THOUGHTS FROM THE FRONTLINE

Demanding Energy

By John Mauldin | December 14, 2024

Unlimited Demand
Clear as Mud
Las Vegas, NYC, Austin, Newport Beach and Italian Cuisine

Energy is everything. Or, if Einstein was right, you and I are just energy in material form. Accelerate us to lightspeed squared and we might become something else.

All economic activity involves converting energy from one form to another. This requires harnessing sufficient quantities of usable energy. That task is becoming more difficult, to the point economic growth would suffer if we weren't constantly seeking new sources.

In other words, energy isn't just another market sector. It's the foundation of *every* sector. And you know what happens when the foundation gets shaky.

I want to spend a few letters exploring different angles of the energy challenge. I started my research with a long, fascinating phone call (with some of my colleagues) to Mark Mills, one of the world's top energy authorities. He recently joined with an all-star cast of other energy experts to launch the National Center for Energy Analytics. The research they've published so far is extremely valuable. Mark told me a little about what else is coming. Suffice it to say, you should pay attention.

Through the magic of AI, we were able to transcribe my conversation with Mark. Today I'm going to share with you one short section (of 30 pages!) in which he masterfully explains why energy demand is a much more complex topic than many people think.

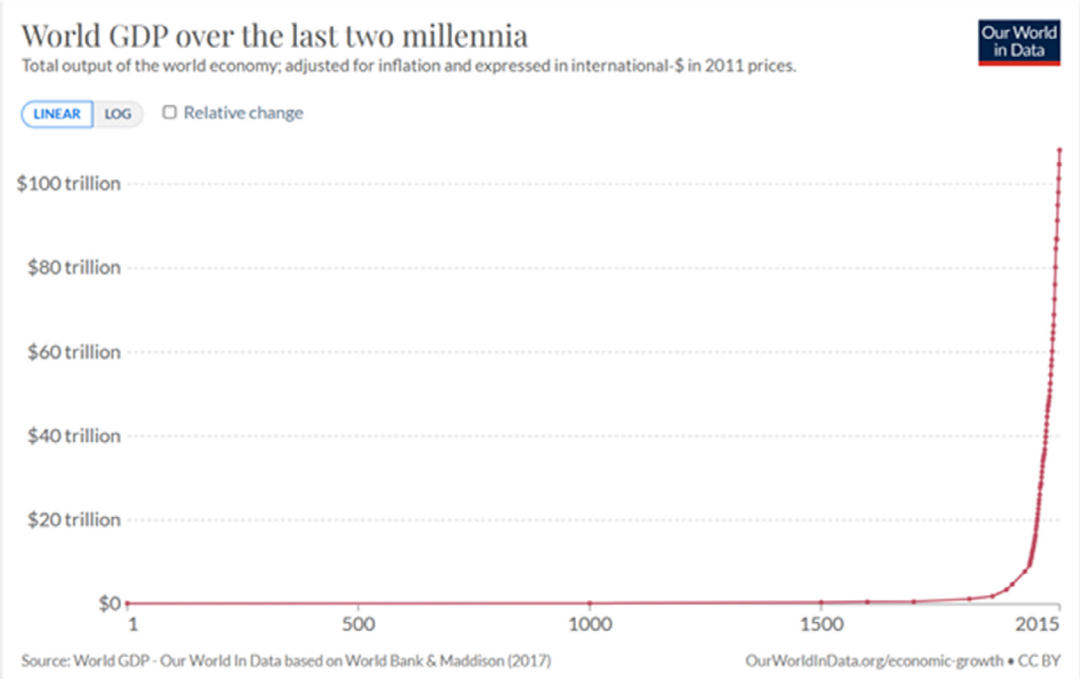
Mark has an amazing ability to riff on almost any energy-related topic. What follows is a mostly verbatim transcript (with a few minor edits) extracted from a much longer conversation, along with some additional charts and comments [in brackets] from me.

