

Transcript of “Energy Is the Economy” Panel Discussion

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Chris Martenson, Moderator

Panelists: Art Berman, Richard Heinberg, Gail Tverberg

Chris Martenson: Hello everyone. I'm Chris Martenson and I want to welcome you to this energy panel. We've got three incredible guests to join me here today. We've got Art Berman. We've got Richard Heinberg. We've got Gail Tverberg. They're going to be discussing what is really a very, very important concept here, which is that *energy is the economy*. We've just had this massive blow to energy, production, and consumption. What's the impact of that on the economy and, more importantly, what steps should you be considering to take, given the various problems and predicaments that this presents? This is a really important topic.

I'm very excited to have this panel with us here today. Let's turn now to that panel. Welcome everyone to this panel. It is so great to have you. I'd love to introduce our panel one by one here. I'm going to start with Gail Tverberg. Gail, as many of you know, is the author of the blog, ourfiniteworld.com, which is where her blog posts have been published since 2010. So, happy 10-year anniversary on that, Gail! She's a researcher focusing on figuring out how energy limits in the economy are really interconnected and what this means for our future. Her background is as a casualty actuary, working in insurance forecasting. All about numbers and risk and assessing all of that. She is a fellow of the Casualty Actuarial Society, also a member of the American Academy of Actuaries. Hey, welcome Gail, and thanks so much for being part of this panel today. Really appreciate it.

Gail Tverberg: Thank you for inviting me.

Chris: My pleasure. Next up, we have Art Berman. Art is a petroleum geologist with 42 years of oil and gas industry experience. Is that right Art, 42 years?

Art Berman: Sadly, yes.

Chris: 42, a good number though. He is an expert on US shale plays and is currently consulting for several E&P companies in the capital groups in the energy sector, E&P is exploration and production. These are oil companies out there doing the work of getting oil out of the ground. During the past year, he's given more than 25 keynote addresses for energy conferences, boards of directors, and professional societies. He's published more than 100 articles on oil and gas plays and trends and been interviewed on CBS, CNBC, CNN, VNN, Bloomberg, Platts, Financial Times, Wall Street Journal, and on and on.

Most importantly though, he's been a frequent guest on Peak Prosperity and is one of my favorite energy experts that we talk with pretty regularly. He's also worked for Amoco now, BP for 20 years, another 22 years as a consulting geologist. That's where we get our 42. Welcome, Art. Thanks so much for being part of this panel today.

Art: Thanks for including me, Chris.

Chris: Last, but certainly not least, we have Richard Heinberg with us. He's a leading-edge journalist. He's an educator. He's written extensively on energy economic and ecological issues, especially including oil depletion, author of 13 books including-- They're all good. They're great. The one that's titled *The Party's Over*, when did that come out, Richard, that was like 2003 or something?

Richard Heinberg: 2003.

Chris: Yes. I got to tell you that one was very, very instrumental in shaping my own view of the world. It really caught my attention big time. Richard, Senior Fellow at the Post Carbon Institute, regarded as one of the world's foremost advocates for a shift away from our current reliance on fossil fuels. Numerous articles and essays that appeared in places like Nature, Wall Street Journal, Reuters, stuff like that. He also appeared in many film and television documentaries, including *Leonardo DiCaprio's, 11th-hour*. Recipient also of the M. King Hubbard award for excellence in energy education.

In 2012 was appointed to his majesty, the King of Bhutan's international expert working group for the new development paradigm initiative. Hey, welcome Richard, and thanks so much for being part of this today.

Richard: Thank you, Chris. Good to be with you and good also to be with Art and Gail.

Chris: Excellent. Richard, first question to you because I think this is where it all starts and begins is what is net energy and why is that important to our economy, and what many people consider their way of life?

Richard: Well, it takes energy to get energy. For example, if a lion wants to get the food energy of a gazelle, it has to use some energy chasing down the gazelle. The lion depends on getting more food energy from the gazelle once it's caught it, than it expended in all of that running. This is really important throughout all of nature, but of course, we are particularly interested in the human world and net energy or energy returned on energy invested is just as important for us. When we live by hunting and gathering some anthropologists estimate that we had about a 10 to one energy profit ratio, which was actually pretty good.

That's why hunters and gatherers can spend so much time singing and dancing and telling stories and so on. Then, when we adopted agriculture, actually our energy profit ratio went down on average. Obviously, there were good years and bad years, but farming is a much harder way of making a living. Why did we adopt agriculture? Well, there were a whole slew of reasons, we could produce more food in a given area. It was often a more reliable source of food, energy, and the stuff we grew, which was mostly grains could be stored and taxed, and so on.

