



MACRO Voices
with hedge fund manager Erik Townsend

Adam Rozenchwajg: Energy, Gold, Copper & Uranium

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Erik: Joining me now is Adam Rozenchwajg. Co-founder of [Goehring and Rozenchwajg](#), a commodity research firm and fund manager. Adam, it's great to have you back on the show. I want to start out with you know, the last time we talked, you and I were in strong agreement about something that well, either we were wrong or it hasn't happened yet. And that is that we both thought there would eventually be a very significant increase in energy prices due to lack of supply because of insufficient investment. I still hold that view, although it's on hold until the coming recession plays out. It seems like the expectation that increasing Chinese demand was going to be the catalyst that would really take things forward. It was going to change everything... Didn't really happen. Now as we're speaking, we've just had a surprise OPEC announcement which has jerked the oil markets considerably higher. But that was a reaction to a surprise move on OPEC. Before that, we were really plumbing lows that you and I didn't expect to see last time we talked. So what happened? Has the outlook changed? Is the hypothesis different now or is it just a matter of waiting for things for the market to stay irrational for as long as it can before it finally turns on our direction?

Adam: Lots of great questions and thanks so much for having me back. Happy to be here. Really looking forward to our discussion today. So, before we started recording, we confirmed here that we said the last time we spoke was last July, so July of 2022. And as you mentioned, depending on exactly when, in the month we spoke, but natural gas prices here in the US were probably around \$7 and oil prices were over \$100. And here we are, we outlined, like you said a very bullish view a year ago or just under a year ago. And here we are today before the OPEC announcement, oil was down to 70 and gas, which is even more shocking was all the way down to 2 bucks. You know, which is basically approaching the all time or 20 plus year low, which reached about \$1.91 or so back in the summer of 2020. So like you said, the question is what's happened. And for the most part, in fact throughout, I would say that everything we talked about last year is still very much true. And when we look back five, six years from now, we're gonna say what was this decade about, and it'll have been about the decade of shortages. And the reason for that is because we just have not spent enough money in the sector. It's really as simple as that. If you look at capital spending in the energy business, you're still down 60-70%, from where you were in 2014. And you're almost at the all time low, you're up a little bit off the COVID lows, which is sort of understandable. But you're still 30% below pre-COVID levels on oil and gas spending. And so until you fix that problem, you're really not going to change the bigger theme here.

Where we did get things, we were early is that we had expected the fourth quarter of last year to be a really tight pinch point in global gas markets and global oil markets. And that didn't come to pass. And there's some really interesting reasons... Why? The fourth quarter normally is a period of very strong demand for both natural gas and oil. A lot of it has to do with the weather, you know, as things are cold. We use natural gas to generate electricity for air conditioning in the summer, but we use a lot more of it for heating purposes throughout the winter. And so winters are typically most energy intensive season. And this past winter, we just had incredibly mild weather in both the United States and in Europe. And something else happened from a gas perspective in the US. And that is we lost one of our biggest export terminals, the Freeport LNG natural gas export terminal down in the Gulf Coast. That caught fire back in April of last year. It was 2 Bcf/d and that was offline for over 200 days. So it's about 400 Bcf (billion cubic feet) of natural gas demand that we effectively lost last year. And we saw inventories in the US increased by about 400 Bcf/d. They are 4 BCF or other total relative to averages. So I think that's entirely explained by the fact that we lost Freeport.

And then in Europe, they went from a very, very tight gas market to a very loose gas market, because winter just never came. And you and your listeners may have heard articles or listen to podcasts alluding to that. But when you look at the numbers, it's really, really shocking. You're talking about the warmest winter in Europe in 40 years. And thank God that happened. It really got them out from a very, very tough spot with Russian gas volumes curtailed after, you know, first of all the Russian invasion of the Ukraine and then the Nord Stream pipeline issues and things of that nature. You lost 15 Bcf a day of your imports. That's huge. And the only way that they could be bailed out being Europe was by really, really mild weather and that's what they got. So that explains the gas market. The question, of course, is now when you look forward in the US here, Freeports back up and running again. So those two Bcf a day are flowing, that demand is back. And in the rest of the world, the question now turns to okay, great, we had this warm winter, we can either hope we keep getting record warm winters, or we're going to have to find some way to replace that 15 Bcf a day of Russian pipe imports. And if you were to put that all in the LNG market, the liquefied natural gas seaborne market where you cool gas and to tankers, and you put it out on the water and in vessels, that would be like a 35-40% increase, 35 of a percent increase in the global LNG market. So that can't be absorbed. So I think you've now gone from what would have been a bullish macro story, you know, long term macro story with a very, very near term acute pinch point being the fourth quarter last year, that's clearly been pushed out. But you haven't changed any of the main big picture macro drivers in the energy market, which still points to very, very, very, very tight balances going forward.

