



12/13/2020: Total Energy Flux...

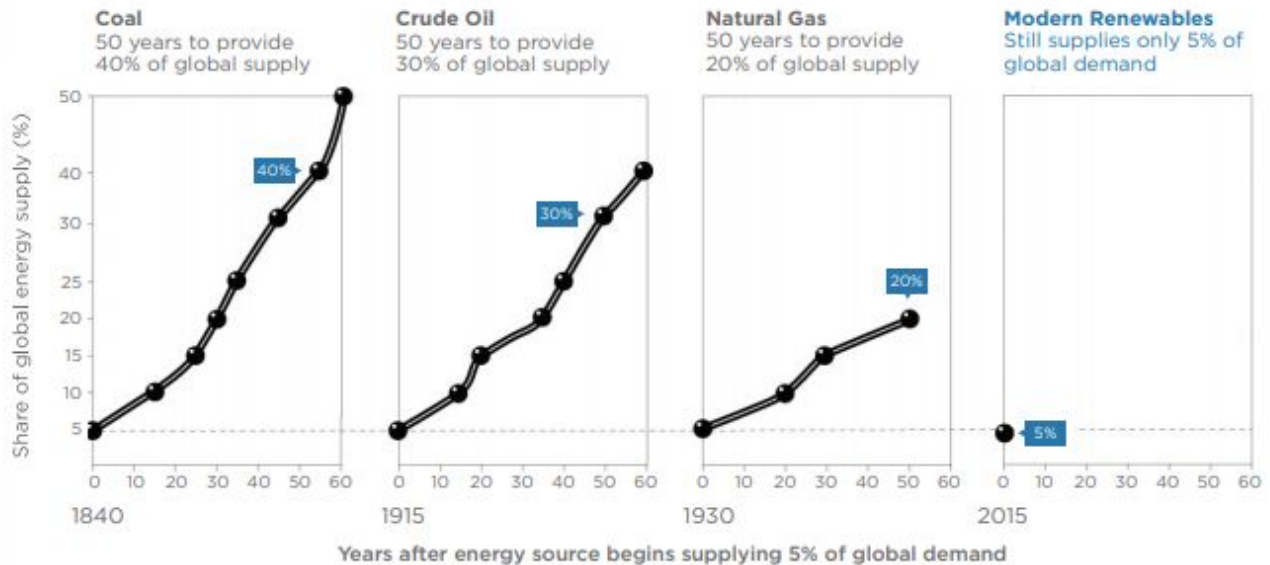
*In 1922 Alfred Lotka (1880–1949) formulated his law of maximized energy flows: **In every instance considered, natural selection will so operate as to increase the total mass of the organic system, to increase the rate of circulation of matter through the system, and to increase the total energy flux through the system so long as there is present and unutilized residue of matter and available energy** (Lotka, 1922, p. 148).*

*The greatest possible flux of useful energy, the maximum power output (rather than the highest conversion efficiency) thus governs the growth, reproduction, maintenance, and radiation of species and complexification of ecosystems. The physical expression of this tendency is, for example, the successional progression of vegetation communities toward climax ecosystems that maximize their biomass within the given environmental constraints – although many environmental disturbances may prevent an ecosystem from reaching that ideal goal. In the eastern United States, an unusually powerful hurricane may uproot most of the trees before an old-growth forest can maximize its biomass. **Human societies are, fundamentally, complex subsystems of the biosphere and hence their evolution also tends to maximize their biomass, their rate of circulation of matter, and hence the total energy flux through the system** (Smil, 2007).*

The above (with emphasis by me) is from Vaclav Smil's paper titled "[Science, energy, ethics, and civilization.](#)" If you're not familiar with Smil, he's Bill Gate's favorite author, having written over 30 books on a range of topics including historical economics to geopolitical philosophy, food sustainability, energy and more. Most know him for his work on the latter.