It certainly served its function and once we started it, our population grew to take advantage of all of this new caloric surplus, so we couldn't go back, but our energy profit ratio went down to something like three to one on average again in agrarian societies. Then when we discovered

fossil fuels, suddenly here was the energy that had been captured by algae and other little critters millions of years ago and gathered and compressed and transformed by natural processes that we didn't have to invest in at all. This was done for us. All we had to do is dig this stuff up out of the ground or pump it out of the ground.

We had fuels that were energy-dense, relatively easy to access, that were storable, portable. In many ways, the best energy sources you could imagine, at least at that time; and these over the course of the 19th and 20th centuries have given us an energy profit ratio completely unheard of in human history. Something like 50 to one on occasion, probably more than that, even a hundred to one. These things are difficult to measure exactly, but it's absolutely clear we had an enormous amount of surplus energy and that surplus energy enabled us to do stuff that we couldn't even imagine doing before: flying to the moon, industrial agriculture, the creation of the middle-class, consumerism. All of that is a result of having cheap, abundant energy that was easy to get.

Chris: "Cheap" there is a euphemism for this net energy that we're talking about. If I followed you right because we have so much net energy available to us, we have this huge population now, because we're living on that, I'm walking oil. I know that I'm a walking expression of oil production.

Gail: I'd like to add a little bit to this, too, though. I'd like to add something, too. When we talk about net energy, there is the amount that is net. It's the amount that we have available to use. We can look at it from a different perspective too. We have however many billion people and each of us have a net energy requirement for our calories, we'll say, of 2000 calories a day. So, there's that net energy requirement. That's the net part that you get back that you're using on a daily basis. Besides the net energy that we use for eating, we also have the net energy we use for cooking our food.

We also have the net energy we use for pumping the water out of the ground. Over time, we need to pump it from deeper and deeper, and we need to transport it from farther away, and we have to do more treatment of it. The amount of net energy we need per person tends to go up over time.

There's a way of looking at what the total net energy requirement is of a given population, as well as looking at the issue as a ratio of something, to something. It's a matter of looking at how much net energy do you actually collect from all of this? If you're not collecting very much net energy, even if it's energy from some good source, if it's not enough to give enough calories for people, then you probably have a problem, at least if you expect to keep the same population.

Richard: There's something else we should know, which is that fossil fuels have given us a very good energy profit ratio historically, but that energy profit ratio is declining and destined to decline further all the way to zero because these are non-renewable resources, and we've extracted them using the low-hanging fruit principle. We went after the highest quality oil, coal, and natural gas first and saved the hard to get stuff for later, and increasingly it's later. So, this is an argument for thinking ahead.

Chris: Well, let's go there though. Gail next, because I know you have an answer to this, but Richard, while you're on it, what happens when that net energy has declined and goes to zero? What happens to our way of life?

Richard: Well, our way of life becomes poorer, basically. Think of it this way. Consumption becomes less affordable because making cheap consumer products involves energy, and if the energy is harder to get, then production becomes more expensive. Consumption becomes less affordable. Production becomes less profitable. We see this in the oil industry right now, as I'm sure Art can tell us in much more detail, the oil industry is becoming less profitable all the time. The third thing that happens is that of inequality. Inequality becomes less tolerable because complex agrarian societies operate by means of a wealth pump because of taxation and interest. They're always pumping wealth to the top of the social pyramid.

As long as the pyramid is growing, as our global economy has been for the last century, generally on average, not always, but on average then even though some people are getting super-rich, Bill Gates and all the 1%, everybody else can look forward to, because of economic growth, having at least a bigger slice than they did previously, but once net energy starts declining, then it becomes a much more difficult to make that argument for people at the bottom of the economic pyramid. Their slice of the pie is declining in real terms, and we're starting to see this in the US and in many other countries, Inequality is growing and it's becoming less tolerable. That eats away at the viability of political systems.

Gail: I think it's part of the situation between World War I, World War II, and the depression that was a period of low net energy. There was a period of low energy per capita, and that was a period of high wage disparity. It was a period of what looked like gluts of food that couldn't be sold to anybody because there were too many people who didn't have high enough wages to purchase it, but that was a period that is similar to the kind of situation we seem to be headed into now.

Chris: Well, Gail keep going because I know you wrote in the blog recently about what would happen to the world population if we suddenly decided we were going to get really serious about decarbonizing because of climate change, we said, we're going to lose 80% of the fossil fuel use that we're using. We got to get that to zero. What happens?

Gail: Well, I suspect that we would lose quite a bit of the population. The place that you start losing it first is in the poor countries. Suppose you start shutting down your economy because of COVID. You think, oh, it doesn't have much of an effect here. Oh, well, yes, but it does have an effect on all of the poor countries. The ones that are most vulnerable are the people who are earning the lowest wages right now and are closest to starvation to begin with.