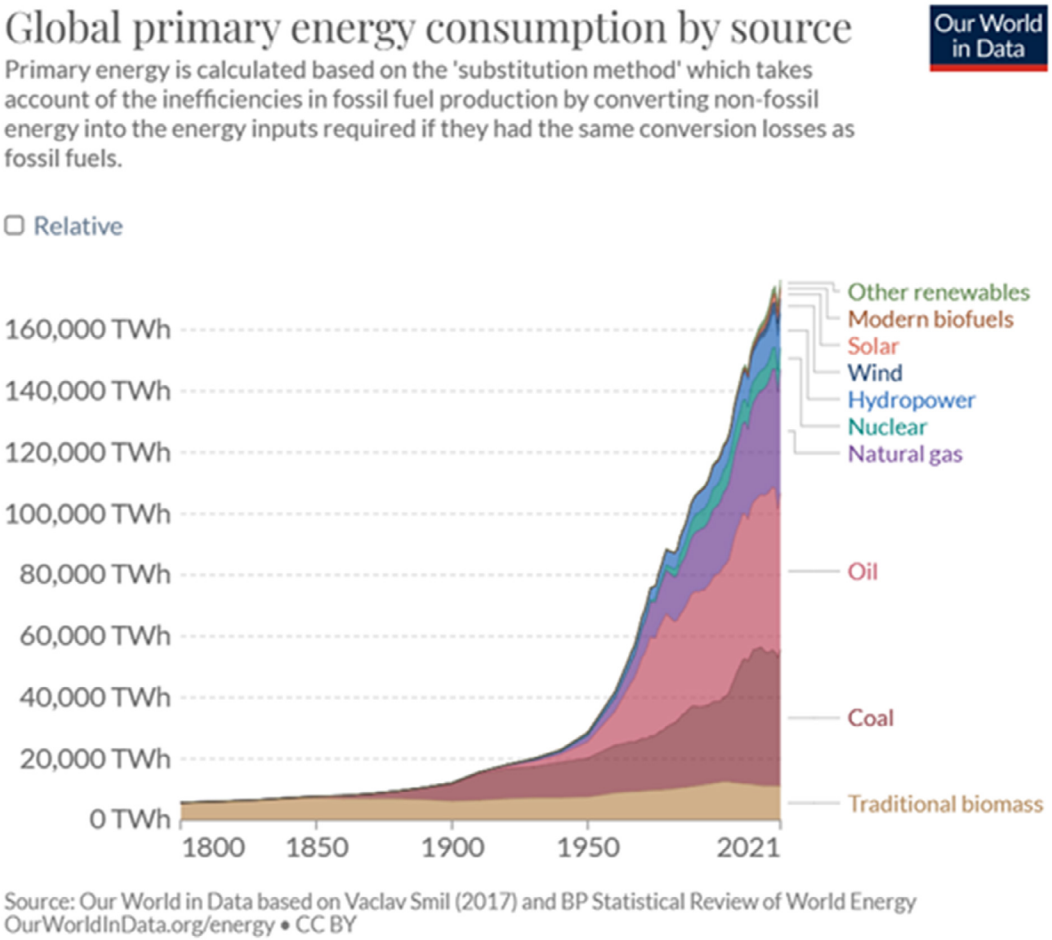
I'll share some more excerpts in future letters along with my thoughts, but I think it is important we start with energy demand. You need this background to appreciate the magnitude of our challenge. Energy is getting harder (or at least more expensive!) to find at the same time we need an ever-growing amount of it.

Unlimited Demand
by Mark Mills

There's no period of human history where economic growth, set aside population growth, isn't correlated with more energy demand. This is a one-to-one correlation. There are no wealthy nations that are low energy consumers.

[See this chart of the growth of global GDP. Then see the chart of energy consumption. It's no mystery why they look so similar.]





Source: Our World in Data

Now, in the wealthy nations, there's variability in the per capita energy use, but that's dictated more by geography than it is by behavior. In tiny countries with short distances, small buildings, and punitive taxes, the per capita energy use is lower than in the United States because we have less punitive taxes on heating and lighting and all the rest. But the correlation is one-to-one.

