Energy Monetization and Power Infrastructure Expansion

Defending Against the Implosion of Society

By Mike Hobart

A Most Ridiculous World

"That Would Be The Road To Hell For America."

I will never not enjoy that clip. "Clown world" has become so much more than just a meme.

Here in the US, but relevant for Europe as well, we have had two tribes within the energy generation industry that have been at-odds for the better part of the past few decades; oil & gas, and renewables (wind and solar specifically). One side calling for the complete phasing-out of the other. While their opposition is pointing to hypocrisies, chiefly: the heavy reliance on demonized resources in order to develop their operations throughout the production, deployment, operation, and maintenance stack – effectively increasing the demand for that which was demonized in the first place. So what is the point of these foolish, childish attempts to sling mud? Are there not plenty of government subsidies alone to justify growing these renewable energy projects? Why the desire for applying a purity test to the energy and power generation stack? Ignoring the difficulties of power generation efficiency and operational executions to produce economically for renewable projects.

It is beyond reproach that the lengths to which the ESG flag was carried went far beyond logic and reason. Now, the pendulum is rebounding aggressively. Europe recently gave up on ESG and added natural gas as a "green" energy[1] while also caving to pressures applied by reality to refer to nuclear as green. With the likes of Blackrock[2], S&P Global[3], Shell's ditching the carbon credits strategy[4], and even McDonald's dropping utilization of ESG narratives in both business activities and public discussion[5]. Energy is one industry in particular that should never have been politicized; we all need it, and we all want it to continually get cheaper, and we all want it to be more abundant. There is no right or left, blue or red, black or white, north or south, that doesn't need energy – and certainly no one that wouldn't benefit from an abundance of energy and an ever increasing availability of power.

How about the whole energy moralization "conversation," which is honestly more like mewling than anything else. Reducing energy consumption does nothing but to guarantee degradation and ultimately dilapidation. And that's not to mention the conversations that may rely on climate catastrophization for their justification or not. Regardless of whether you've read Alex Epstein's *Fossil*

Future, wherever you stand on the whole "fossil fuels are destroying the planet" conversation, may I recommend two actions to be performed either immediately – before continuing to read here, or immediately following reading this essay:

1. Read theFebruary 11, 2019 statement by NASA stating that the continent of Asia has become *greener* since the continent began experiencing industrialization by its largest populations; the Chinese and the Indians[6]. Then ask yourself, is the increase of carbon content in the atmosphere really so bad when it appears to be fueling an explosion of foliage? Do we not want more plant life on this planet? Or is that just a larp by the environmentalists?
2. Watch the lectures by Tom Gallagher that I have linked in between the following paragraphs. Mr. Gallagher provides an abundance of information detailing the long history of the planet's climate and how it has aggressively changed throughout Earth's tenure. It will continue to do so, by the way. Take explicit effort to consider just how much information is being accounted for and responded to by complex systems like weather, convection currents, and the water cycle.

PALEOCLIMATOLOGY Part 1

We cannot afford to slow down consumption of energy. Society is constantly seeking advancement, in a virtually infinite number of directions simultaneously. Advancement requires work to be done, requiring energy. In order to push forward, innovation and efficiency improvements are required, which behooves more energy consumption to develop and establish those progressions. Potentially in less energy being consumed in remedial tasks, and a greater share of the efforts being directed towards developing the new way of performing a task that was once more difficult and where skilled labor was harder to come by. Other instances can involve a true innovation in the form of a new technology or method that enables a completely new manner of work to be done. We cannot afford to slow down consumption of energy.