They find their wages are cut because we're no longer buying the nice fancy clothes that they used to make, or because the price of the commodities that they're selling is now too low, and they're being laid off from mines and they don't have the big wealthy economies that are coming in to protect them. So, what happens is these people in these countries become vulnerable to other kinds of diseases besides COVID, and they start dying at a much more rapid

rate than they would have in the past. It's especially the people in the poor countries that die off first, but it gradually spreads elsewhere.

Chris: Yes. That “outside in” concept, from the weakest to the strongest part. It's a very well understood concept out in nature, but also in finance. So, obviously, where we are in this energy story is really important. I would like to get a handle on where we really are in this. Art, you really shocked me the other day in an Off the Cuff that we did for our subscribers at Peak Prosperity, and you talked about a piece that you wrote recently, were you opined that, or calculated, that there's a good chance that the United States will go from a high of 13 million barrels per day of production, largely on the back of 8 million barrels or more of shale oil production, down to maybe five or six by June of 2021. Where are we in this oil story for the United States and then, and then globally, what do you see here?

Art: For those of us who follow the way we measure this; I mean, basically, you have to drill wells to produce oil. That seems fairly basic, but what has not happened over the last year now is that the number of wells added has fallen. In fact, the total number of wells drilling is roughly a quarter of what it was a year ago. You can look at reports from the government from the department of energy and say, well, yes, production is down from 13 million to 11 million, but it's going to stabilize. That's what we're told. That's not great, but it's not too bad. Well, the problem is that the reason we've stabilized is because we shut in so many wells when the economy was closed and there was no storage left.

Now those wells have been reopened. That's not going to last very much longer. What I'm telling you is that we're drilling enough wells to support about a quarter or a third of the oil production we had before all of this. Well, long before COVID, but certainly, if you want to use that as a benchmark fine. The arithmetic is fairly simple. There will come a time and I don't know if it's June or July of 21, but it's in that range when the production is going to go down to a third of what it was before. It's inevitable that that will happen. What does that mean—which is your question.

Well, what it means for the United States is that we're no longer this energy superpower that we've been beating our chests so loudly about for 15 years, and that's fine. We're supposedly the swing producer of the world, now, some people say, well, the swing producer couldn't survive one price downturn. Kind of a crummy swing producer when you get down to that, but more importantly, what that means is we're not going to run out of oil, it just means we're going to have to import it from somewhere else, which means we're going to have to pay more, which means we're going to have to send more of our money outside the country instead of keeping it in.

It has implications for the economy, for our personal well-being economically, and for the United States geopolitical power. So, what else is there other than human happiness and a few other things, which I think are pretty important, but yes, we're about to lose everything that we have prided ourselves, I include ourselves, for the last 15 years. Easy come easy go.

Chris: Yes. Easy come easy go. Thanks for that. Gail, what's your response to that because you've written extensively about how it's not just that we'll run out of oil or something like that, there's this dance between what consumers can afford and what oil companies need in terms of price, in order to be able to operate. I've called that a ceiling and a floor, you've called it an appetite. What's your views on this? Help people understand what Art's talking about if you could, from your direction.

Gail: Well, I was just recently looking back to see when was it that Steve Kopits was telling us that the oil producers were saying that the price of oil was not high enough. On an inflation-adjusted basis, that was back when prices were \$120 a barrel. That was when the oil prices were not high enough. They were telling us that in 2012.

It was only four years earlier, in 2008, when the oil prices went up to \$150 (or \$155 on an inflation-adjusted basis for an average month). This was when the prices were too high for the consumer. And the oil prices were too low for the producer *already* at \$120 a barrel. We were seeing things out from OPEC at that point (or a little bit after) saying that their needed oil prices were up about \$100 to \$120 a barrel, and it's all because of the *taxes* they need besides all of the other things.

What tends to happen, though, is because these amounts are so terribly high, is the net energy available to society goes down. People become less able to afford the output of the economy, and the price of oil starts dropping. What's happening, partly, is globalization. These people in India and in China, and in Africa, can't buy the cars that we're producing, for example, or not nearly as many of them per capita. As the energy production goes down, the economy tends to contract.

You are right that I was saying that consumption contracts partly because of the affordability issue. When I first thought about it, I hadn't realized that governments could just shut down economies and say, "You're not going to be able to fly overseas anymore." Well, that adds a whole new dimension, and if you can't meet in groups, then you don't need your fancy clothes anymore.

All of these different types of employment get cut back, and so all of these people become much poorer, so they're buying less. That tends to hold the prices down. You don't have a problem with the spiking prices, you have a problem that looks much more like the depression in the time of World War I and World War II where everybody is fighting with each other. The prices aren't terribly high, but everybody's really unhappy, and you have some really weird leaders coming into power.

