

# Implications of Global Peak Energy and the Impact of Diminishing EROEI

This is as "Big Picture" and most broadly categorical stroke of the brush as it gets: the global world as a whole in aggregate totality is now fastly running out of energy, and collectively we have already peaked in late 2019 in terms of both the quantity and quality of high-density energy sources available for our collective use. The decline is terminal and permanent.

**Modern money derives almost entirely its real purchasing power (and thus its value) from the energy that enables the underlining "work/force/productivity multiplier-effect" in the context of the society in which it exists in. Modern "money" is a claim on existing energy deposit's future ability to do "work".** Put another way, money as a claim on energy, specifically, it is the ability to use the money to apply that energy to do productive work in the future. (When the money is spent/exchanged/actualized in the context of a society that still has readily access to available net energy for use)

There is virtually no economic activity that doesn't require an energy input from the external environment in the form of a primary energy resource (coal, oil, natural gas, etc etc).

**At the end of the day "Net Energy" is what counts because it alone powers all the other non-energy sectors of the economy.** And all of the goods and services in the modern economy, without exception, require such an energy input.

**As that societies/civilizations primary energy sources dwindle and/or its EROEI (total net usable energy in terms of Energy Returned on Energy Invested) threshold declines, then so does that society's money likewise deflate and devalue.**

The same unit of money will be able to fetch less energy, produce less work, contribute to less productivity, and thus enable less real economic activity etc

If you are a carpenter and could no longer use powered tools and had to go manual, then its no-brainer your productivity will decrease, and my paying you the same nominal dollar rate per hour will yield less product simply because the "work multiplier effect of energy" was gone.

So as a result the purchasing power of my dollar has diminished simply because of the lack of available energy. Not because you worked less hours or got lazy. Energy is what gives modern money its value and purchasing power.

From here on out globally the world will have less net energy available globally for productive use. What's not shown is that globally we are using up more and more energy to get less and less.

In such a situation, **using money to measure economic activity is like using an ever-shrinking ruler/yardstick to measure the dimensions of your physical property and volume of your tangible assets.... even as you get poorer and had to sell off more of your things, if your ruler or measurement device is shrinking at a faster pace, then it would still appear by all measurements you were well off (for example using money to measure GDP as a signifier of the health or status of a nation or global economy when in fact the dollar is constantly losing its purchasing power)**

For example, US stock market is no longer any indication of the well-being of the nation as a whole nor does it represent the standing of most average Americans, the Feds basically printing directly to prop it up. But energy is what underpins everything, and in the final analysis at the end of the day there is no cheating the 2nd law of thermodynamics. (All pyramid schemes eventually collapse)

Bottom line is that money's value is derived from the underlining net energy (EROEI) that civilization has access to use.

As a result, long term, **that nest egg you saved up (401k, social security, retirement, investments) is not going to be there for you for the simple fact that the global useable energy is gone... The raw purchasing power of money was always almost entirely inflated by the availability of cheap and abundantly high-quality energy (and the “work/productivity multiplier effect” derived thereof) and the assumption that it would always be the case of remaining exercisable and actualizable into perpetuity...**

For every calorie of food that is consumed, on average nine other calories of energy were required to produce it. When the first barrel of oil was produced back in 1850's the global world population stood at just 1 billion people. Since oil was first discovered the human population on earth has exploded over 800% in this very short period of time and this would never have been possible without the existence of cheap and abundant energy dense hydrocarbon resources that directly powered and fueled the mass production of food required to sustain such artificially high population levels.

A gallon of gasoline contains about 132 million joules of energy, or the equivalent of nearly two weeks (actually six weeks if considering 8 hour workdays) of manual human muscle power and labor. Currently the minimum wage is \$7.25/hr and with gas at \$3.00 USD per gallon, this roughly translates to acquiring 2 gallons of gas per hour and obtaining the energy and work/force multiplier of almost a factor of 672 times for the lowest paid member of society. By some estimates every American has somewhere between 200 to 8,000 'Energy Slaves'.

Currently you can buy 1-kilowatt-hour of power from the electric grid for about ten cents. But imagine what it would cost you to hire a worker to pull a car of 2,500 lbs, using a pulley with a factor of 1:40, from the ground to the top of the Empire State Building or Paris tower or Auckland Skytower. That's at least a day's of hard work or \$200 to \$300 in money terms. This perfectly illustrates the huge subsidy modern industrial society enjoys while the oil age will last, which is not too long anymore.