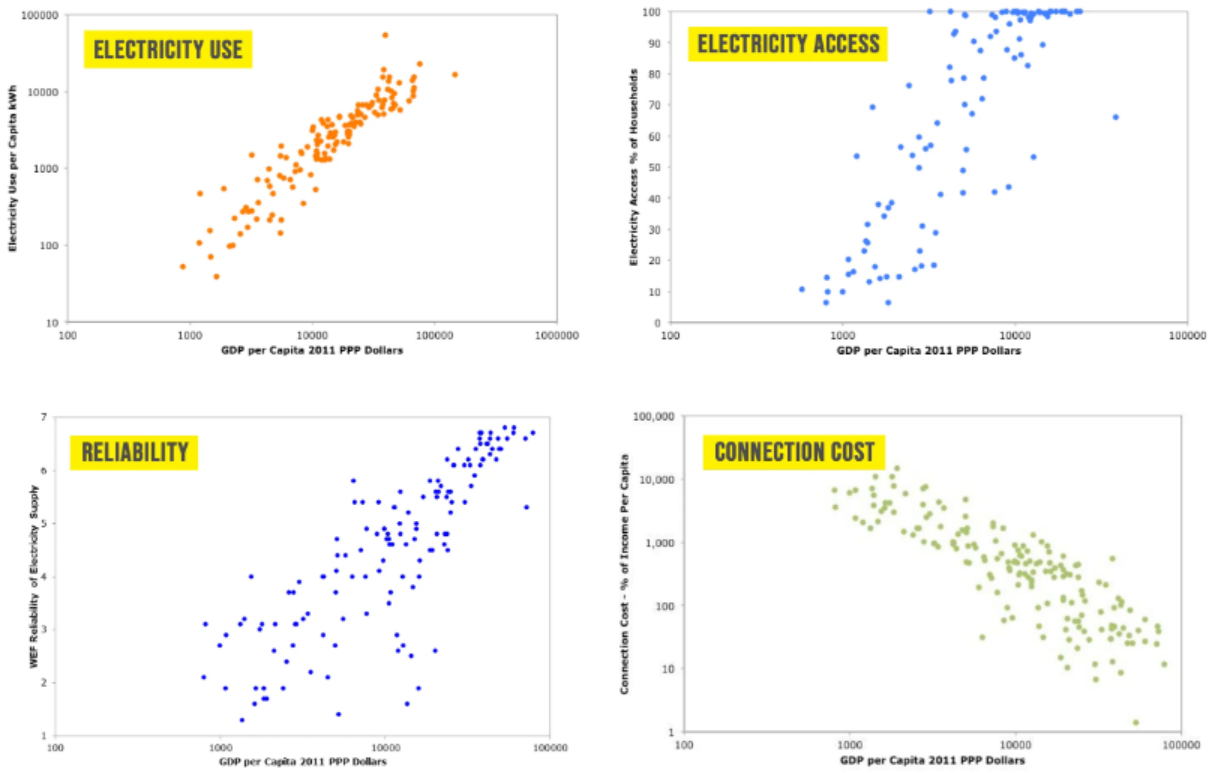
Paleoclimatology Part 2

Energy consumption growth is a requirement for a society to continue functioning, let alone eking-out improvements (more on this later). And just like the body, if we aren't growing and constantly pushing forward, crushing new limitations, then we begin to rot and ultimately perish. Without the struggles and growth that results from pushing limits, cancers and dysfunction will set in and demise will continue to be pulled closer on the timeline.

Paleoclimatology Part 3

Let's discuss this relationship of energy availability, energy consumption, and infrastructure with societal advancement and the importance of availability of power, shall we? Then we will discuss some recent developments in the technological space that are laying the groundwork for a very real renaissance across the energy industry.

Figure 1: Different Dimensions of Energy are Closely Associated with Rising Per Capita Incomes



"The Impact of Electricity on Economic Development: A Macroeconomic Perspective" David I. Stern, Paul J. Burke & Stephan B. Bruns.

Figure 1. Source: https://blogs.worldbank.org/energy/how-much-do-we-know-about-development-impacts-energy-infrastructure

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The Power Behind GDP

Feeding the Grown and the Growing

Stern, Burke and Bruns (2016)[7] concluded in their analysis that *access* to electricity is not sufficient for economic growth but that electricity *use* and GDP have a positive relationship. Simply providing the availability of a resource does not dictate advancement, it is the use that results in advancement. Common sense.

> *"As a result, energy is an essential factor of production and continuous supplies of energy are needed to maintain existing levels of economic activity as well as to grow and develop the economy (Stern, 1997). There may also be macroeconomic limits to substitution of other*

inputs for energy. The construction, operation, and maintenance of tools, machines, and factories require a flow of materials and energy. Similarly, the humans that direct manufactured capital consume energy and materials. Thus, producing more of the substitutes for energy requires more of the thing that it is supposed to substitute for. This again limits potential substitutability (Cleveland et al., 1984)."

– The Impact of Electricity on Economic Development: A Macroeconomic Perspective (2017)

The problem is this witch's brew of ESG over exuberance, demonization of oil & gas, and climate catastrophization has caused a bubbling-up of energy moralization discussion and social pressures to focus specifically on emissions of energy generation. While ignoring discussions of reliability of electricity provision and the capacity of supporting infrastructure. And yet, also ignoring the real substitutability of oil & gas (rather the lack of substitutability), from our current state. All of this is under the intent of establishing limitations on the consumption of energy and power. A strictly anti-growth mission. As we have stated, being anti-growth for an ecosystem is patently pro-catastrophe.

Focusing solely on emissions without also considering the need to maintain availability, reliability, capacity, and cheap costs, only results in a cannibalization of already established infrastructure – weakening provisions for developing and supplying innovative new methods to continue improving efficiencies (including reducing generation of waste and pollution). These growing inefficiencies would then also lead to inviting inefficiencies in energy generation and electricity provision, leading to increases in costs of production and living. Snowballing to a reduction of living standards across the board, and furthering the inefficiency problem(s).

This gets us back to the ridiculousness of over tribalization and politicization of our energy generating projects and infrastructure. The combined smear campaigns of hydrocarbons (oil & gas) and nuclear, and the pedestalization of renewables (wind & solar), with the complete exclusion of hydropower from these discussions, invites significant fragility to already developed economies.