Erik: And with respect to the oil market, we both thought that the reactivation of Chinese demand when China reopened its economy would be a big catalyst to change everything. It seems like that's mostly played out in you know, it's not completely back online. But China is making a fair amount of progress. Of course, we've had a completely change geopolitical tension situation between the United States and China. But in terms of industrial demand, they're coming back. Are we about to see oil prices? Have they bottomed? Is it time to put the longs on on oil or we're not there yet?

Adam: Yeah, I think so. What's really been interesting about the oil markets, since we last spoke is what's happened in terms of price, as I said, we were over 100 bucks last time we spoke. And then oil entered into a pretty protracted bear market from 120 in June, all the way to a low of 67 just a couple of weeks ago. But also what hasn't happened, which is to say, there hasn't really been much of a demand response in terms of demand destruction. We had a little bit of a weak number in the fourth quarter, but really nothing to really justify the price sell off that we've seen. And instead, I think what most traders tend to be agreeing on is that you actually have just seen a huge amount of liquidation, a huge amount of paper oil being sold on recession fears, and on general deleveraging. As you've seen, liquidity and leverage in the system begin to come out a little bit. So we've heard this time and again, there's a couple interesting points that suggest that yeah, so first of all, the inventory numbers have moved up a little bit, but really not very much at all. They don't really point to any huge slowdown or weakening. And one of the more interesting features of the oil market today, and I don't want to get too in the weeds here, you know, where we are long term investors. So we're not traders, and I'm sure your listeners aren't necessarily physical or paper oil traders either. But one of the interesting measures that you'd like to look at is what's known as the contango or the backwardation. So that means are future oil prices higher than the spot market, or are they lower than the spot market. And it stands to reason that if future prices are higher than the spot price that's bullish, but actually it's backwards, what happens is in a tight oil market, the spot physical, so the near term or the prompt end of the curve gets bid up, because people are willing to pay a premium to get their hands on that barrel. You know, a futures contract on a barrel for delivery next year, two years from now is all well and good. But when you have a really, really tight market, you're willing to pay a premium to have that oil in your tanks today.

And so what your listeners should think about instead of the far end of the curve being pushed down, what actually ends up happening is the near end of the curve is pulled up. And so in a tight physical market, a typical crude curve is what's known as backward-dated. The near term contracts are more expensive than the long dated contracts. So that was the case last summer, you had near record backwardation in the oil markets, and then oil prices sold off, you know, nearly 45%. So you would think that that would mean that the balances had loosened that the market was getting more and more amply supplied, and if that were the case, your backwardation would have gone into a contango, but that hasn't happened at all. The entire curve has moved down and again, I don't want to get too lost in the weeds here, but I don't recall another major oil sell off that has not been associated with the market swinging from backwardation into contango. If in fact, this market were over supplied, that's what you should have seen. You haven't! You've just seen people selling oil at any duration all along the curve. And to me that points to a lot of speculative unwinding.

Erik: What will be the catalyst to bring the price around? A lot of us thought it was going to be Chinese demand. Chinese demand has come and gone. That didn't seem to do it. A lot of us have focused as you've said on backwardation staying in the market. Okay, we all think that but it hasn't really turned the price around yet. Is there a catalyst coming or do we need to really wait for the end of the year to see more demand come into the market as we get closer to winter

heating season again and will we be in another situation where it's really dependent on weather?