The important part about predicting demand is you have to bifurcate it to just two separate buckets. They're related, but different. One bucket is obvious: Population grows very predictably, give or take small variables. Even if there were no economic growth, you would get more demand.

The world has had reliable economic growth for three centuries since industrialization and the fossil fuel era. Everybody wants to be wealthier and more wealth is correlated with more energy use.

You can measure that by the OECD's “deprivation index.” They actually have an index that measures the percentage of people in different countries who don't have a toilet, a TV, a car, own a house, or rent a house—the set of the things we would consider in wealthy nations that are basic products we all take for granted.

There's a remarkably high percentage of people, poorer people, who have a high deprivation index. They're not wealthy enough to have a car or wealthy enough to own their own house or have air conditioning. So, wealth naturally brings more demand for the things that already use energy. Wealth brings more demand for the really poor countries that want to use what we have.

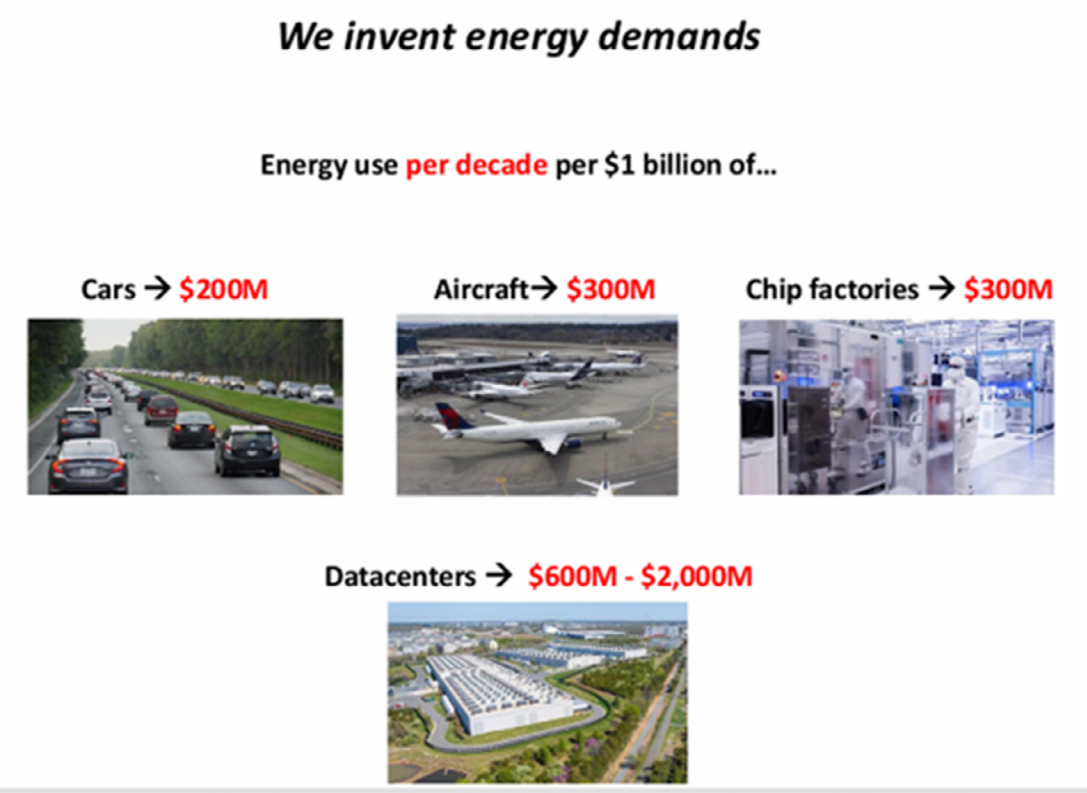
I mean, only one in 700 people in the poor part of the world have ever flown in an airplane. And in the poorest parts of the world, only one in 800 people own a car. So, you don't have to be a mathematician or an economist to know it doesn't take much growth to create incredible demands for energy to manufacture and operate cars and airplanes, even if only 10 percentage points more of those people get wealthy enough to want to fly and drive cars.