"While solar energy is abundant and inexhaustible, it is diffuse compared to fossil fuels, and plants only capture about 1% of the energy in sunlight. Therefore, the maximum energy supply in a biomass-dependent economy is low, as is the 'energy return on investment' for the human-directed energy expended to extract energy. This is why the shift to fossil fuels in the Industrial Revolution was so important in releasing constraints on energy supply and, therefore, on production and economic growth (Wrigley 2010).

In spite of this, core mainstream economic growth models disregard energy or other resources (Aghion and Howitt, 2009), and energy does not feature strongly in research on economic development (Toman and Jemelkova, 2003)."

– The Impact of Electricity on Economic Development: A Macroeconomic Perspective (2017)

Ultimately suggesting that to try and "phase-out" already entrenched energy resources and sources of power by force (such as through legislation), rather than through free market dynamics, is a

fool's errand and a further waste of time and resources. Making the legislators like those in the clip provided at the very beginning of this essay involving Jamie Dimon explicitly comical. Not only because these approaches would almost certainly break the system itself if they were to succeed, but such activity would be met with such aggressive resistance due to increasing costs of power that the more than likely lashback may result in a successful defense of the system itself anyway. Ultimately leading to only failure, regardless of which of these outcomes occurs.

In general, a well functioning society continues to utilize entrenched energy sources while using the most efficient and reliable energies in greater percentages to further improve efficiencies of these methods, while also working to develop continually more innovative and rewarding sources of energy. Improving the economics and return on investment in energy generation itself, which ultimately uplifts the standards of living. A positive feedback loop.

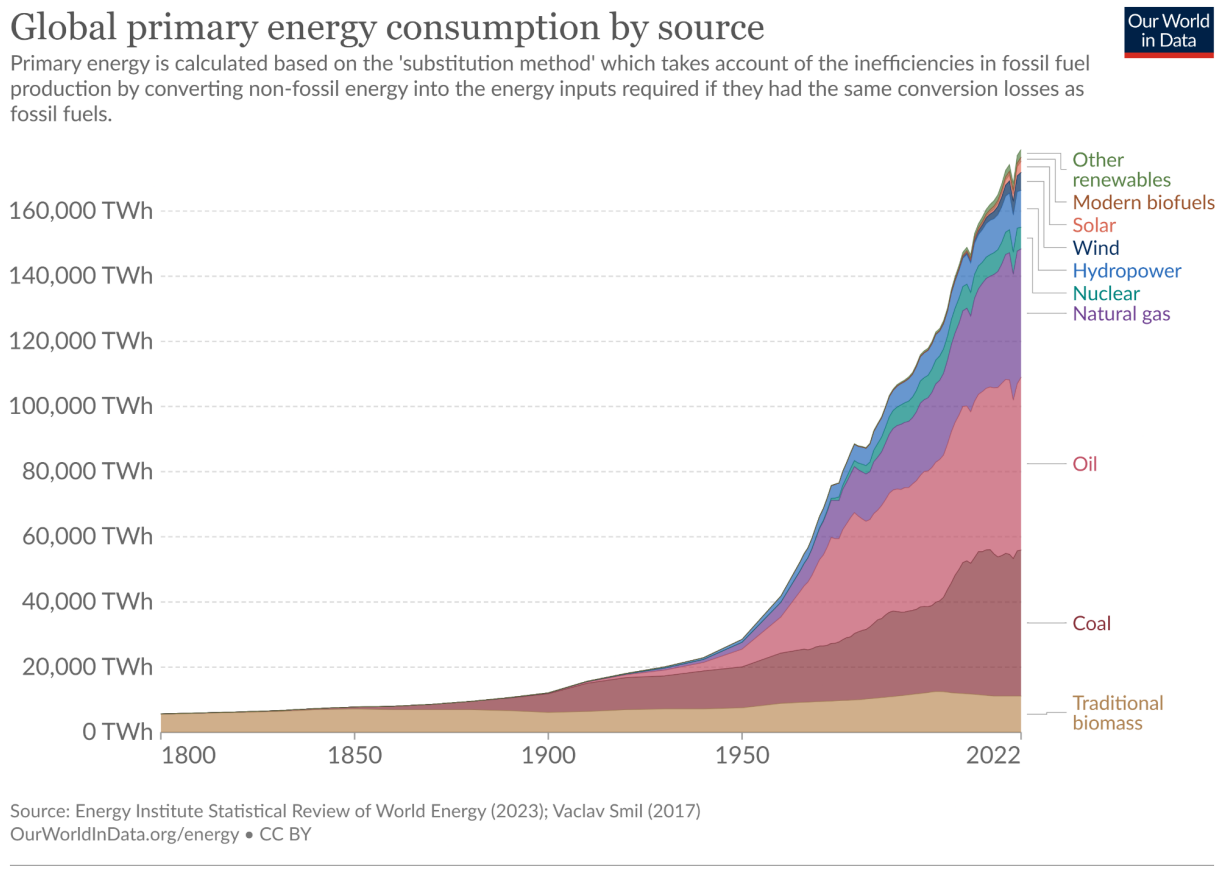


Figure 2. Source: Our World In Data

Let’s take a look at the investment relationship with regards to energy generation, capacity, and infrastructure itself.