If you look at our planet as an isolated physical system (a "3D" sphere in vacuum of outer space) then from a physics, mathematical, energy and entropy/thermodynamic standpoint it's clear that we have already used up (collectively on global scale) the vast majority of the high-density, high-quality, high EROEI, "low entropy" energy sources on our planet, while at the same time our human population is higher than it's ever been before, whilst many of the developing countries are still trying to jump on the capitalism bandwagon and chase their own version of the American dream by propelling upwards the quality of life, living standards and GDP/energy-usage-per-capita of their own citizens... **All the economic models of modern times are based on the axiomatic and 'a priori' assumption of infinite perpetual growth... and none of the models account for the fact that by all accounts back in late 2019 we have already globally peaked...**

Money is just a mere abstract symbolic token representation of the ability of cheap and abundant higher EROEI (Energy Returned On Energy Invested) energy to do 'work' on our behalf. No amount of funny-money fiscal policy can change the fact that the underlying physical system that powers absolutely everything we do has ran out of energy. It does the world absolutely zero net-benefit to expend more energy to extract, process and make useable an energy source than the energy we can get out of it, regardless of how much money someone is willing to pay for it. Likewise, ethanol as a net-energy-sink (basically converting oil to fertilizers to grow corn and then reconverting corn back to fuel) also does nothing but serve to make our collective energy problem that much worse regardless of how much the government is willing to economically/price subsidize for it.

When the quality and quantity of energy available to us continues to decline and decrease, then proportionately so does the value or purchasing power of the money that we hold... for that money was a mere representation of the 'multiplier-effect' of energy/work and the resulting productivity that cheap energy had amplified and enabled. But with the energy depleted so too does our money become worthless.

In high school and through much of our higher education we are all taught the concept of the time value of money. We are told that if we save a little and put aside a portion of our money to allow it to grow (make your money work for you) that by the time we retire at age 65 or 70 or older, that given a reasonably sustained interest rate and steady overall rate of return of the growth of our savings due to compound interest, etc it would have amassed into a small fortune of a few million dollars or more.

All of the above is indeed predicated upon the assumption of perpetual and continuous global growth. In pre-agricultural times when there were no forms of monetary accounting nor any surplus, we consumed what we had and when we had it, and anything extra that we set aside would either retain value or lose value over time, naturally and even from a physics and thermodynamics and entropy standpoint, it would certainly never grow in value. So taken in aggregate and in general, the growth of an individual's savings or investments is directly coupled to the overall ability of society to grow as a whole. By deferring expenditures and putting that aside and allocating that portion of their monies to go towards capital to helping society and civilization to continue to expand, populate, and grow, the individual is repaid in kind at the end of his or her life as their investment in the entire pool is conflated with the overall growth of society. By putting a piece of their money into the pie, their individual slice grows larger as the entire pie as a whole expands.

In the long run, and from the bigger picture perspective, a net-positive rate of return-on-investment overall in aggregate is only possible in whole of society if that society or global civilization continued to grow as a whole... Continued global growth is only possible if we are able to consume more and

more resources as well as have increasingly abundant access to usable energy of EROEI density sufficient to power modern global civilization and it's continued upwards growth.

Given that our modern civilization and globalized economy/world is predominantly powered by fossil fuels and hydrocarbons as the main source of energy, and given the fact that we enjoy and are indeed direct recipients of this "multiplier of work/productivity/wealth" enabled by the use of (still relatively) cheap and abundant oil, natural gas, coal, etc it stands to reason that as we approach the final global limits to energy consumption growth, so will our aggregate economies contract... by most estimates global production of conventional oil peaked back in 2019, and there is no turning back...

There is no debate that we have long since passed peak discovery curve. And there is no doubt that all production/consumption curves must necessarily follow and trail their discovery curves/peaks...This is basic logic, math, physics...

Nothing in the short term will be able to replace in masse nor fully substitute the vast energy deficit left by both the decline in quantity of fossil fuels and the drop in quality (EROEI) of the limited quantity still remaining. Renewables such as solar are currently subsidized by governments economically and entropically by leveraging our existing fossil fuel infrastructure, and solar is a net energy sink as far as modern civilization is concerned given we require at least EROEI of 7 to just survive (15+ to thrive) and the rate limiting factor of lithium, battery technology, rare-earths all add up to the infeasibility of solar as a renewable solution.