Chris: Yes, weird leaders. Well, these are weird times for sure. Richard, we saw both from a top-down lockdown standpoint and we also saw from a bottoms-up behavior change standpoint which Gail was speaking to on both of those that COVID cratered oil demand. The current narrative says that 20% decline in oil and stocks are near all-time highs and powering up strongly again today as we're recording this. The narrative is this is all good. Was it true, Richard? Did the world just not need that 20% of oil or do you think that maybe there is some

mortal wounding going on that has been masked and there's a dead man walking aspect in part of this?

Richard: Well, yes, I think it's more of the latter. The energy of the economy is declining. Sure, since the early part of the lockdown there's been some recovery but now, we're starting to see some of the long-term casualties. Small businesses, restaurants, movie theaters that were kept alive by government bailouts early on now are just closing up shop for good. Once they're gone it's going to be very difficult to bring them back. Really the only reason this wasn't just a complete economic bloodbath was the fact that there was so much government and Central Bank intervention.

From the Central Bank standpoint, of course, the intervention took the form of ultra-low interest rates and pumping a lot more money into the financial sector itself; not Main Street but Wall Street, and that's why Dow Jones and the other stock indices have been riding high. It's because the people at the top of the economic pyramid, who are in a position to invest and make bets, their bets are covered in effect by the Federal Reserve; not so much for the rest of us.

Chris: Well, I'm trying to figure this part out, Richard because the story, you've painted before, which I completely concur with, is that the economic pie expands or contracts, according to Gail and to everybody here, is that the pie expands when we use more energy. If the net energy is no longer there to do that, you can fake it for a little while by throwing more money at it and it appears good, but as you just mentioned, as a consequence of the COVID collapsing the oil demand, a lot of emergency things happened. Trillions of dollars of stimulus and all of that.

I'm going to harken back to the original comment you made in your opening comment, which was that all that seems to have happened is steepen the wealth gap, the pyramid. The haves and the have nots. It's really shoveling the few remaining resources to the haves at the expense of the have-nots. That brings to mind Plutarch's old adage that, "The oldest and most fatal ailment of all republics is a gap between the rich and the poor." Is this just humanity making a classic blunder, but this time writ large?

Richard: Well, what we're talking about is, is mostly US-centric. All four of us live in the US and this is what's been going on in our country. Other countries have handled the pandemic and the bailouts and so on, differently, and in some cases much more successfully. I think it is correct to say that for this country, we are seeing this divergence between the haves and have nots, and it's eating away at the viability of our political system. Unless we change direction, I think we're in for, no matter who wins the elections, this cycle (President, Senate, and all the rest), no matter who wins, we're in for more and more political dysfunction and violence.

Gail: I think I would explain a little bit differently. The economy is a dissipative structure, just like each of us humans are dissipative structures. There are a lot of dissipative structures. They are things that grow, and they can continue to grow for a while, but they can't continue to grow or operate forever.

I think of the pandemic as being like somebody taking an older patient and saying, "Well, we're going to have you stay in bed for a while, and you're not going to need the 2000 calories today because you're staying in bed all day, and so you can get along on 1800 calories or 1700 calories a day. Look, we don't need all of this energy here."

Now, it's a different kind of a situation. As the physics professor, Francois Roddier, has said, the way it works is that the energy flow tends to rise to the top. It's like boiling water. It rises to the top and it freezes out those at the bottom when there's these disturbances (not enough to go around). This is just the physics of the situation. As the economy moves to more complexity, then you need hierarchical organizations. These hierarchical organizations have some high paid people, and those high paid people are also owners of shares of stock, so those are the very rich people, but the bottom people get practically nothing.

And, it's a *world* wage disparity problem. It's not a US wage disparity problem; it's the fact that our things are being made in these poor countries today. It's not really, "Well the US does this, this, and this, and this is not as good as that situation." It's a world situation and it's a physics situation.

Chris: All right, thank you for that, Art. Peak Oil. Is that a real thing?

Art: It depends on what you mean by Peak Oil. My definition of Peak Oil is the way that it was originally defined by Campbell and Laherrère which means the end of cheap oil, and a lot of other people took Hubbard literally which I think he would object to and said, "Well when will it peak?" To me, really doesn't matter. Peak price, Gail has described pretty nicely, the price peaked in real 2020 dollars in 2008, and it peaked again at a lower level in, whenever it was Gail 2012 or 2013, and it keeps peeking, if you will, successively lower peaks. The concept is impeccable. You said it earlier, Chris, that it's a finite resource. We're not making any more of it, or we're not making it any more of it fast enough to matter.

The issue, and I think Gail and Richard have both touched on this nicely, it's a question of what's the affordability of being able to consume it. I want to make what I think is a really critical point here, and that is that, we're talking about economies. We're talking about COVID, and we're talking about money and all of that, and it's my view that the only thing that COVID did, was to accelerate problems in the global economy that had been building for something like 30, 40, 50 years. In other words, and just to be simplistic about it, we're talking about debt.