Energy and Return On Investment

Stern and Kander (2012) concluded that increasing population without also increasing energy supply results in a degradation of output[8] – shocker. Stern and Kander produced their own version of the Solow Model to include a low substitutability energy source (such as oil and gas) as well as labor into economic projections, as they believed that current economic models do not adequately incorporate the economic importance of energy to the health of an economy, particularly when looking at developed nations with higher access to reliable power and energy. Doing this brought them to an additional conclusion that increasing supply of energy, alongside population, and utilizing technological advancements that augment energy generation, improve output. Again, shocker. But more importantly, this would suggest that energy generation augmentation, while increasing access to energy (as well as supply), improves utilization and output, thereby boosting GDP, even for already developed nations.

The Solow Model and the Steady State

For those that do not know what the Solow Model is (and did **not** watch the educational YouTube video that I *so graciously* provided above to assist your understanding), let's take a brief detour.

The Solow Model

The Law of Diminishing Returns, when plotted against depreciation (which is a constant), and incorporating investment and rate of return on those investments, results in a trajectory that approaches break-even over time. Later resulting in negative returns on investment on a long enough timescale. This dynamic is particularly real in the energy infrastructure and output discussion with regards to civil development and the health of an economy. What this shows is that countries that are under developed and incorporating modern technologies in energy generation and distribution receive greater returns in the early stages with diminishing returns as energy availability and use across their country becomes ubiquitous. Leading countries that have saturated access to reliable power (like the US & Europe) to see slower return on investment than do the underdeveloped countries that are playing catch-up by deploying modern strategies. Makes sense.

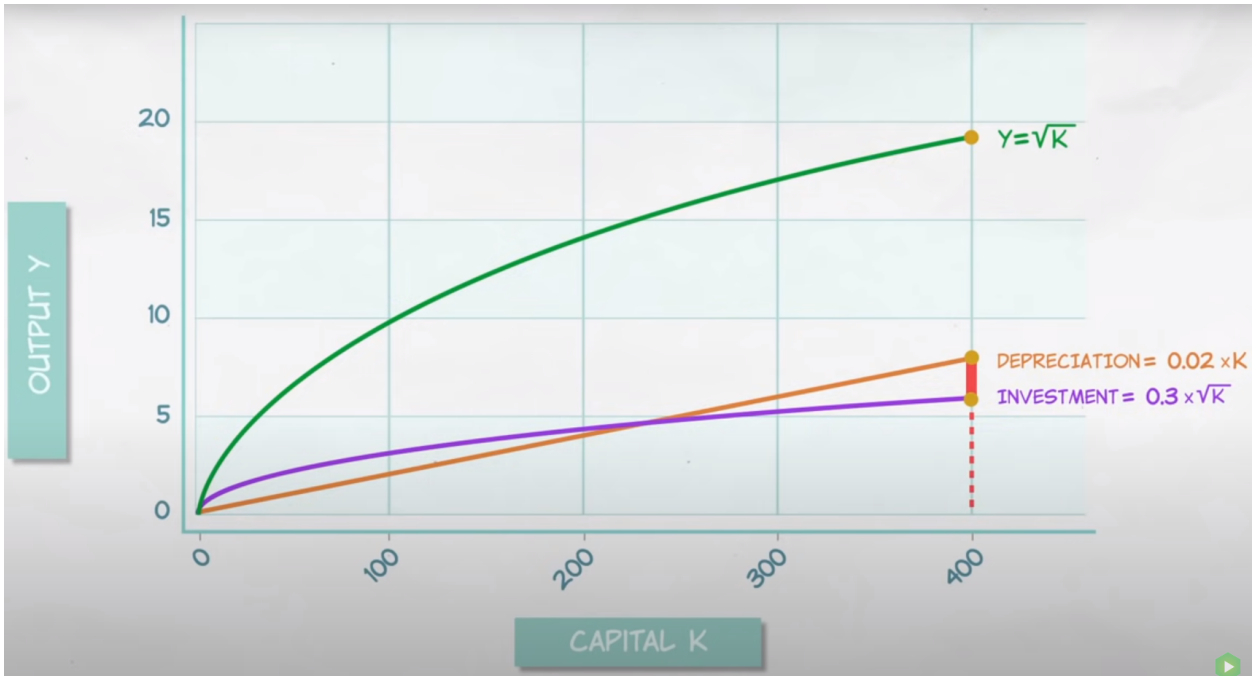


Figure 3. Source: *The Solow Model and the Steady Stat*e, Marginal Revolution University

What this also suggests is that failing to successfully deploy continually improving methodologies and technologies for producing, capturing, distributing, storing, and utilizing energy results in costs of mere maintenance that will begin to eat at investment. Meaning you're wasting more and more time, effort, and resources to simply tread water while only managing to slow your own degradation, and gain zero ground. Requiring a constant search for improving our capabilities in everything related to energy; we cannot afford to stop. To stop looking for greater sources, methods of capture, distribution, utilization, and consumption strategies would quite literally lead to expiration.