His thoughts on the energy landscape are as persuasive as they are prolific, which is saying something (over a third of his books focus on the space). If you had to distill his views on the subject — an impossible task, but we'll try — down to a few bullet points, you'd get something like this:

- Complex systems naturally trend towards greater complexity and greater energy intensity as long as the physical means to do so remain available
- Human societies, being a natural form of a complex system, have increased their total energy flux exponentially over-time and are set to continue to do so unless drastic policy measures are taken to slow consumption growth
- Major energy transitions are an incredibly slow-moving process, historically speaking. And it typically takes *many* decades before the up-and-coming energy source comprises any meaningful percentage of the energy mix (see chart below).



Source: Vaclav Smil. Modern renewables include: wind, solar, and modern biofuels

We're referencing Smil and his work on energy today because he touches on a critical thematic that's going to play an increasingly substantive macro driver in the years ahead. This is the global move up the energy consumption curve. He writes (emphasis by me):

*National averages show that at the beginning of the twenty-first century annual consumption rates of commercial energy ranged from less than 0.5 GJ per capita in the poorest countries of sub-Saharan Africa (Chad, Niger) to more than 330 GJ per capita in the United States and Canada... Persistent consumption disparities result in a hyperbolic distribution of average per capita energy use... **With less than a sixth of all humanity enjoying the benefits of the high-energy civilization, a third of it is now engaged in a frantic race to join that minority, and more than half of the world's population has yet to begin this ascent.***

The potential need for more energy is thus enormous... The utterly impossible option is to extend the benefits of two North American high energy societies (about 330 million people consuming annually some 330 GJ per capita) to the rest of the world (about 6.5 billion people in 2005). This would require nearly 2.3 ZJ of primary energy, or slightly more than five times the current global supply.

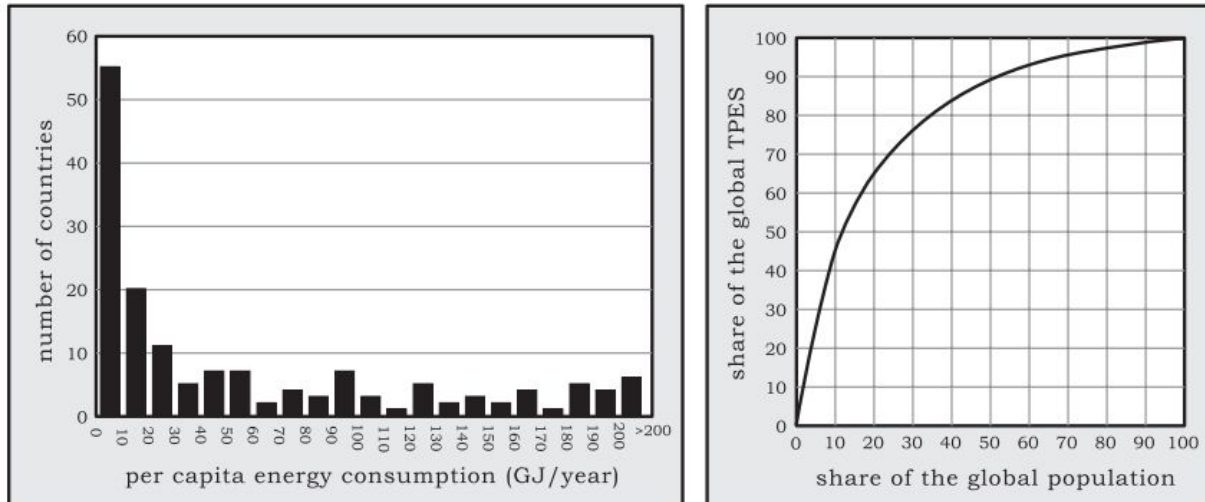


Fig. 35.6. Pronounced inequities of global energy consumption.

As global per capita income rises, people consume more. And over time, the consumption habits of developing countries trend towards those of developed ones. This equates to a much greater *energy flux* as Smil and Lotka put it, which is just a fancy way of saying more people are going to be consuming more things and the entire system is going to require a significant more amount of energy.

This may all sound a bit familiar to Operators who've been with us for a while. We've been writing on the topic of [Wealth S-curve](#) dynamics for some time. Here's a short refresher on the subject.