So, lots of people don't have what we have. **Roughly three billion peoples’ annual energy consumption is equal to the annual energy consumption of your refrigerator.** Their total energy consumption for all purposes over the course of a year does not exceed the energy consumption of your refrigerator. If you think about how much more energy they could use, well, you can do the math. Two-thirds of the world population could increase its energy use tenfold if they lived at close to European or US levels.

That’s not going to happen overnight. So, the variable in forecasting energy demand is then a tough one. How fast do you think economies would grow if the global growth rate were to rebound back to say 3.5% instead of 2.9% or 2.7%? That is a delta [change] of 500-hundred-plus basis points. As you know, John, that's huge.

Ten years of half-percentage-point increases in GDP growth would be a monster increase in global GDP which drags up energy demand. So, energy demand follows economic growth. Energy demand shrinks if you have a depression. It's just one-to-one.

The other factor, of course, is that we invent energy demands. The invention of the car was the invention of energy demands to make cars and drive them. The invention of the airplane was the invention of energy demands to manufacture planes and fly them. The invention of the computer was the invention of energy demands to make computers and run them.



Source: Mark Mills

The invention of pharmaceuticals was the invention of energy demand to make pharmaceuticals. Pharmaceutical energy demand is as great as semiconductor energy demand, roughly five to tenfold more energy per square foot of manufacturing space for pharmaceuticals than industry at large.

There is no limit to what we can imagine we might want to invent for entertainment, for luxury, for healthcare. Imagination translates into tools, things that we invent, services we want, entertainment we want. All those things consume energy. You can't make Amazon work without trucks. Trucks take energy to build and run. You can't make Amazon work without computers and a communications network to make one-click work.

So, if you were a curious person, you'd ask how much energy is consumed when you go online to Amazon, then search and hit Buy Now with one click. What you do when you click that button on your computer is you light up computers all over the United States. There is no other service that exists that when you make a decision, you personally cause energy consumption by machines instantaneously, all across the United States.

You light up computers and communication networks all across different disparate parts of the supply chain. And you cause a truck to be driven, a warehouse to be used, a human or a robot in that warehouse to move a good. These are all energy-consuming activities.

So, we invent demands. We'll continue to invent demands. And for all practical purposes, there's no limit to our demands. And the demand limit is not from the limited number of people. The demand limit is how much wealth there might be, which I think is unlimited because that comes from technology and productivity.

So, the demand limit is unlimited because it's not how many people are in the world. It's how smart we are in inventing new things and wanting new things, including entertainment. I keep adding entertainment because depending on how you measure it, entertainment is something like a $4 trillion global industry which didn't exist as an industry at scale a hundred years ago.