Adam: Look, as far as trying to pick catalysts for big market turns that's always a very dangerous game to play. But what I can tell you is that as the market gets tighter and tighter and tighter, which it is right now, it becomes much more prone to black swan events. For instance, we just had this big OPEC cut, announced last week big surprise, the oil markets were up Monday, April the 3rd 10% and oil stocks did very, very well. And I think you could start to see more things like that, whether OPEC cuts or whether they're geopolitical disruptions, all I can tell you is the market is awfully tight right now. And when things get tight, weird things begin to happen. But the other thing I would point out, you know, you talked about a few issues there. You said, we were hoping that China would be this big catalyst. And you were hoping that, other elements like that, I wouldn't count out China's reopening just yet. Leigh and I just got back from Hong Kong and Singapore. And one of the more interesting observations we had, when we were in Hong Kong. We talked to a lot of people via mainland Chinese or all over Hong Kong, as always more and more so. And one of the things that was communicated to us which I thought was kind of interesting, is that they just don't have particularly on the international air side of things. They just don't have that infrastructure back in place it and you might say, well that's crazy, How could they reopen and have this big massive reopening without managing getting the airplanes in and getting the pilots ready and stuff like that. But people don't fully appreciate. You're talking about 90 to 100 days often in order to look out route reservations in order to get gates at different big airline airports rather around the world. So, if you wanted to fly from Shanghai to London, three times daily, you can't just decide to do that on a whim, you need to take some time to get the planes positioned, to get the pilots position, and most importantly, get your airport gate reservations in line.

And you'll recall that, this whole reopening in China was very, very unexpected. And I think it was unexpected by the party as well and unexpected by the leadership. It was really the response to huge protests within China. And so I don't think a lot of these things were in place. So now here we are, beginning of April. We're kind of 100 days or so on from those events. And I would suspect that you're going to see a lot of that fireworks if you will, from the China reopening that you didn't necessarily see straight away begin to work its way through the system. Obviously, industrial production is a whole other animal. And like you said, those numbers are actually looking pretty good. Domestic travel and China is looking really good too. But what you're not seeing is you're not seeing the airline numbers back up to where they should be. And I think that that'll be the next shoe to drop here. So I'm not ready to count out the China reopening story just yet.

Erik: Let's move on to a commodity that is performing extremely well, which is gold. We've seen a big rally here on Tuesday afternoon that we're speaking just today, we finally saw a decisive break above the round number resistance that we were experiencing at 2000. So we're looking at about 2038 on the June contract is we're speaking right now on Tuesday afternoon. It seems to me that you know, it's easy to explain why this market has been so strong with the apparent forced changing of the Fed's hand or challenging of the Fed's position in the Silicon

Valley Bank route. But boy, we're really starting to approach all time highs again, the last couple times we were there they proved to be very formidable resistance. What do you think happens next?

Adam: Well, I think every major commodity bull market has a huge gold component to it. That was true from 1929 to 1940. And people forget that, that was the first really strong commodity bull market in the 20th century, not exactly what you would expect, given the fact that the world was in global depression at the time and commodities are thought to be so economically sensitive. But that was the first one that had a huge gold element to it. gold stocks rally 10 folds over that period. The 1970s as well and then from 1999 to 2010, gold was all if you look at kind of you know, the full cycle gold tended to be the best performing sector, but it really paid to pick your moments and so, going all the way back we were how have really invested in the gold market until about 2020. And then when oil prices went negative and gold was holding in quite well above 1600, eventually making its run up to 2063 for the all time high in August of 2020. We said, okay, look, this is the time we have to begin to reallocate our investments away from precious metals, and towards energy. That was a really good call. Obviously, gold has traded down over the next two years and oil stocks have led the market dramatically. But we've always liked the long term outlook for gold. And the question has always been the right timing. And I think that timing is getting closer and closer and closer. We started adding to some of our gold positions that the beginning part of last year. I think, hopefully your listeners who as they get a taste for some of our analysis will begin to realize we tend to be early on everything and that was really no exception. And you had some good tailwinds and some good headwinds.