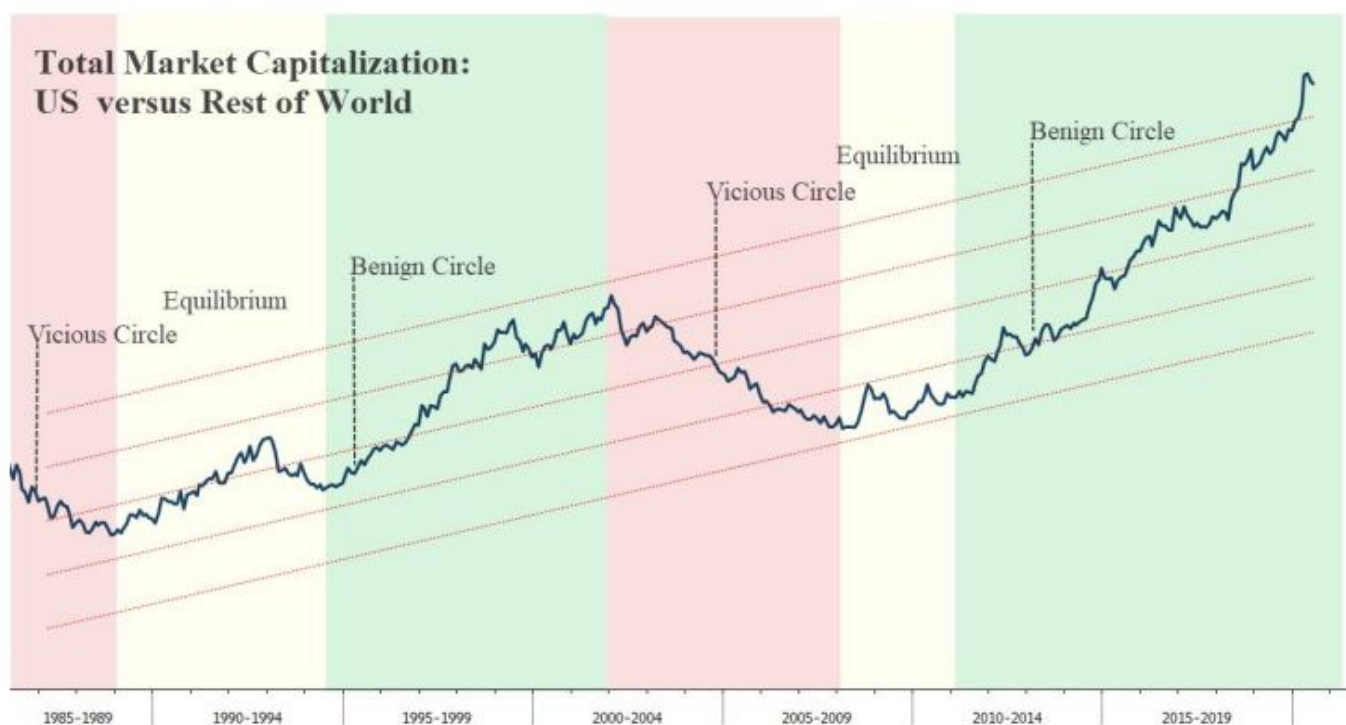
- When a country passes the Wealth S-curve Tipping Point (between \$2,300 - 3,300 gdp per capita) consumption begins to increase exponentially, following a sigmoid curve (aka S-curve)
- Example: They begin to eat a considerable more amount of protein. Raising livestock is 7x more grain intensive than producing for a simple plant based diet, so demand for all agricultural goods rises
- Example: China crossed the Tipping Point in the early 2000s... The average Chinese citizen went from consuming only 1.4 barrels of oil a year to 2.2. Instead of two vehicles being sold per thousand citizens, by 2008 this figure reached nearly nine vehicles. Total passengers carried by airlines increased from 57 per 1,000 Chinese citizens to nearly 100. All together, **Chinese oil demand growth quadrupled from 0.03 barrels per person per year to 0.12 barrels per person per year in less than a decade**
- This matters because... Next year is likely to be the start of the Tipping Point where, for the first time in history, a majority of the global population will live in middle-class or rich households
- According to the Brookings Institute, over the coming years **170mn are expected to join the middle class every year. By 2022, the global middle class is expected to be consuming approximately \$10trn more than in 2016, making for the "most rapid expansion of the middle class, at a global level, the world has ever seen."**



Here's the thing though... secular stuff like this means little from a practical trading and investment standpoint if the cyclical and technical drivers aren't also aligned. This hasn't been the case for the last few years but we can now, for the first time in a loong time, give the big affirmative.