**The "energy payback time of renewables means it will incur a permanent 'energy taxation' on all work/productivity/interactions in society somewhere between 20% to 40%, and this a thermodynamic physical energy taxation that comes before any government taxation** (resulting in a total collapse of global economies and permanent macroeconomic depression everywhere) and that is even assuming there are enough raw resources to scale up (and later maintain) renewables to replace fossil fuels in mass in the first place. (there is not)

**None of the renewables are energy dense enough (high threshold of EROEI) to power modern society at scale and certainly not the kind of globalized world we have become accustomed to...** for example solar has an energy payback of 2 to 3 years currently... that means for the first three years of a solar project you have net sunk energy into it and don't make an energy profit until after that period. Then after ten years or so you have to expend even more resources and energy to replace/maintain the panels and turbines. Whereas oil has an energy payback period of exactly zero days, you can use it immediately to provide net positive energy and it is both a means of energy and storage of energy. The problem with solar and wind is that it needs energy storage, and there are not enough lithium, copper, nor rare-earth in the world to be able to build enough batteries to store enough energy to scale to the entire world's current energy consumption levels even if we could achieve 100% renewable sources... (solar, wind, hydro, etc)

Even if we solved nuclear fusion or fast breeder reactors today it would still take another three decades to fully scale up, and our global civilization cannot avoid the common collapse in the meantime...

Given that globally economies will shrink as a whole, given that our total access to energy both in terms of quantity of energy and the quality of remaining energy will continue to steadily decline over time, and since clearly it has been established that modern global wealth is entirely dependent upon its access to energy; it is inevitable to assume anything else other than the reality that as the aggregate amount of real energy, resources and wealth on our planet falls off a cliff and we enter the long decline/collapse that we will have a massive surplus of the "symbolic human construct" that we have used to "count up, tally, measure, represent and account for energy, resources, wealth, etc out there in the world." and therefore with a bunch of existing money no longer able to find/pair/bind with their corresponding resource/wealth counterparts out there in the 'real world', we have a situation of hyperinflation whereby all currencies and monies will lose the vast majority of their currently perceived value and purchasing power... **those that get out fast and convert to real hard assets and tangible resources first will be much better off than those left holding fiat currency or digital cryptocurrencies...**but in truth almost none will be spared as the current situation is more akin to the Earth being one giant 3-D "Easter Island" in space and we have used up all the high density 'free energy' that accumulated over the course of billions of years in a comparative blink of an eye (roughly 150 years since the Industrial revolution and most of it on the backend of the last four decades)

**Wealth creation is actually the extraction, conversion and consumption of energy. All other forms of wealth are merely derivatives that are layered on top of and powered directly or indirectly by the underlining energy infrastructure of society/civilization.** For billions of years, through a process of photosynthesis and thanks to the natural energy from our closest star the sun, our planet has steadily built up a massive reserve of energy, mainly in the form of hydrocarbons underneath the ground. And yet in less than 150 years since the industrial revolution began, we have globally already consumed more than half of all available hydrocarbons and nearly all of the sweet crude, high density EROEI, and other easy-to-extract low-hanging-fruit energy sources on earth. The implications are indeed foreboding.

**Modern civilization is built upon both the expectation and the requirement of perpetual infinite growth in order to be sustained, and its tenet is one of always borrowing from the expectation of future growth to use as collateral to pay for the present/current debts and expenses...** essentially it is the most massive high level Ponzi Pyramid scheme of the ultimate form of kicking the can down the road that humanity has ever conjured up or invented... From fiat currency to fractional reserve banking systems to petrodollar hegemony and quantitative easing, etc it is simply the way we have structured our society and our financial systems by assuming that we will always grow ourselves out of debt and using the assumption of tomorrows growth as collateral for today's level of expenditures. The issue is modern society and thus growth as we know it to be, are both entirely predicated upon the prerequisite ability to continue to extract, process, convert and consume energy at increasingly faster and faster rates. Indeed, our entire global civilization is wholly dependent upon the sort of specialization-of-skill, just-in-time logistics, and economics-of-scale that only a massive interconnected global population sustained by very high-density net-energy sources (hydrocarbons) could provide.

Pertaining to the Net Energy Cliff, modern civilization is highly dependent upon high thresholds of EROEI (Energy Returned on Energy Invested) in order to sustain the sort of globalized Just-In-Time structures needed for modern society and trade, and to prop up the sort of high standards of living and at the enormously high levels of carrying capacity (almost 8 billion humans) that we've all come and grown to be accustomed to in the so-called modern world for the past hundred years or so...