Back to Richard's metaphor, you put grain in the barn and you can you can store it and you can use it to eat later, but what actually happened was, that did happen of course, but people who had extra grain, or extra energy in the barn could use it to pay somebody to do caloric energy for them. Eventually, that was cumbersome to be trading bushels of wheat, or millet, or whatever, and so money was invented. Money was just a convenient way of exchanging energy, is all it was and that's all it is today. Our mutual friend and colleague Nate Hagens has said it very clearly, money is a claim on energy, and debt is a lien on future energy.

Peak oil came into people's consciousness largely because we ran out of the low hanging fruit that Richard mentioned, the easy to get, inexpensive energy, long before Campbell and Laherrère's (whenever it was in the 1990s) article. In the United States the way we solved that problem was debt. The great hero of the American conservatives was Ronald Reagan, and what Ronald Reagan and his fed Chairman, Paul Volcker, did was they raised interest rates to 18.5%. Which had the effect, I don't know if it was planned or not, of making the US treasury bond, the only asset in the world that anybody with half a brain would want to own.

Why would you risk any other investment when you can get 18% on the United States? Money just flowed into the United States like crazy, and Reagan and every successive president used that to goose the economy. Basically, to borrow against future energy by bringing it into the present, and that felt like progress. That felt like prosperity, and if it felt like it, I guess it was, but all of that began to unravel in 2001, and then in a big way, in 2008, and we solved that problem with more debt. Those of us on this panel know this, and I've been saying this for years, what's happening right now was going to happen at some time in the future.

We were all hoping, maybe we'd all be dead by then or something. We're not so young, but I thought maybe another 10 years or so, if we're lucky. COVID, it just pulled everything into the present, and so the idea in energy and oil that, "Oh, well, as soon as things get back to normal. As soon as we find a vaccine blah blah blah." No, I don't think so. We find a vaccine, maybe COVID goes away. What about the 30 million unemployed people? What about all the businesses that we were just talking about that aren't coming back. These are victims of the end of a debt cycle that's been going on for 50 years.

I'm not pessimistic or grim, this is just the way it is. I think it'd be great if we can get rid of COVID. I don't think that's going to happen too soon, but let's just say it does, we're still in deep trouble because of COVID, because it accelerated everything that was going on. To finish, we got to stop thinking about the economy as something different from energy. The two are exactly the same, and the fact that energy (all energy, not just oil), all energy is now close to 2% of the market capitalization of the S&P 500, tells you that our sense of what is important is hugely distorted.

Try to convince Richard's lion that having enough energy to catch the cheetah, so you can live for another three weeks, is only worth 2% of your energy for investment. The lion would tell you first, "I don't know what you're just talking about, but get out of here man, you're nuts. I'm going to get that cheetah." So, we have basically told ourselves, we're just fine without energy.

Chris: Yes, so let's connect those dots because to me that's the crux of this whole thing, energy, and the economy. Richard, you've talked about it a lot, written about it a lot. On Twitter today, I don't know why I get in Twitter battles, it's dumb, but I can't help it though.