Back in September we discussed the last remaining pillar to the USD trade in "[The End of Core Domination](#)", writing:

...the dollar only has relative market performance (m) working in its favor... And as we can see in the chart below, this sole-remaining USD bull pillar of relative market performance is historically stretched.



The fact is that capital concentration is likely near its zenith here in the US. The valuation premium placed on US financial assets is over 1.5std above its long-term average. And it now no longer has the supportive tailwinds of positive growth, yield, or exchange rate differentials...

So at this point, the primary thing preventing the dollar from completely tipping over is relative US asset outperformance, or rather the bullish trend in tech. And this speculative trend that has driven Domination by the Core is itself being driven by stimulus-funded trend followers.



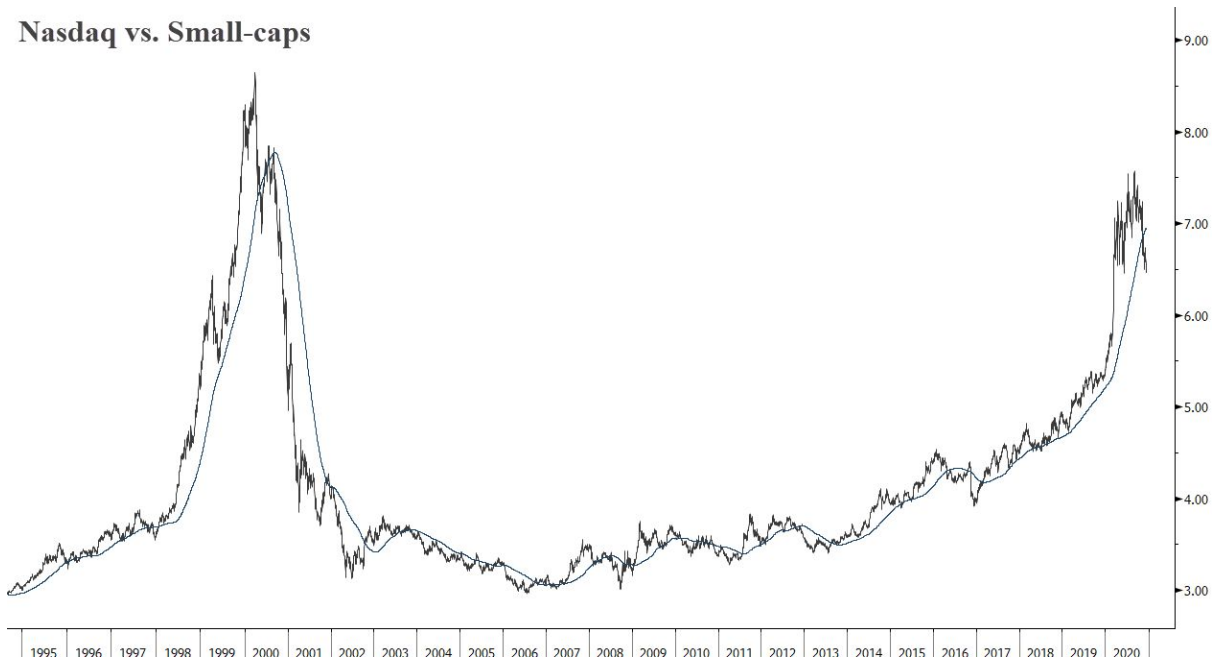
In macro, everything is in some sense a dollar trade. Long EM, commodities, small-caps, and value are short USD trades. Conversely, long tech, growth, bonds, rate sensitive assets are long USD trades.

That's why we see these big long cycles in relative performance... currency regimes tend to persist, especially bullish USD ones. This is why the recent weak relative performance of synthetic long USD trades against shorts, is so important to watch here. It's the only leg of the USD bull that's still intact and it's looking increasingly wobbly.