The Solow Model & Energy

What Stern and Kander elucidate is that when advancements in technological augmentation of energy generation are incorporated into a growing population base, alongside improving utilization of energy, economies can extend the life of the Solow model to avoid crossing the break-even junction. Effectively allowing for consistent GDP expansion, much like the US has experienced over the past two centuries.

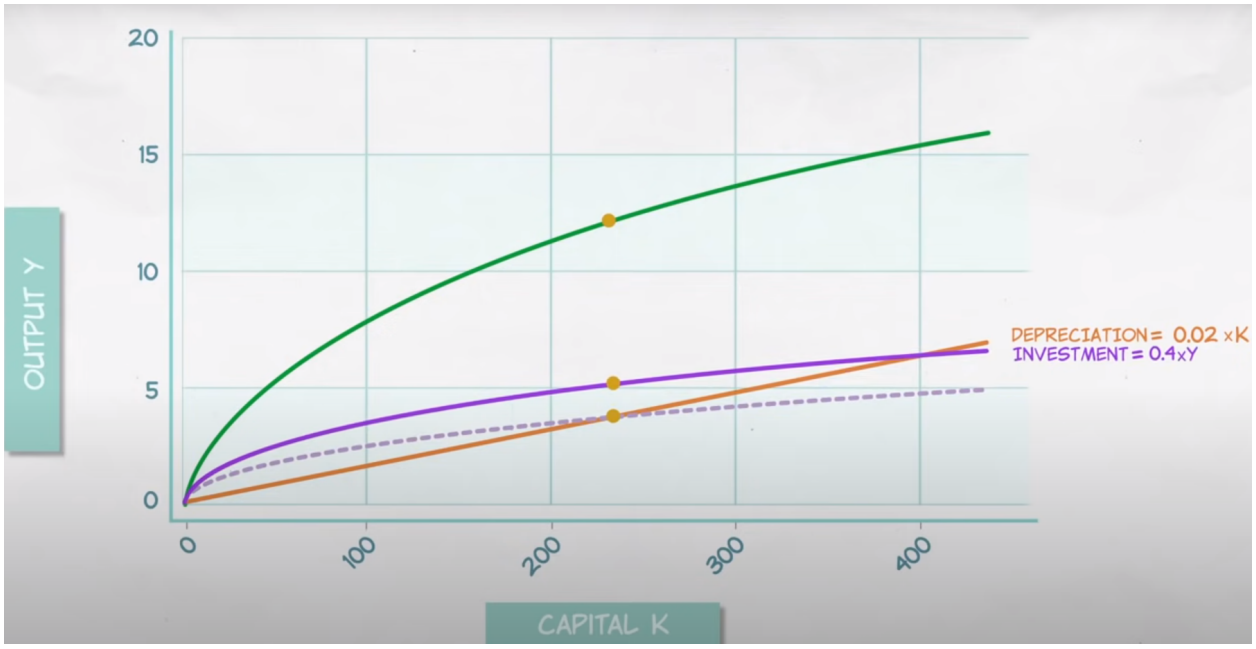
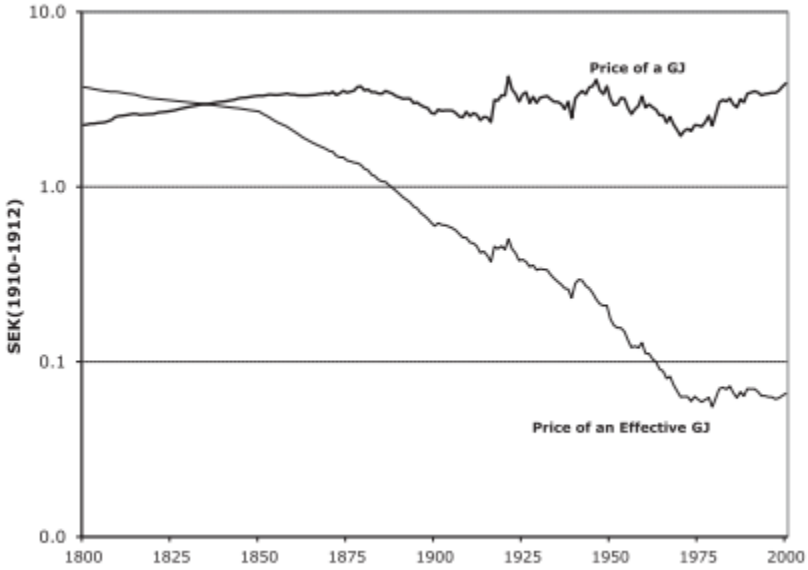


Figure 4. Source: *The Solow Model and the Steady Stat*e, Marginal Revolution University

Through innovating energy generation with augmentative technologies and methodologies, increasing the access and capacity of energy, and increasing the population base, we get prices of effective energy that continue to trend towards 0. In layman's terms; we are getting greater and greater returns for the amount of energy that is being consumed by getting more work done. Even though we continue to consume more energy than we ever have.