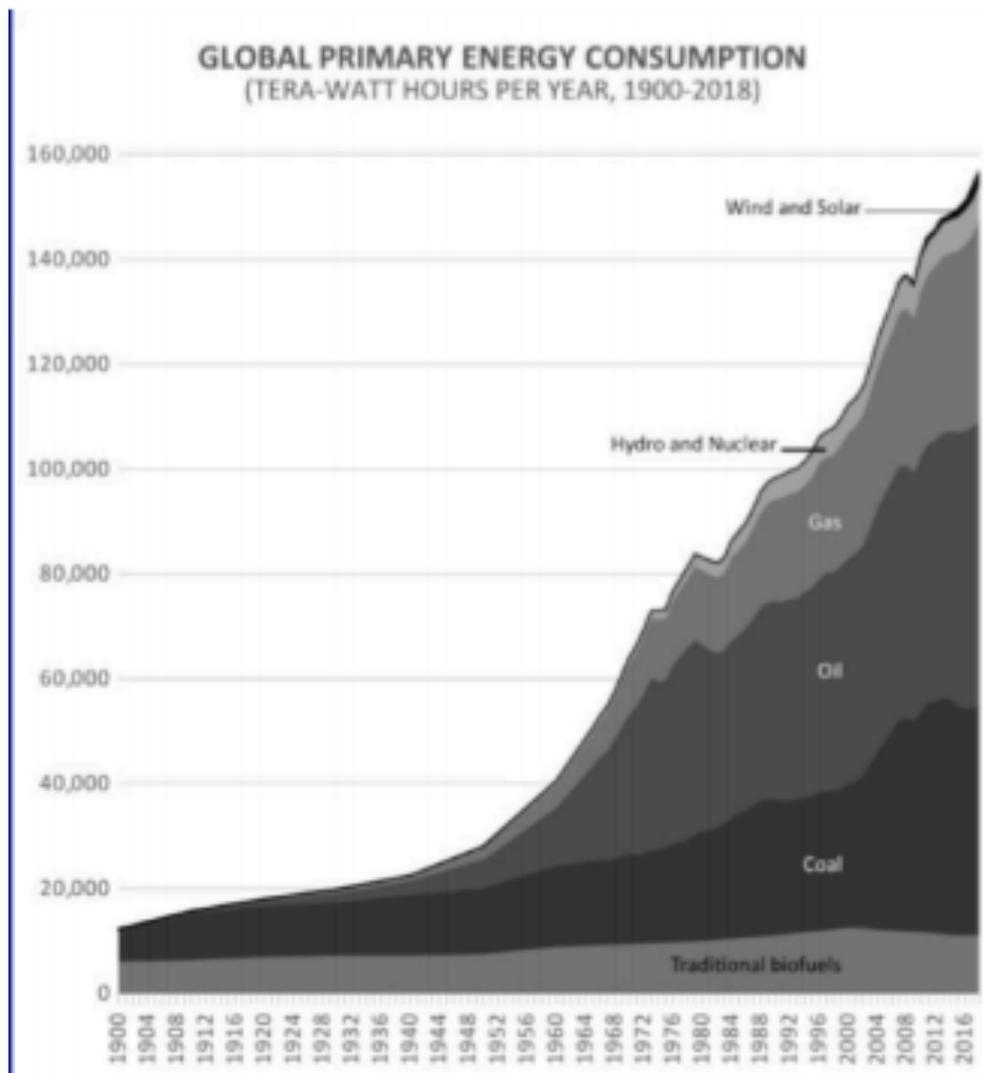
Richard: [chuckles] Me, too.

Chris: Today's battle, one recently when people are viewing this, I put out this thing where Austria hundred year bonds this economist was saying, "Look at this, they're selling at a yield of

.53%, so I just said that brings us to the year 2120, and so I said, "By the way, people out there, all oil gas and coal is so far in the rearview mirror by 2120. Who thinks .53% is adequate return, given that?" You wouldn't believe the battles I got into. All these people saying, "You don't understand Chris, we're going to electrify cars. We're going to this renewable thing."

I'm going to have Jason pull this up, I'm sure you're all familiar with this, but I'm going to have this chart get pulled up.

It just shows the contribution of biofuels on the bottom, then coal, then oil, then gas, then nuclear, and that little thing, little smear on the top. That's all solar and wind's contribution is at this point to world energy. When I look at that chart, I just see that renewables are an almost ignorable smear. I get that this is going to ruffle some feathers to people who have a lot of hopes pinned on that, but Richard, what are the chances that we're going to make this smooth transition from that big ever-rising mountain of fossil fuels, underneath all of that solar and wind, in order to make those Austrian hundred-year .5% funds be worth something?



Richard: The chances that will make a smooth transition I think are zero. I think we can hope for a survivable transition, and if we actually started planning and made some significant sacrifices that's doable. It was a lot more doable if we'd started the transition 20 or 40 years ago, but every year that we wait makes it much, much less likely. I worked with David Fridley of the Energy Analysis Team at Lawrence Berkeley National Lab for a year to analyze the prospects for renewable energy. We wrote this up as a book called, *Our Renewable Future*, which you can find for free at ourrenewablefuture.org on the web.

Anyway, our conclusion was that there are some big roadblocks, one of which is electrification. Solar and wind produce electricity. We only use 20% of our energy in the form of electricity, so that other 80% we have to deal with somehow. We either have to electrify it by way of electric cars and all that sort of thing, or we have to produce synthetic fuels using electricity, and maybe carbon captured from the air to make, I don't know, methanol or something. That would be handy because we could store it and it would provide... and it could be more practical for long-term storage than battery storage of electricity and so on.

The problem is scale. There's a technical solution to all of these problems, but trying to scale it up is incredibly expensive, requires enormous resources, and would take decades and decades if it were even possible. When we looked at the overall picture, our conclusion was the best thing we could do, especially in big industrial societies like the US, is find some way to scale energy usage back by some huge percentage (half, 75%) over time. Obviously, we can't do it overnight, and then provide as much of that as possible by renewable means. Even though there are these big problems with renewables, I still favor developing them as much as possible for a couple of reasons.