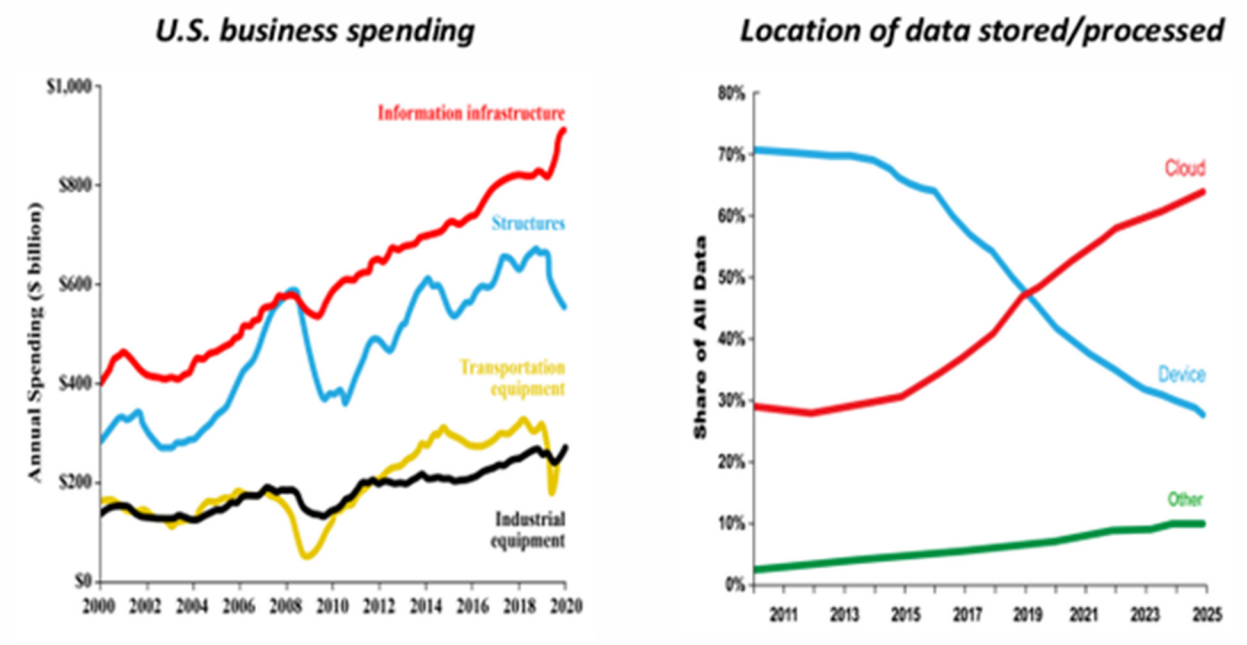
If you unbundle the architecture of the entertainment industry which includes tourism, by the way, it's a monster. In fact, sticking with tourism, which is a purely entertainment industry, people who study the aviation industry know 85% of air travel is non-business. Only 15% of air travelers are business travelers.

That means 85% of air travel is for fun, for tourism, for entertainment, for personal pleasure. It is not a business serving some business. It's a business servicing entertainment and human pleasure. It was an invention that people liked because who doesn't like to go somewhere fun? Who doesn't want to fly and see their relatives assuming you like your relatives?

So, that means over 80% of all the energy used by aviation has nothing to do with a human "need" like survival. It has to do with what humans do. They invent products and services because they like to do things. That is unlimited.

Growth drives a lot. And then you have to ask yourself, "Will we invent any new things that will be net energy consumers?" Well, the question answers itself. Sure. The easiest one of course is AI and clouds and data. But the magnitude of that infrastructure's energy appetite is so huge that only now are people beginning to wake up to it. I've been writing about it for two decades. It is a monster infrastructure. The existing cloud infrastructure is equal to Japan's worth of electricity demand.

[Think about that. “The cloud” as an industry did not exist 30 years ago, except in imaginations and on drawing boards. Today, it is the equivalent of 124 million people in a highly developed country in terms of energy consumption. And quantum computing is getting ready to explode.]



Source: Mark Mills

The cloud’s energy consumption falls into three categories. And the most important category is not the electricity used by your smartphone. That's the least of it. The networks that connect your phone to the data centers consume far more energy. And the data centers themselves do all the logic, the processing, the analysis. And of course, the networks that take the things back to the market.