The human body is 70% water. You don't have to lose the very last drop of water in your body to die. Once you lose 10% of water weight you are severely dehydrated and at the edge of death, by the time your body lost 20% of its weight in water you are already dead. Likewise, modern civilization doesn't have to run out of oil before it dies... We are already margined to the hilt and basically the entire system is like Gamestop gambling on margin and we need continuously growth in order just to sustain the fabric of globalized society, any slowdown means the entire house of cards come toppling down! In terms of high quality conventional oil the world has already peaked back in 2008 and now we are relying on unconventional shale, fracking, etc etc to make up for the energy deficits but like turning the knob faster and faster towards the Hot side of a shower as the hot water starts running out, we are only delaying the inevitable and making the collapse cliff that much more steeper when it finally implodes upon itself...

Back in the golden age of oil for one barrel of oil energy expended we could drill, extract, process and make usable about 100 additional barrels of oil, that was an EROEI ratio of 100 to 1. Now we are barely at EROEI ratio of 10 to 1. All the sweet crude is gone, there are no more low hanging fruits, it's just the dirty, sulfuric, hard to extract/drill and energy intensive to process/refine tar stuff left now... so even the quality and density and usable energy we are getting from the remaining hydrocarbons under the ground have reached terminal point of diminishing returns... when you have reached "peak" oil and have approximately half of the reserves left underground, from an energy perspective you really only have 10% left in the gas tank even though the meter says it's still half full...

**Infinite growth in a finite environment is a mathematical impossibility. Human population growth tracks precisely that of bacteria growth in a Petri dish right before it encounters rapid die-off as it hits its resource constraints...**

It is perhaps all about the so-called 'second law' of thermodynamics. Which is also intertwined with the concept called the "arrow of time" in our physical universe. Nature abhors a vacuum, we simply live in a universe in which entropy maximization/optimization is the highest order directive. It is the only real imperative, if you will, that drives everything else. Indeed, life itself and including evolution by natural selection, etc... are all direct and inevitable consequences of this so-called optimization of entropy maximization.

Due to the 2nd law, the evolution of the neocortical regions of our brains in the homo sapiens species, intelligence evolved in humans because there was so much energy potential in the ground, such energy gradients required an advanced mammalian species to come along in order to truly take advantage of it and help it speed up the inevitable journey of low entropy to high entropy. The evolution of intelligence in biological lifeforms such as humans and the emergence of complex systems (math, science, written language, human society, social networks/civilization, specialization of skill, economies of scale, industrial revolution, the computer age, etc) are the direct result of the impending march towards optimization of equalization of energy gradients. The purpose of biological life is to disperse energy. Nature abhors a gradient, thus open physical systems all embody the law of being driven by the dispersal of energy, continually attempting to achieve equilibrium.

Since the first Planck era moment of the Big Bang, the arrow-of-time marching incessantly forwards means constant and eternal increases in Entropy, from low entropy state to higher entropy. (Cosmic inflation, not to be confused with the monetary sort) "Life" as we know it to be, (at least carbon based biological life that replicates on DNA) is merely a temporary localized low-entropy region/state at the

expense of expelling more (higher) entropy elsewhere into the external system. Think of it as a refrigerator on a hot summers day, a small local region of cool temperatures at the expense of it expelling even more hot heat waste into the rest of the already warm outside environment.

They say nature abhors a vacuum, and so perhaps the optimization of maximization of equilibriumization of energy gradients (low to high entropy temporary transition process) is what gave rise to the evolution of life, and later to that of the evolution of intelligent life (including us homo sapiens species) eventually leading to revolutions of industrialization, age of fossil fuels, and the advent of computerized technologies to help assist in the more expedient exploitation and consumption of said aforementioned resources.

Energy underpins everything, it is energy and resources that power and run society and civilizations. Money, in all its forms,(be it Dollars, Yuan, gold, bitcoin, NFTs, stocks, real estate, bs artwork, commodities, etc) are merely nothing more than human social construct of abstract proxy tokens meant to symbolize and account for and help make sense of these energy flows and resource deposits/allocations.

It is human nature to go after the low-hanging fruit first. When the first barrel of oil was pumped out of the ground it took the energy equivalent of that one barrel of oil to pump, extract, and process and make useable an additional 100 barrels of the same oil, thereby yielding a EROEI (Energy Returned on Energy Invested) ratio of 100. In recent times the global EROEI of oil has dipped below 10; and it is still rapidly falling... Imagine an oil-tanker semi-truck that had to drive further and further each time it made a delivery of fuel (analogous to having to drill deeper and deeper for more sulfuric and lower energy quality/density hydrocarbons) and thereby burning more and more fuel in order to make each subsequent fuel delivery run in the first place, he is doing more and more work (driving longer hours) but delivering less and less net usable energy (even though nominally he brings back a full tank each time) and thus he is living in a society with ever falling productivity/ and less real wealth (purchasing power) even as he is working harder than ever before. I think many if not most people can personally relate to this, however very few people realize the root cause of the issue is actually a net decline in EROEI.

