hilton is also the host of a video shown on this post.

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Michael L'Merchant says:

February 8, 2021 at 8:42 pm

I-MASK+ Prophylaxis & Early Outpatient Treatment Protocol for COVID-19

<https://covid19criticalcare.com/i-mask-prophylaxis-treatment-protocol/i-mask-protocol-translations/>

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