And a lot of those headwinds are now beginning to give way and so the biggest headwind of course, was that we were still very much in a rate hike cycle last year. However, the positive signs were, of course, the amount of money that was printed, first after the 08-09 bailout. But then more recently, during the Cares Act and during COVID, and things of that nature. And the fact that Western liquidation was beginning to slow which has continued to slow, and it meant that this sort of marginal buyer was coming back as a more price stickier buyer in the East. And then what happened in the fourth quarter of 2022 really can't be understated or overstated rather. And that's the reemergence of central banks as these huge Gold Buyers. And there's a lot of rumor and innuendo as to who was buying? Everyone figured that China was buying and that Russia was buying, I think that those are both true. And I think that going forward, that is just going to be an on believable catalysts to potentially move gold prices much higher. How high could prices go? Well, back in the summer of 1999-2000, my partner Leigh was featured in Forbes Magazine and he said that gold could hit 2500 bucks. Remember, gold was like 275 an ounce back then. And his analysis tried to compare the value of the above ground gold supply with the amount of paper money in circulation. And that's how he got his \$2500. If you do that analysis today, you're in excess of \$20,000 an ounce. And so the question is, if we've entered a gold bull market, that's going to be very, very powerful. And I think we probably have, you know, I think the fact that central banks are now this huge buyer, when of course, in the late 1990s they were this unbelievable seller. They were selling all of their gold positions. But I think what you're starting to see now as people begin to move away from the dollar, at least on the margins as a global reserve currency. Whether that's allowed to go forward, whether it works is still an

open question. But I think you're starting to see central banks around the world begin to diversify their reserves away from the dollar and have at least some gold element to it. And that's going to be potentially a very powerful force here that could take gold, much, much, much higher.

Erik: Do you have a target for what much, much, much higher means... Is that 2500? Is that 3000? Is that 20,000?

Adam: Oh look, I think that if gold reaches if gold becomes a preferred asset class, like it has several times in the past, gold could well be over \$20,000 an ounce. If gold even reverts back to sort of a normal relationship between paper currency or any type of financial asset, and gold, you could easily see over \$10,000 an ounce. So we're not gold bugs, you know, I don't think that gold is the answer to every problem all the time. But there are moments when gold valuations get extremely out of whack, and it tends to be a good time to buy. And I think we've seen that in the cycle. I think we saw it probably earlier last year. And now I think we are off to the races. So I think ultimately, this is going to get completely out of hand, it's going to overshoot what it ought to be at. And I think it'll probably be somewhere between \$10,000 and \$15 by the end of this cycle.

Erik: And how long does that cycle take to play out? That's 10 to \$15,000 by what date?

Adam: Well, they say never give a price and a date. But I will say that the cycle will be over in 2030. And that's going to be the amount of time that it's going to take to get investors positioned a little differently. You know, you're going to have a move, you'll have a pull back. People will say oh I told you we shouldn't have had real assets. But ultimately we need to recapitalize the extractive industries. We need to get several trillion dollars of unspent capital back into that. And the only way you're going to do that is going to be by an unbelievable speculative bull market, that's going to attract generalist capital in all of that told, I think we probably get to about 2030 before that begins to really hit its last blow off top.

Erik: Speaking of extractive industries, let's move on to copper. If we still believe that climate change is a problem, and that the world is going to decarbonize by 2050, which is still the stated political agenda, that would require more copper than any copper executive that I've been able to find or even knows where to look for. What does this mean for copper prices between now and 2030?

Adam: Well, I think that was a nice setup, I think it means it has to go much higher, doesn't it? When you look at Copper as opposed to any other commodities that we look at. There's a couple of different ways of talking about it with successful investment, obviously, just straight performance is going to be a key number, you know, the percent that it goes into total return basis. However, another thing is like the possibilities of outcome, right, like, how many different possibilities could there be. And in the case of energy, we're very, very convinced that traditional energy is going to be with us for a long time. But if we're wrong on that, you know, I could paint a bearish story on energy. With copper, it seems almost impossible to paint a bearish demand

story in the copper market, because you have China that still believe it or not, is underinvested in its copper infrastructure. And so we like to look at the total installed copper in an economy relative to its per capita GDP. And when it comes to copper, China's still a little bit under invested there, and its GDP is going to grow going forward. India, which should have about 100 pounds of copper per person right now, is at like 15 pounds of copper installed per person and their economy. So that in and of itself is going to be a huge tailwind for global copper demand.