Figure 3: Sweden 1800–2000, Input Prices *(continued)*



C. SEK per Gigajoule of Energy

Figure 5. Source:
https://crawford.anu.edu.au/distribution/newsletter/research-newsletter/pdf/Energy-Journal-Stern.pdf

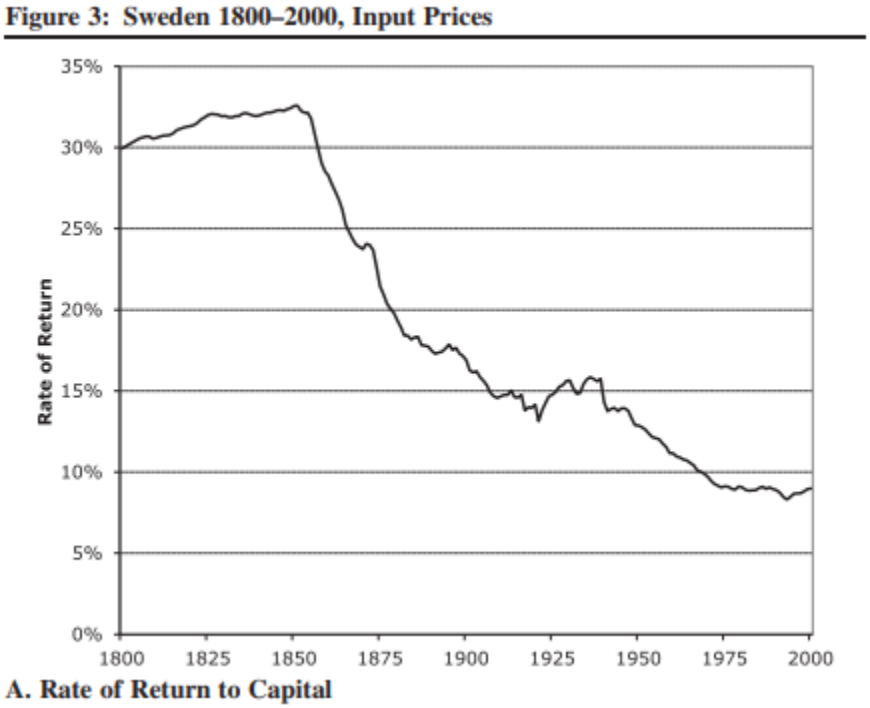


Figure 6. Source:
https://crawford.anu.edu.au/distribution/newsletter/research-newsletter/pdf/Energy-Journal-Stern.pdf

Augmenting Energy Generation

"Time-series analysis (Stern, 1993, 2000) shows that energy is needed in addition to capital and labor to explain the growth of GDP. But mainstream economics research has tended to downplay the importance of energy in economic growth. The principal models used to explain the growth process (e.g. Aghion and Howitt, 2009) do not include energy as a factor of production."

– The Role of Energy in the Industrial Revolution and Modern Economic Growth, Stern and Kander (2012)

If energy is so important to any and every economy, why is it so aggressively avoided in research and discussion? Going further, why such heavy over politicization and division in the industry? Discard the tribalism in energy as nothing more than noise. It's nonsensical down to its very core. We need as much energy being generated as possible in a way that doesn't break an economy, and that can allow us to keep the wheels of society turning. How do we achieve such a lofty goal?

Direct monetization of energy generation.

One issue: demand for power is volatile. It does not remain consistent throughout the day, let alone throughout the year. This volatility also bleeds into the varying forms of energy for economies that experience seasonal climate volatility or may be restricted in access to diverse sources.