Nasdaq vs. Emerging Markets



Nasdaq vs. Small-caps





The best trades are the ones where you stack positive condition upon condition upon condition. When you do that, it makes it very difficult to lose and easy to win. You create a kind of conditional asymmetry of sorts... something that can then be further boosted by aligning entries with technical setups, proper position sizing, and of course, trade management.

The energy space as a whole is gathering these varied conditional tailwinds. The world is increasingly long energy consumption yet very short the means to produce and meet those needs. The US dollar and liquidity backdrop that's needed to kickstart and carry a transition to a Periphery led regime are in place. The technical picture has set up... a cyclical bottom in EM and commodities is in.

There will be fits and starts to this trend, as there is with all major turning points. But we can say with high conviction that this is the beginning of a new regime, which is why you'll see us continue to focus a lot more on various emerging markets and commodity plays going forward.

Uranium, finally...

We've been watching and commenting on the uranium space for a few years now, as the supply and demand fundamentals have continued to improve. We haven't aggressively invested in the space because the conditions weren't yet aligned. That's now changed.

Let's summarize the the bull thesis real quick:

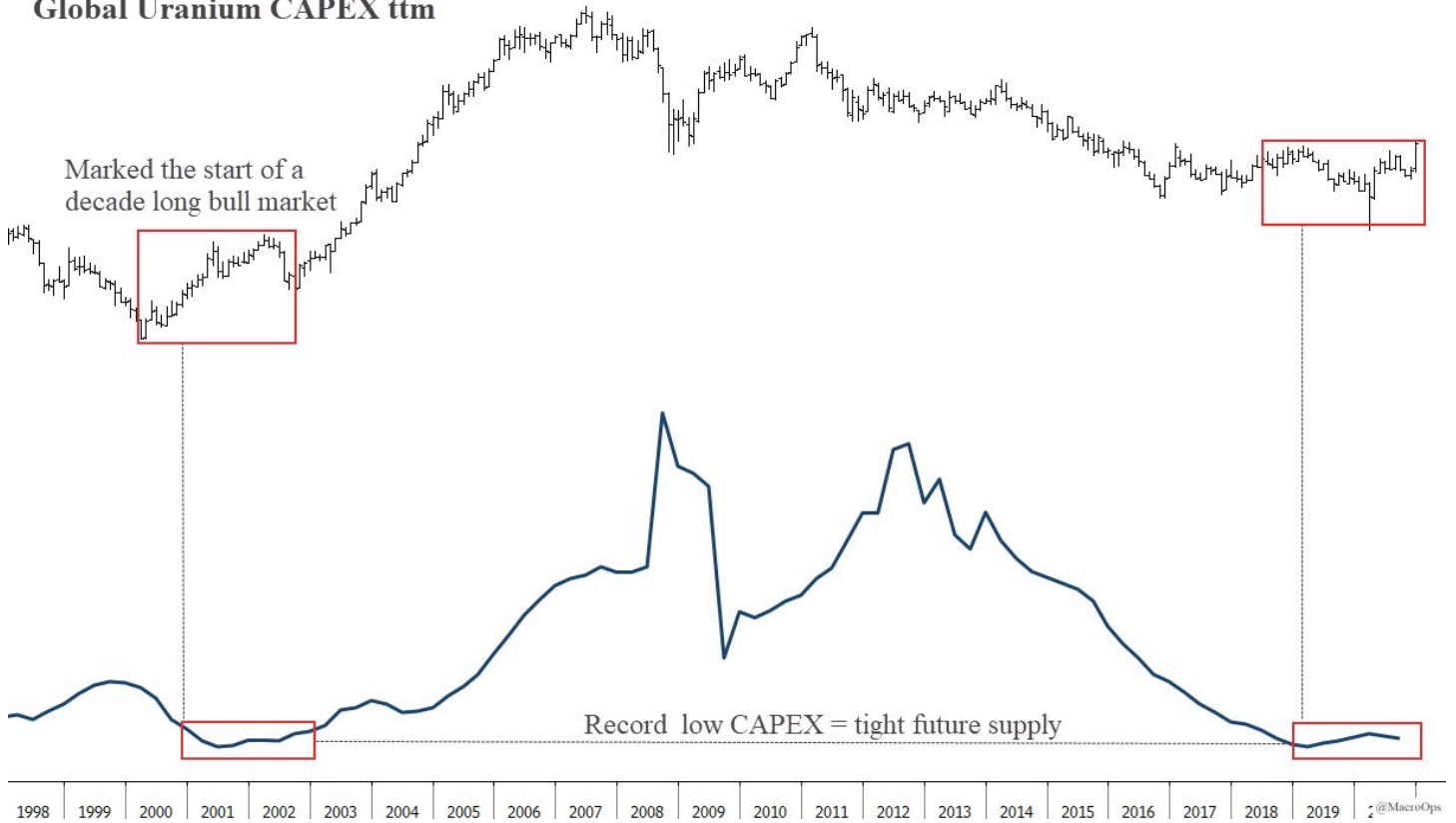
- ❖ Uranium spot prices are coming out of a decade long bear market after having declined 75%+
- ❖ 10-years ago there were over 500 hundred uranium miners around the world. There's now less than 50
- ❖ Despite the negative stigma around nuclear, there's currently 56 reactors under construction around the world and enrichment demand is expected to increase over 40% by 2035
- ❖ Mining at today's spot price is uneconomical for the majority of producers. This has led to producers shuttering production and buying in the spot market to fulfill contracts
- ❖ CAPEX has been slashed to record lows (see chart below) and there is now not enough production and secondary supply to meet future demand
- ❖ The uranium market runs off long-term contracts (7-10 years) with utilities. Most contracts are legacy contracts, meaning they'll be expiring soon, and there's increasing risk we'll see a major supply shortage and inability to roll over and support these contracts