Net-usable-energy available for global society is falling sharply because the EROEI threshold keeps diminishing and is itself already falling off a cliff. Massive money printing is a mere futile attempt meant to 'mask' (pun intended) and cover up for this issue but it is akin to putting on a Band-Aid on one of the holes of the hull of a sinking ship when all it does is makes the water flow in faster from the other countless holes and gaps. Money is an abstract proxy for the ability of energy to do "work" in the future. Increasing the money supply while actual resources are all being depleted and whilst EROEI keeps diminishing means modern money is now almost entirely decoupled from what it was meant to represent. There is too much pumped up paper/abstract money out there and not enough real resources, net usable energy, nor the supply chains to effectuate and make good on it. It is all but a mathematical certainty that for the vast majority of people today that nest egg they saved up is not going to be there for them for the very simple fact that the global useable energy is gone... **as the raw purchasing power of money was always almost entirely inflated by the availability of cheap and abundantly high-quality energy (and the "work/productivity multiplier effect" derived thereof) and the assumption that it would always be the case of remaining exercisable and actualizable into perpetuity...**

The "work and productivity multiplier effect" of energy (the vast majority of which is primary energy of fossil fuels in all its forms) afforded to us by the inheritance bestowed upon mankind (billions of years of solar energy captured in the form of plant/phytoplankton/zooplankton/algae photosynthesis and converted into rapid-release capacitors of hydrocarbon based coal, oil and natural gas etc which we have consumed to near depletion in less than 150 years which is the mere blink of an eye) is diminishing commensurate to the global net decline in EROEI of said primary energy sources. This is why governments have to print more and more money while the living standards of their citizens continue to fall off a cliff. The United States, being the current global hegemony with its dollars still as global reserve currency, is no exception to this nor is it immune to the Energy Trap. In the last couple years alone it has printed more than 50% of all the dollars that has ever existed cumulatively in the entire 245 year history of the United States Empire. Yet the real living standards of the vast majority of Americans have continued to nosedive faster than ever before.

Money (or rather its real purchasing power) is really just a measure of the work/productivity multiplier-effect of energy (net usable primary energy), so therefore printing more money to try and account or make up for the decline of availability of remaining energy resources (and also the diminishing EROEI of these primary energy sources) is akin to opening the refrigerator door inside your home to try to cool down the house room temperature after your central AC failed. Locally your face might feel cooler but globally you are just making the entire house even hotter than before. Simply put, energy is what gives modern money most if not all of its real value, so printing more money to try to cover up for the decline in energy is really just locally masking up the issue while globally having zero effect or perhaps making it even worse. Alas, there are no thermodynamic free lunch nor free energy perpetual machines in the real world. This is nothing more than kicking the can down the road while making the eventual day of reckoning that much more worse. It has collectively allowed society to continue on business as usual until one day we find it's too late to even attempt an energy transition in earnest and are already well inside the "Energy Trap" looking out, much akin to the fate of the inhabitants of Easter island. It is very probable that we have already crossed that point of inflection.

An intercontinental flight/trip from the US to EU is estimated to burn up to 100 gallons of gas (aviation fuel) per person for the round trip. One gallon of gas if burned efficiently yields as much energy as equivalent to 2 to 6 weeks of natural man muscle power. It would take at least four years to naturally accumulate the amount of energy needed to make such a cross ocean trip and yet most middle income American's can currently still purchase a ticket for the flight with less than a week's salary. During our ancestor's hunter and gatherer days everyone spent most of their time scavenging for food, it was only after the invention of agriculture that there was an net-energy-surplus (there was more than enough food so some members of society could spend their days working on other things) so that the surplus energy could be used for things like building Great Wall of China or the Pyramids in Egypt etc... But yet it wasn't until the discovery of coal/oil/NG approx. ~150 years ago that human society and global human population and global economic activity really compounded exponentially.