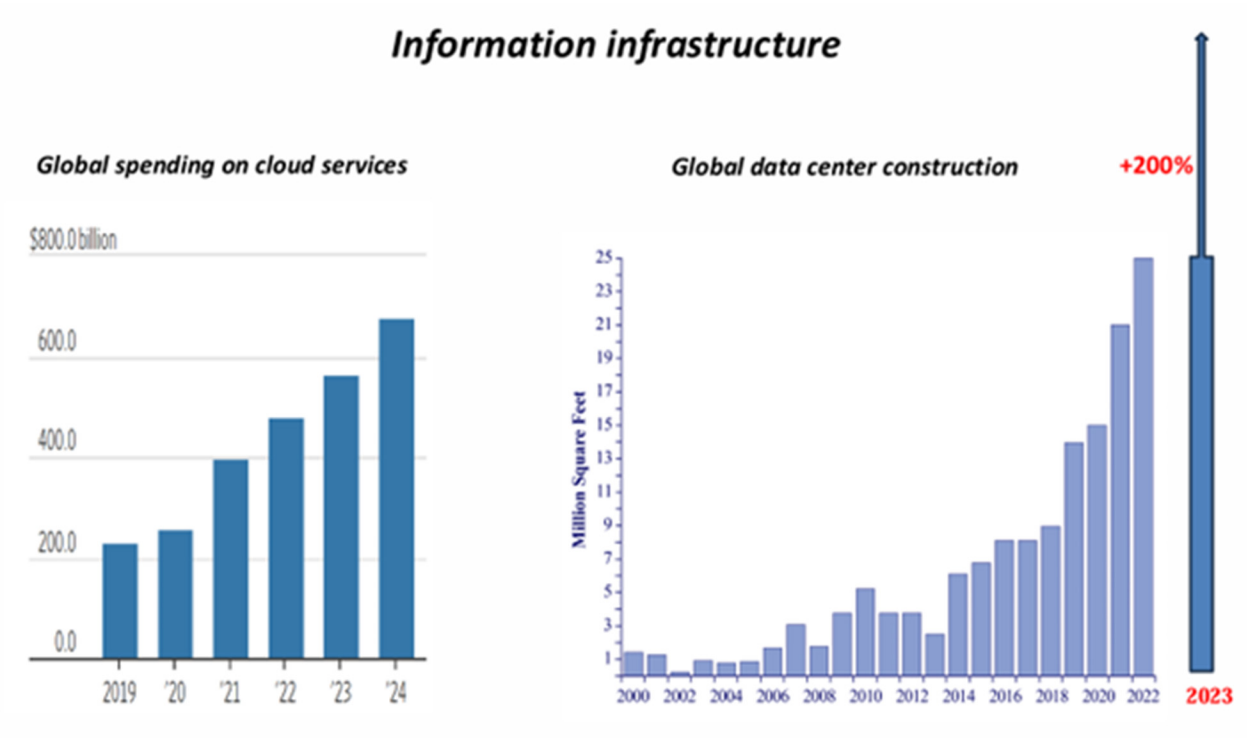
And the third part is the energy to manufacture all that stuff. Because unlike other infrastructure, the underlying infrastructure of the information economy has a refresh rate like your phone, but in the data centers and communications networks it’s about three to five years.

So, the energy used to manufacture all the semiconductors and all the communications devices, you have to amortize over the three- or four-year lifespan. It turns out they're roughly co-equal. The energy used to make all the stuff, the energy used to operate the communications networks, and the energy used at data centers are roughly all about equal. **All three of them together is a global network that uses roughly as much energy as global aviation right now.**

Now we've created/invented a new feature: artificial intelligence. Artificial intelligence is not computing, it's inference. If you're driving a car or selecting a product, you want an answer that's close, reasonable, but not exact. Inference is different than calculation. But inference is really hard, it turns out, in computing terms. So, roughly speaking, a computing task, if it becomes an inference task, the energy use goes up tenfold.

Say you do a Google search to find a document that John Mauldin wrote. If I convert that to ask a question and I'm having an AI engine answer it to find other things that John Maulden did, the energy cost of that search goes up tenfold, that one search. Everybody is already searching that way. And this is why there's this explosion of energy demand for data centers.

So, put in dollar terms, a billion dollar data center, which is becoming pretty common, consumes $600 million in electricity over 10 years. If I add AI to it, we'll consume somewhere between $1.5 billion and $2 billion of electricity over a decade. Or put differently, energy consumption over the decade will exceed the cost of building the data center which makes a data center more like a car in terms of energy consumption.



Source: Mark Mills

The energy cost to make a car is significant. It's about 20% of the energy the car uses over its lifespan. But the car uses five times more energy over its lifespan than the energy used to make the car. Computers are now becoming more like cars for very similar reasons.

Another thing AI is doing is amplifying the need for conventional computer technology. So, the inference function doesn't exist unless I have conventional computing and communications to collect data and store it and then put it into the AI engine. And when it comes out of the AI engine, it also has to be stored, manipulated, and sent to markets.