First, what we use electricity for right now is some important things like keeping the lights on and data processing and storage. Basically, we've taken all of human knowledge and put it in bits and bytes. If the grid goes down right now, civilization just goes away completely, and billions of people die very, very soon. Keeping the lights on is really, really important, and we need to produce electricity for that purpose.

Then the second thing, there are lots of other amenities and necessities that could be provided by small amounts of renewable electricity if we adapted our demand to the nature of the supply. Right now, our demand for energy is adapted to our major sources, which are fossil fuels. Our demand is completely not adapted (sorry for the poor sentence construction) to the nature of these other energy sources. We have to adapt the ways we use energy, the amount of energy that we use, and this, it's going to require leadership, it's going to require sacrifice and it's going to require time, and nobody at the top is telling us these things, unfortunately.

Gail: The thing I was going to point out, though, is that the major thing that is wrong with, especially solar, (but the wind, as well) is that our energy needs are heavily concentrated in the winter, when it's cold out. This happens because the population needs heat and, of course, they always need to cook their foods, but they need heat. Solar energy is at its worst in wintertime.

So, our big problem is storing energy from summer to winter, or somehow or other adapting ourselves to being able to live in freezing temperatures. With below-freezing temperatures, you don't have indoor plumbing, and there are all kinds of other things that have to change.

It's a different situation, and this idea of adapting ourselves to when renewable energy is available, it's very difficult one. We can't hibernate during the winter, like bears. We have to eat year round.

Chis: (Chuckles) All right, well said. John Michael Greer helped frame a lot of things in my mind, but one is the difference between problems and predicaments, where problems have solutions, but predicaments have outcomes. As we've talked about it here, it just sounds like we're facing an energy predicament because of the scale time, the costs, all of those things. Maybe there's a leadership vacuum, I don't know. It could be one and we'll see. As we look into that for me, each of you and we'll start with you Art for people who are listening to this and they get it, they see this energy future, they see this dwindling. They're wondering how to position themselves. What's your advice for them?

Art: Learn to live with less. We understood that some of us understood that reasonably clearly in the 1970s. Now, we were hearing from the Club of Rome. We were hearing from Paul Ehrlich. We were hearing from Rachel Carson. A lot of people were saying, "Hey, we can't keep doing this." Of course, we ignored them and with every seeming temporary victory, we said, well, see, they were wrong. They were, they were pessimists. And of course, all four of us have been accused of similar, if not worse, being Malthusian pessimists. I guess the advice that I would give is, first of all, never forget that *the economy is energy* and if you think it's anything else, correct yourself, just like when your temper gets the better of you, you say, "Wait a minute, I shouldn't be that way."

The other thing is, is that *technology does not create energy*, and I get in Twitter battles, just like you do Chris, and people have this almost divine sense that technology is going to solve all of our problems.

Well, you know, I can't speak to all technology, but I can tell you definitively with energy, all technology does is *figure out how to convert energy into work*. You can do whatever in the world you want to with technology, and you ain't going to get more energy out of it. Get that out of your mind! Technology can help, but not if human behavior doesn't change, and human behavior isn't changing as far as I can tell until there's a trauma. The other thing I want to just throw in there is, I mean, the whole reason we've got seven and a half billion people on the planet is because of petroleum.

That if we didn't have a way of getting free nitrogen from the air and producing commercial fertilizer, the planet probably wouldn't have more than two or 3 billion people on it, which was about the population in 1920, and if we only had two or three billion people, we wouldn't be running out of stuff. We wouldn't be polluting the atmosphere and causing climate change. We would have other problems, don't get me wrong. My advice, which I try to internalize myself, is "You can't change people who have belief in technology or belief in human ingenuity."

I admire all of those things just as much as the average person, but if you don't get that, that the energy, that energy is the economy and technology is not a solution, then you're going to be perpetually disappointed, and then you're going to be unhappy. What I try to do is say, well, I'm not going to be able to change the world, except by giving information to those who find it useful. I need to learn to be happy with what I got. If you're looking for investment advice, I don't do that, I'll refer you back to Chris, but probably oil companies are not the worst investment in the world, because once we get over this magical thinking about renewable energy being a clean transition, people are going to really come scrambling back to fossil energy because it's going to be affordable.

I'll just leave it there. I'm not making any investment suggestions, but people do eventually come around, and they will. For the sake of their own survival, they will figure out that we need productive sources of energy. Hopefully, that doesn't come to the exclusion of renewable energy.

Chris: Well, thank you for that and well said. If anybody needs a primer on the role of how energy is actually created and its vital role, come help me stack firewood sometime. You'll learn. Gail the same question, what advice do you have for our listeners here today?

Gail: Well, I guess I'd give fairly different advice from what most people do. I say, look at all the advantages you have now. We're at a peak period in history. We've got more now than we've ever had before, we've got lots of green stuff growing outside, too. We've got our families, we've got everything that we've got going on. Some of us have money in our bank accounts. We need to take advantage of every opportunity we have to be with our families, to go on trips, to do whatever.