Even right now, with the US Federal minimum wage still at \$7.25/hr, (where it's been since 2009) even the lowest paid member of American society (even if it's just sacking groceries into bags at Kroger or making latte/coffee as a Barista) can 'earn' enough money in an hour to purchase roughly two gallons of gas at his local gas station. Those two gallons of gasoline contains enough energy to be equal to 4 to 12 weeks of manual human muscle power/labor. This Kroger clerk is still tapping into the billion year sunlight inheritance. At \$15 per hour you are tapping into twice the rate! This immense "work and productivity multiplier effect" (in this case more than a factor of 224x times) of energy that we inherited from billions of years of captured sunlight compressed into the form of fossil



fuels/hydrocarbons is the true reason why during the 70s a mere cashier working in a grocery store could afford to make a decent living with a nice house in the suburbs and comfortably raising a family of four. It is also the reason why that as energy becomes more scarce and EROEI continues to diminish that lower paid workers of society can no longer afford to even drive across town for their jobs and at the same time businesses cannot afford to increase real wages because their own "work and productivity multiplier" has drastically decline as well, hence the seemingly contradictory juxtaposition of massive so-called labor shortages yet abysmal real unemployment rates all at the same time. This is why the US middle class has been effectively wiped out and tent cities are popping up everywhere in America at an ever increasingly and soon to be exponential rate. It's not a stretch to imagine that concentration camps are right around the corner especially once the US dollar loses its global reserve currency status and all the privileges that came with it.

Now that the printing money game is soon to be over, the next stage is the clamping down on freedom of movement and the artificial suppression of consumption demand by way of covert destabilization of global supply chains. After all, you cannot spend your money on goods and services that aren't available to purchase in the first place. When push comes to shove, as much of the world undergoes a forced self-cannibalization in a very scale invariant fashion, it is the so-called discretionary activities that are first to be chopped, already including things like luxury cruises, tourism/vacations and air travel, going to bars or clubs, or even buying expensive graphics cards for pc gaming machines, etc etc etc... One way or another, in the name of endless booster shots and vaccine passports, or mandatory individual carbon caps, before long whatever money that you have left saved up that hasn't already been diluted and inflated and taxed away by then will still be worthless as it's no longer able to buy the things or services that you want nor take you to the places that you wish to go...

As that one 'New World Order' person said, by the end of this decade you will own nothing, have no privacy, be able to go nowhere, and "be happy" about it.

Now a brief history of how we got here...

Right now its estimated only 1% of the US workforce is directly involved in food production/farming/etc. Of course in the historic times and pre-agricultural age, especially during our ancestors hunter and gatherer days, everyone spent most of their time scavenging for food... those that succeeded in finding food survived long enough to pass down their genes, but the not so lucky folks starved to death. In mother nature there is no 'borrowing on credit' or payday loans, if the energy input was less than the energy output, if they weren't able to find enough to eat to cover for their individual calorie expenditures then they starved to death. The energy net, if you will, that these prehistoric cavemen cast was what was within walking distance, and what Mother Nature grew and made available by the natural rate of berries and fruits and at the rate that sunlight allowed in "real time"...

Once farming and agriculture was invented all of a sudden the systematic planting, growing and harvesting of food allowed for a massive food/energy surplus, whereby many people in that society no longer had to spent time looking for food and could use that surplus energy to do other things, such as researching and inventing tools that made the farming and agricultural process even more efficient and thus increasing the size and scale of that societies "energy net" that it could cast...

But farming and agriculture was still just converting sunlight into energy/food/fuel at a relatively slow rate... it wasn't until hydrocarbons underground were discovered and the steam engine was invented that the likes of coal, oil, and later natural gas that afforded society an exponential increase in the energy outlays... The fossil fuels underground had accumulated over billions of years, capturing the sunlight and compressing it into solid/liquid fuels over the eons... It's fair to say that we have globally consumed roughly half of the available net fossil fuels within merely 150 years since the advent of the industrial revolution and yet this was not a 'real time' accumulation (otherwise oil would be growing back as fast as we have been using it) and was the result of billions of years of natural sunlight/photosynthesis accumulation....

With the advent of new hydrocarbon energy sources, we tapped into this billion year energy inheritance in order to vastly increase our civilizations casted energy net, and this energy was available as a work/force/productivity multiplier effect. Where previously before the age of oil and coal, the pyramids and great walls were built by muscle labor from the energy surplus of grains and foods produced in farmland via agriculture, now we could tap into the billion year sunlight accumulation compressed into the form of high EROEI liquid/solid fuels, and coupled with machines that ran on these fuels we instantly increased our civilizations total access, production and consumption of energy by several orders of magnitudes...