So, AI's appetite for data is enormous, but the data itself is created and handled by conventional computers. So, it's an amplifier. It's not just that it's using more power itself which it does by a factor of 10 to 100 per chip, but it produces more demand for conventional computing. So, it's a double whammy which is why we're seeing in the United States now, utility regions all over the country that were previously making forecasts for the next decade through 2030 showing demand electricity growth of maybe a few percentage points or 10%. All of the forecasts are now coming in at 50% to 100% increase in electric demand. The biggest vector for that are data centers.

Clear as Mud

John here again. While we're thinking about energy, let's talk about recent Middle East events.

Experts have been concerned for a year now the Israel-Hamas and Israel-Hezbollah conflicts would expand into a wider war, interrupting oil supply. It has already slowed down Red Sea shipping traffic. But the worst fears haven't come to pass. They still could. We don't know.

Last week brought a new development as rebel forces brought down the Russia-backed Assad regime in Syria. This seems very likely to produce other changes in the region, but what they will be is as yet unclear. My friend Renè Aninao sent a report last weekend noting how we shouldn't rule out possible *positive* changes from this.

For example, what if the Syrian regime change inspires an Iranian regime change, removing the current nuclear sanctions and letting more oil flow? That would put downward pressure on oil prices, helping reduce inflation around the globe.

Then imagine if Assad's fall helps Putin decide to leave Ukraine in exchange for the West droppings its sanctions? That should put some Russian oil and gas back on the market, further depressing oil prices. What would be the effects?

What if, despite historical precedent and my own trepidations, the new Syrian leader actually does what he recently said and allows people to pretty much live peaceably with each other? I hear you laughing in the background, and I have that same skepticism. But if he really followed through on his diplomatic approach, we could see an oil and gas pipeline from Saudi Arabia, Qatar, and the UAE going through Syria to Turkey and then Europe. That would lower the cost of transporting oil and gas and thus the price.

To be clear, I'm not *predicting* any such things. My point is that we really have no idea what the next few months or years will bring. It all depends on factors that are outside of anyone's control. We may think we know what Trump will do but he's still weeks away from office. We could be in a radically different world even before January 20.

Energy is an area where the long-term trends are actually clearer than those for the next year or two. Which is why it's important to both a) understand where the world is heading 5–10–20 years out, and b) not get too excited about the daily and weekly noise.

And a quick side note: President-elect Donald Trump has said that he wants to expedite approval of any project where investors want to spend $1 billion or more in the US. Given the need for clean energy, why not make it possible to build 20 nuclear power plants over the next five years? We are going to need that power, and it would let us reduce our dependence on coal. Reducing the regulatory barriers would be a good start.

Las Vegas, NYC, Austin, Newport Beach, and Italian Cuisine

I am in Vegas Saturday at Longevity Fest 2024. I am sure I will learn a lot of new things and hopefully get a better idea where things are headed and when. Part of next week's letter will be on what I learn. Sunday afternoon I leave for NYC and a solid schedule of meetings and writing. Then Austin in early January and later that month in Newport Beach.

Just the way it works out, I will be eating Italian cuisine for five nights when I am not eating airline food. I see a lot of salads for lunch and hopefully gym time in NYC.

Tuesday night I will be sitting down with old friends Peter Boockvar, Barry Habib, Danielle DiMartino Booth, Steve Blumenthal, and Ben Hunt, all of whom are known to readers, plus a few others. We will of course talk markets and the general world, but in particular we will tell Art Cashin stories. I wrote about Art last week. Below is a picture Barry sent me of him, Peter and I with Art a few years ago.

And with that let me hit the send button and wish you a great week. I come home Thursday after dinner with David Bahnsen, Renè Aninao, and others (more Italian!) for what will be very thought-provoking conversations. Thursday night is the annual Christmas Gala here in the Dorado Beach neighborhood with 1,800 of my neighbors and friends. What a night! I am sure I will be ready for bed! And don't forget to follow me on X!

Your thinking about visiting Italy next year analyst,

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