This whole COVID thing is interesting. We had a flu epidemic in 1957, 58, which killed about the same percentage of the population as COVID does, and it was never mentioned to people at all. It was put in the back pages of newspapers. Leaders said, "Stay at home, take aspirin if you are sick." They told hospitals, "Just close the ward, if you have too many nurses and doctors out sick. You don't say anything about it. It'll pass, and we'll just go on with life.

Now, with COVID, the outcome is different. The fact that the economy was in such bad shape, everywhere leaders felt like they could close down the economy. Leaders felt, "We can stop all of the protests. We were having trouble because our factories were not operating full-time before; we can kind of disguise that if we close our economies down." All of this closing down fit in because the economy was doing so poorly. It's like an old person being escorted to bed and saying, "You'll feel better if you just stay in bed. Don't get any more exercise. Don't worry about anything."

Our oil prices are *too low*. *We need more demand*; we need more cars driving down the road to keep the price up if we want to keep the production going. We need more people using more natural gas, we need people using coal, we need whatever. In fact, one of the big functions of making the solar panels is to use coal and to bring its demand up.

I think we need to strengthen our ties with our families. If we've got money in the bank, we can give it away knowing that probably the money is not going to be worth the same thing in the future; we won't be able to buy these things. We can go on trips if we can to go visit people, or we can least call them on the phone. We should take advantage of whatever opportunities we have right now.

Chris: Thank you so much for that. Spend time with your family. Use your money while it still has value. I like that one a lot. Richard, you have the last word here. Same question for people who are listening. What's your advice? What do you tell people these days?

Richard: Well, whether your concern is climate change, or peak oil, or economic collapse, don't assume somebody else is going to fix it for you. I think one of the failures of the big environmental organizations over the last 20 years has been their tendency to focus on climate policy at the national and global level. Really, the message they were getting back in the '70s, which is "Reduce, Reuse and Recycle," that's gone by the boards. If you're going to make it through this bottleneck that we've been talking about, your life is going to have to change. Start experimenting now.

My wife, Janet, and I have spent the last 20 years trying to figure out how to minimize energy usage and fossil fuel usage in our lives. We spent 10s of thousands of dollars doing it, not just putting solar panels on our roof, but, solar hot water heater, solar cooker, solar food dryer. We have chickens, we have fruit and nut trees, an electric heat pump, instead of natural gas heat. All of these things cost money, they take time. After 20 years, there are still things we haven't gotten to. Don't assume that because politicians somehow suddenly get smart and enact some new legislation, that's going to solve this problem for you. It's ultimately going to be up to all of us to change how we're living and to do it intelligently. Get started.

Art: If we don't want it to be done for us; not by politicians, but by destiny.

Chris: I love it, particularly that idea that you have to get started because really, it's a lot of skills, trial, and error, all of that. I think the piece that was hinted around, which is really important to me, I think, Art you got right, too, is that none of this matters if we don't fundamentally change how we operate. This is a clarion call to say we have to start doing things very, very differently. My invitation to people, again, it's a pretty serious offer, come to my little hobby farm here, which is not actually a hobby, I'm minimizing it. I'm trying my level best to build soil and I'm doing it with an extraordinary sense of urgency, and maybe not even for myself, but for whoever occupies this piece.

In essence, I own it, but I'm just renting in every sense forward. I feel urgency around this. I hope that people watching this have somehow come away with that same sense that this energy predicament we're in is actually quite the emergency at this point in time. Get busy. Take advantage of these things while we have this year, spend time with your family.

COVID's taught me, I think a lot of people, that what really matters is your family, your health, your happiness, all of that. I actually think there's this bottleneck, however, comes through, to me, is an opportunity to.

To me, it's an opportunity. I don't know if I'm going to be the ones making it through that bottleneck, but I plan to. If not, I'm still going to be one who's positively contributing to this little piece of land I'm occupying and doing all of that. That's what I take away from all of this. If people can understand this larger framing of what energy really means, and how this is a predicament, and how this is bearing down on all of us, it informs everything I do, from every decision I make about whether I'm going to put this much insulation on the house or this much, and how much, all that.

Lots and lots of decisions, investments, everything. Thank you, everybody. Richard, Art, and Gail, thank you so much to each of you for participating here. I know people have gotten a lot out of this. I invite everybody to follow each of these esteemed guests in their work. You can go as deep as you want and get all the context you need, but I think this is the most important topic, energy, because as Art said, energy is the economy, not the other way around. Thank you, everybody, for participating here. We'll have links that people can find their way back to your incredible work.

Gail: Thank you.

Richard: Thanks, Chris.

Art: Thanks.