You can also throw in the fact that nuclear is the *greenest* of the renewable energy sources and the only viable near-term option for supplanting fossil fuels as a primary base load energy source.

The [Capital Cycle](#) is strong in this one with CAPEX at record lows, even below the lows that marked the bottom of the last uranium bull market.



Global Uranium CAPEX ttm



The technicals are FINALLY signalling a major change in trend, with the World Uranium Index breaking out of its 5-year base this month.

World Uranium Index - monthly





There's a number of ways to play this trend. You can buy the uranium trust, Uranium Participation Corp (U:TSX) which currently trades at an 11% discount to NAV. You can buy a stalwart producer like Cameco (CCJ) which has an excellent looking chart, or you can buy Centrus Energy (LEU) or Paladin Energy (PDN:ASX). On the surface, these seem like more speculative plays but as we'll show, they're anything but and offer extreme asymmetry to ride this budding trend.

We'll cover LEU today and save PDN for later.

Centrus should be familiar to most of you. I wrote it up last year and picked it as one of my three stocks for the MO stock picking competition. It's up 153% ytd but still has a long runway for explosive returns.

Okay, some quick background on the company. LEU was spun out of the US government's uranium enrichment program in the late 90s for roughly \$3bn. The company initially operated as an agent in the US government's "Megatons to Megawatts" agreement with Russia, where they downblended highly enriched uranium (HEU) from former Soviet nuclear warheads into LEU fuel to power US nuclear reactors.

In 2014, following the Fukushima disaster, the company underwent a financial restructuring and emerged with a fresh balance sheet and new leadership. It continues to provide US and international utilities with LEU supplies today.





The micro LEU bull thesis:

- LEU received a one-time market-related price reset on its uranium supplies from its Russian counterpart, TENEX in 2018. This reset dramatically lowers LEU's cost basis going forward
- Since LEU deals in long-term contracts with both supplier and buyers, we get visibility on a minimum steady run-rate of \$30mn+ TTM in EBITDA
- LEU has a \$1bn+ long-term order book (including \$300mn in deferred revenue) that's growing and which extends into 2030
- Last year the company reduced its debt by over 70% to \$74mn and the notes aren't due until 2027. Plus, they have \$152mn in cash/cash equivalents and roughly \$900mn in NOLs

A solid balance sheet US supplier of enriched uranium trading at just 6.5x long-term contracted EBITDA and 1.3x cash, sounds like a pretty good deal to me. But the real kicker is the free call option we get on LEU's HALEU business.