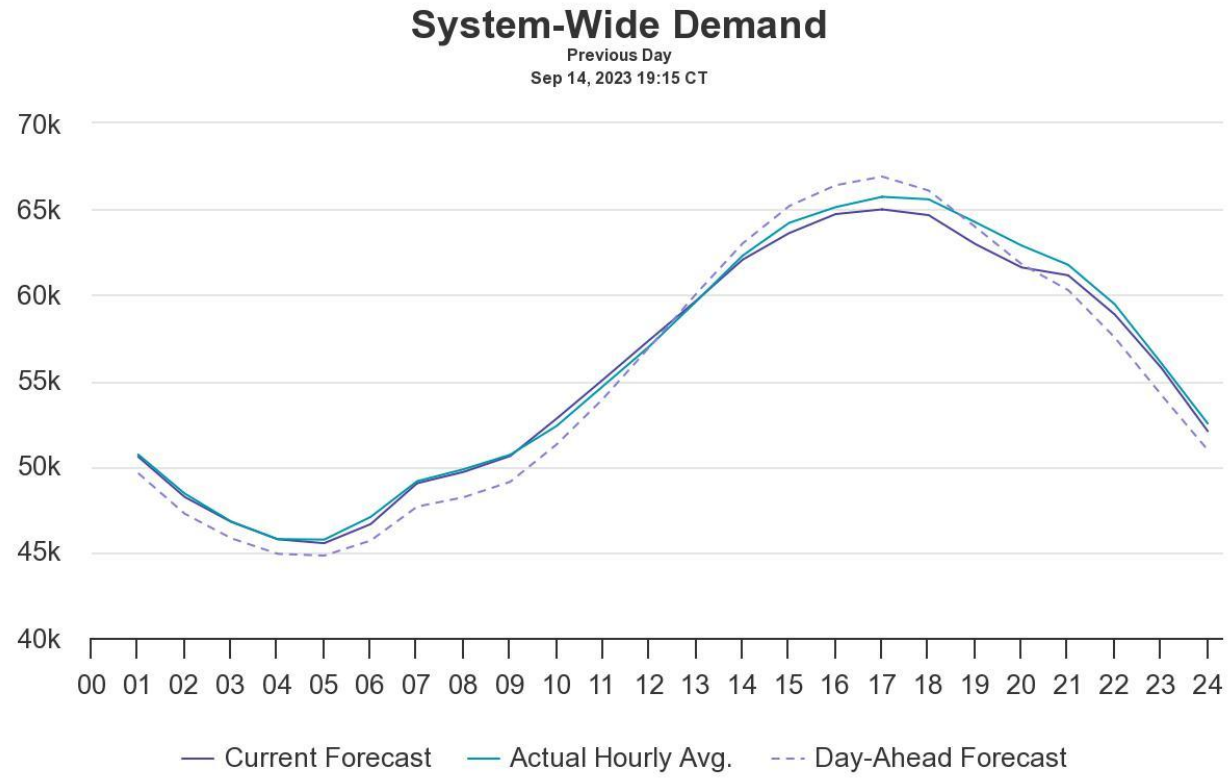


Figure 7. Source: ERCOT

Is there a way for us to smoothen-out this demand volatility so that energy producers can maintain a consistent run-rate while still being capable of providing reliable power to societal fluctuations?

The Future of Energy

The answer is yes. This is achievable through bitcoin mining. We can use bitcoin mining to squelch the fraternal squabbles between all of the energy generators. All are free to compete for hashrate and seek that fabled next bitcoin subsidy distribution, so long as they agree to redirect power to the grid in society's moments of need (which has been shown to be effective in multiple events and scenarios on Texas' ERCOT system[9] as well as in Georgia). The greater the power generating capacity of the operation, the more that they can afford to give society what it needs and still be capable of capturing revenue via bitcoin mining. The best part is, that bitcoin doesn't care where the energy is coming from or being sourced; it wants it all.

We can now justify the rapid expansion of energy generation and distribution infrastructure by providing perpetual and highly competitive demand for that energy. Demand that is both buyer of first resort and last. This demand can be sourced through the cheapest energy resources, or through expanding current operations to provide greater output and maximize efficiency. All strategies are viable with this approach. Providing a responsive demand to the grid that can smoothen out the total demand curve is ***revolutionary***.