As a direct result of this massive energy surplus, not only did the vast majority of society no longer need worry nor concern themselves around finding or making food, in fact it relinquished the need for almost all forms of traditional human labor/muscle input, in that we started building roads, buildings and skyscrapers with power drills, caterpillar machines, and transporting materials via train and ship etc... and the underlining infrastructure all required these massive inputs of energy, and it was this extreme work/force/productivity multiplier effect of energy that allowed all of this to happen. To put another way, it was this billion year sunlight energy inheritance compressed into the form of fossil fuels that allowed man to amplify his muscle power and manual human labor, to use this newfound energy to power the machines that did the brunt of the physical work...

Then came the digital/computer revolution... Since most people in society were now freed from having to find food and also freed from having to do manual labor work, this allowed the population to focus instead on math and science, and later on hard physics that brought about transistors and integrated circuits, and other folks to focus on software design, coding, etc and basically the advent of the computer age is what allowed us to leverage the speed of microprocessors coupled with the ingenuity of code/algorithms and later that of AI in the form of deep machine learning and artificial neural networks in order to leverage the intellectual capabilities of modern computers/automation/AI to serve as an "intellectual multiplier effect" to replace and displace a huge portion of what had traditionally been skilled human labor or that of intellectual jobs etc...

In the 1960s a jumbo jet required five pilots in the cockpit, but now with the advent of GPS, ILS, and the FMS/FMC/CDU only two pilots are needed for intercontinental long haul flights, getting rid of the navigator, flight engineer, radio operator etc... and soon it's possible to get rid of all pilots altogether with the coming era of autonomous transports of all kinds be it self-driving cars or air taxis etc... You can still buy a flight to the other side of the world for a couple hundred dollars, which is like a weeks of average middle income American salary. Take away the energy surplus and suddenly you will find that it would take you months if not years to naturally cross the oceans on a wind powered sail boat... and the cost would end up being years if not most of the length of your natural lifespan to accumulate that same amount of energy.

With food taken care of, and both human manual labor and most of the intellectual skilled work also automated away soon, there leaves little in the way for most people to do in terms of having to work for survival... we are at a point in which income can become decoupled from actual meaningful work. And had energy not been the limiting factor, we would have surely progressed to a fully automated workforce society that afforded everyone a comfortable UBI/UBS (universal basic income/services) lifestyle where the machines produced all the products and services and we existed to enjoy the surplus productivity/allocations....

This is why most jobs today can afford to be useless jobs like Instagram models and sports stars and NFT day traders and this that and the other. It is only because of the underlining physical layer that has been propped up by the hydrocarbons underground and powered by the high EROEI billion year compressed sunlight inheritance that the derivative jobs on the upper layers are even possible to exist in the first place!. Take away this energy surplus foundation (high threshold of EROEI) and all the other layers riding on top suddenly collapses like a house of cards domino chain reaction supernova implosion style...

Another example, take the guy making \$11 USD flipping burgers at McDonalds... his job wouldn't be possible without oil to power his car so he can get to work on time. But more than just the price of gas, in order to be able to have the job of flipping burgers it requires the existence of everything upstream of him, from the fossil fuel powered infrastructure that grew, harvested and transported the grains, vegetables etc to the machinery needed to process the meats and the fuel needed to power the trucks that transported the food to his local chain etc by the time these ingredients got to his town it already relied heavily on the energy inputs of fossil fuels to make all of it possible in the first place... without which, his job wouldn't exist. So it's not just about having energy pocket change to cover the costs of rising gas prices so that he can make it to work in his car, it's about how EROEI impacts every other aspect and every level/layer upstream and downstream of him that makes his position and pay even possible in the first place.... without the high EROEI that made the work/force/productivity multiplier effect of energy possible, then McDonald's wouldn't be able to make the sorts of profits that enable them to be paying this burger flipper \$11 USD an hour, a rate which he can use to fetch nearly 3 gallons of gas, which is roughly 6 to 18 weeks of human muscle labor!

Nowadays the new fad is cryptocurrency, and high-end NFT art, and we have a guy that bought a jpeg image online (literally) for 60 million USD. His 'rationale' for doing this is because he believes one day this single jpeg image (NFT) would be able to fetch 1 billion USD. So I suppose we can all just quick get rich buy, selling, and flipping NFT (blockchain) jpeg images online.... In real life, everything is powered by energy, not money, as Money is just a token/symbol that we use to reductively make sense of the resources and energy flows that enable the economic activities around us. 1 billion dollars can currently buy enough gas to be equal to 12 million man years of human labor manual muscle power.... Instead he believes a jpeg image can be the same.... he thinks there are enough oil underground to be able to enable him and others like him to set the valuation of absolutely worthless digital virtual images to be the same as the power that built the great pyramids or great wall.... This is the fallacy of our times.