A couple years ago, LEU entered into a \$115mn cost-share agreement to build the only US uranium enrichment plant licensed to produce HALEU (High-Assay, Low Enriched Uranium). This is the fuel that's going to be used in the next generation of reactors (SMRs) and is critical to the US's long-term security by restoring the viability of the entire front-end of the nuclear fuel cycle, which the April 2020 White House Nuclear Fuel Working Group noted is a strategic imperative.

This is a big deal... **LEU is the only licensed US producer of HALEU.** HALEU is uranium that's been enriched in U-235 up to 20% — commercial reactors use 4-5% enriched uranium today. The benefit of this is that higher concentrates allow for much smaller fuel cores, which means dramatically smaller reactors, greater fuel efficiency, less refueling needs, and reduced waste.

Demand for HALEU is expected to grow in the high double-digits over the next two decades (chart via [LEU's deck](#)). LEU expects to complete the demonstration in 2022 with an aim to then quickly transition to commercial production.

The company has strong relations with the two winners of the DOE's Advanced Reactor

Potential HALEU Requirements from Advanced Reactors
MTU HALEU (19.75%-equivalent)

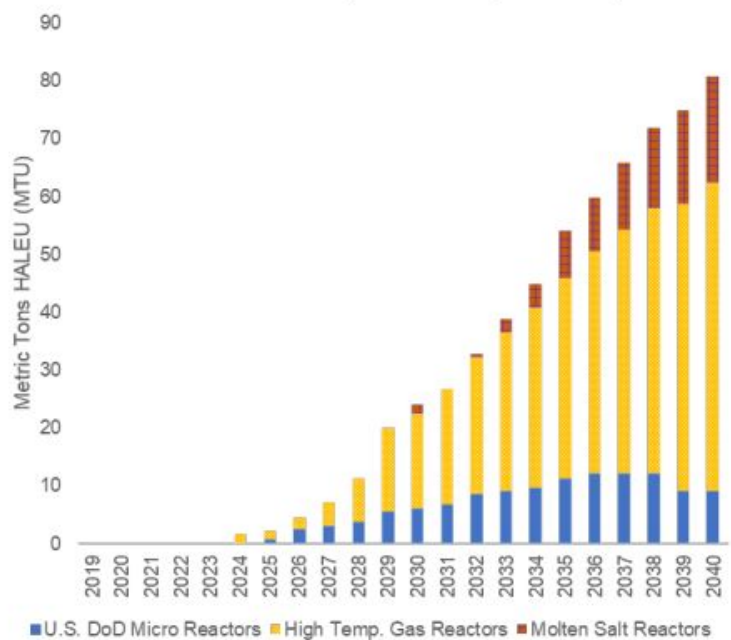


Chart does not include potential HALEU demand for accident-tolerant fuel designs for existing reactors (up to 500 MTU/yr HALEU).



Demonstration Program (ARDP), TerraPower (backed by Bill Gates) and X-energy. So is well positioned to be the monopoly supplier to this potentially fast growing space.

Knowing all this, it's pretty incredible that even after the stock's 150% ytd run it's still trading at less than 1x revenues, less than 7x EBITDA, and only 2.6x net cash. That's a total head scratcher which is why I love the play.

Oh, and I forgot to mention this, but Dan Poneman, LEU's chief executive, was deputy of the DEO during the Obama/Biden administration. That's an important detail in these types of industries...

I'm uber-bullish on uranium's long-term prospects. Governments are starting to go raving mad for "green" energy. And there's no feasible future where we lower our carbon footprint without nuclear making up a LARGE part of our baseload energy supplies — Vaclav Smil agrees 100% on that point.

This trade has conditions, upon conditions, upon conditions going for it. It's not crazy to think this thing could 10x over the next 5-7 years. It'll be a bumpy ride for sure, uranium small-cap investing always is. But the payout is well worth the vol. The key is to size right and sit tight. We'll be putting on a position at the open tomorrow.

Stay safe and keep your head on a swivel!

Your Macro Operator,

Alex