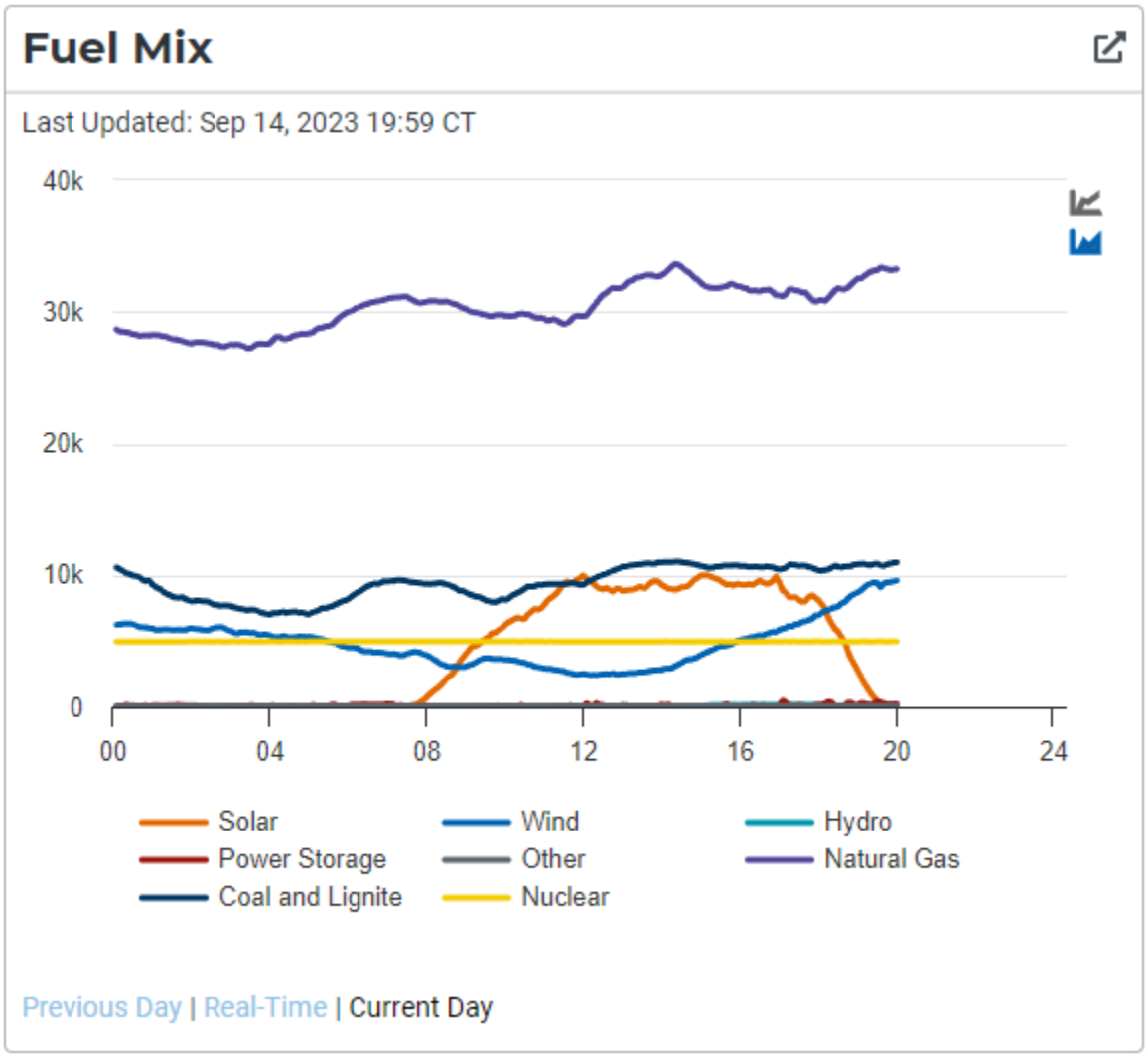


Figure 8. Source: [ERCOT]

A well balanced system would have overall demand looking as consistent and flat as that line representing nuclear power supply above (yellow). But when you have natural demand ebbing and flowing (as seen in Figures 7 & 9) you need a flexible demand source that can fill in the gap between. You need a load that can shut off when societal demand surpasses forecasts, but provides such a benefit through both operational improvements and revenues that their product is readily sought after when circumstantial demands are satisfied, that they can be brought back online as soon as possible.

That, ladies and gentlemen, is what the bitcoin miners down in ERCOT and Georgia are doing. They are filling the gaps. What this is also doing is providing an incentive for energy generators to produce as much as possible. Meaning there is now a justification to build out operations that are capable of producing far more energy than is required now (but can be of use in the future).

Figure 9.

Slippery Orange Coin

What happens to demand when the supply of electrons does not make production of the commodity easier. Where such an asset only continues to gobble-up as much energy as is thrown at it, not like gold, not like oil. These are two commodities that result in natural market forces bringing an end to

high prices by justifying increased production during high prices and decreased production during low prices.

That is the beauty of the difficulty adjustment in bitcoin mining. When more power gets dedicated to the network, and blocks begin to get completed too rapidly, the network ratchets up the difficulty (and vice versa when blocks are coming in too slowly). There is no over production and over saturation of supply due to high prices.

Meanwhile mining pools allow for bitcoin miners to work together to earn the bitcoin subsidy. When such an outcome occurs the mining pool distributes earnings to the pool participants according to how much effort was dedicated as a percentage of the pool total (a fair collaborative system). Resulting in a far more consistent stream of income than if these miners were working alone.

Conclusion

All energy generators stand to benefit from deploying datacenters full of ASIC miners to take advantage of the perpetual demand afforded the bitcoin mining network. Furthermore the highly competitive industry is providing visceral demand for improvements in chip efficiency as well as the sourcing of not only the cheapest energy, but the most abundant capacity that is not being effectively utilized. Which is why energy producers and utilities are doing just that; using bitcoin mining to maximize efficiencies and improve operations, while earning an extra line of revenue.

The very foundations of energy are being retooled. The tribalism within energy will die away as all producers aim their sights at the great orange future cresting over the horizon. And they're all positioned to make a lot of money for it.