We can see it as market caps expanding far faster than the price of energy (or any other physical product but it all boils down to energy in the end). If the trends continue, eventually an entity will possess securities in value equal to the entire energy supply. This is essentially an economic singularity: once this occurs, the 1 entity that controls all energy can do nothing with it, because

there is no possible demand from everyone else who has literally no energy. No buying or selling is possible.

Clearly this is nonsense. So there needs to be an off-ramp before it reaches this point. There are only 2 scenarios to avoid this scenario: 1) Energy inflation matches rate of market cap expansion. This is the hyperinflation scenario. or 2. Market caps decline below what they would've been if they rose in lockstep with energy inflation. This is the crash scenario. But neither are good. There's no other way to avoid the collapse scenario of "1 share buys all energy in the world" when market cap growth

Now that the energy has run out, this mother of all bubbles of all times is collapse inwards on itself domino chain reaction hypernova style... scale invariantly.

At the end of the day Net Energy is what counts because it alone powers all the other non-energy sectors of the economy. And all of the goods and services in the modern economy, without exception, require such an energy input. When EROEI went from 100 to 10, there were still plenty of Net Energy available, but once EROEI is at 7 or less, there suddenly is very little net energy available, please reference the EROEI to Net Energy graph to see why we have already past the point of inflection in terms of the Energy Cliff.

Per capita net energy (accounting for EROEI) has already dropped off a cliff and that is the underlining reason why productivity and real wages have gone down even as technology was supposed to increase the productivity of workers. (An increase in economic growth rate by one percentage point is associated with an increase in primary energy consumption by 0.96 percent). The math doesn't lie.

**We are essentially, for all intents and purposes, living in a so-called fractional reserve energy economy. In that there is not a commensurate amount of energy set aside or locked away for each unit of money invested, printed or saved.**

**Energy is priced on the basis of output vs consumption demand, even as the total global reserves themselves are starting to run empty/dry but as long as it can be pumped out at roughly the same rate then the price stays relatively stable... But this false stability is misleading because the total remaining extractable/usable net energy reserves in the world are already far less than the amount of total money out there in circulation and in terms of monies saved up or in the form of investments, retirement funds, profits earned and accumulated etc etc**

**Energy is being priced by an economic system that relies upon the assumption that the very instruments of what it is relying on to price will always exist into perpetuity.**

The dollar was decoupled from the gold standard when it was exposed that Fort Knox vault was empty and there was in fact no gold left, the parallel is that global energy reserves underground are all but empty and depleted especially when accounting for the remaining paltry net usable energy that can still be realistically extracted. But unlike back in the 70s when the US government cheated

the peoples of the world with the financial con, this time around there is no tricking the second law of thermodynamics, and robbing Peter to pay Paul by printing to no tomorrow does not more energy make.

As access to energy peaks and declines (as globally it did back in 2019) and EROEI threshold diminishes, the same amount of nominal dollars is now actually worth less and less. This becomes a double problem when we still try to price energy in terms of dollars and use classic economic models to try and forecast the future. Imagine pumping fuel into your car gas tank but as you are pumping it the price per gallon keep going up in real-time. But what would your total price come out to be? It now also depends on the rate of your pump and how fast price of energy goes up.

Energy is still priced way too low (not to mention not all resources are the same, its uniquely energy that gives or props up all other economic activities including human labor the vast portion of their value etc) and in this regard money as a unit of measure and in fact modern economics itself has completely failed in being a true signifier or being able to accurately measure and price the remaining energy we have left.

Energy is the prerequisite to all economic activity and indeed all life itself, in a decreasing EROEI world, money loses ability to accurately price/value the remaining energy thus causing a viscous cycle of energy being monetarily cheaper than it should otherwise be, which again in turn contributes to propping up the value of money itself -- (recall that modern money derives almost entirely its real purchasing power (and thus value) from the underlining "work/force/productivity multiplier effect" in the context of the society in which it exists in. ) -- which it itself in turn means it only serves to accelerates and compounds the errors in pricing or accounting for subsequent consumption of energy and the remaining energy and so on and so forth...

At the end of the day Net Energy is what counts because it alone powers all the other non-energy sectors of the economy. And all of the goods and services in the modern economy, without exception, require such an energy input.

Down the cliff we go.