And then, of course what you nailed, which is something we've been talking about since 2015, is that any move towards wind, solar, and electric vehicles, you're talking about increasing the copper loadings in those end uses by anywhere between 10 and 20 fold relative to what they're replacing. So if you go from natural gas fired power plant to a offshore wind farm, the amount of copper that's required per megawatt hour goes up, 10 to 20 fold. Not 10 or 20 percent, 10 to 20 fold. So, any way you cut it, it strikes me like copper is going to do quite well. Substitution is fairly limited. And from a supply side, it's really difficult to see where you bring on any new mines supply in the next short term anyway. So, when you're looking at oil for instance, particularly during the days of shale, you could cycle some of that capacity on fairly quickly, I think it's more challenging to do that now. When it comes to copper, it's going to be 10 years plus before you can bring on a major new copper mine. And the clocks would have had to start 10 years ago to see what's going to come on next. So I think that that market, almost any world that you look at is going to do well. Copper prices, where do you hop them out? Well, I guess you have to look at where do you start to squeeze out demand. And again, since there's no ready substitute, the answer is probably could easily be 8-10 bucks a pound, it's \$4 a pound right now.

Erik: Adam, let's talk about this energy transition and how it's going to play out with respect to affordability of the vehicles and other things that everybody's kind of counting on. Because we have so many people that are obsessed with a zero carbon future. They're just really excited about it. And I think there's an expectation built up. It's kind of like, when you first buy computers, they're expensive, but then the price comes down. Well, when we first got these electric vehicles, you know, these Tesla's cost \$75-\$80,000. Most people can't afford them. But surely the price is going to come way down. Well wait a minute, what we just said about copper... Is the price really going to come way down? Is there room for this energy transition to become affordable to the average Joe, when you consider the amount of both copper and also rare earth elements that are going to be needed for each unit of electric vehicles in order to accomplish this energy transition. Seems to me like everybody is expecting it to get much cheaper, I think it might be going the other direction.

Adam: I think you're exactly right. And I can't tell you how few people we can get to agree with us. So it's nice to hear from someone that does. If you look in the last 10 years from 2010 to 2020. What was notable that period of time. Well, the cost of capital effectively went negative, it became 17 plus trillion dollars of negative nominal yields. So you had the lowest cost of capital in human history and the price of basically every source of energy, whether you're talking about gas or coal, nuclear, oil... What have you fell by about 90%. And somebody's going to come back and say that the price of nuclear didn't fall but the price of uranium so that's what I'm quoting there. Everything fell between 90 and I guess in the case of oil over 100% in terms of

energy costs. And very few people as of yet here we are in 2023 have really talked about that impact. I think a lot of people have talked about the cost of capital. And if you read Jim Grant and others, they talk about the huge malinvestments that have taken place because money was cheap. And when money is cheap, you don't put it in the right areas. But when energy is cheap, you don't invest it in the right areas, either. And people don't fully appreciate that when you talk about wind or solar, the amount of material that goes into generating energy is so much more than when you're talking about oil or natural gas. And for instance, like four megawatt wind turbine stands, the size of a 30 story building, and basically is comprised entirely of steel and the basements made of cement. Well, if your prices of energy collapses by 90%, it stands to reason that the cost of that steel is going to come down too. You know, copper in 2011, was \$4.50 and by 2017, got down to two bucks. So I think that's very, very typical. You saw that across a lot of metals and a lot of materials, most of which was the embedded energy cost inside that, because if you think about it, what's the cost of copper? What's the cost of burning diesel to drive these trucks all around and crushing the ore and, and refining it and things of that nature?

So when we look back on the last decade, I think people have to really take stock of these two massive tailwinds. We had cheap capital and cheap energy. And what did we get? We got a massive investment boom, and things that were capital intensive and energy intensive, namely wind, and solar, and electric vehicles. So you're totally right, everyone has extrapolated what they call the learning curve. They think that Moore's law is basically taking hold in renewables. But in our models, we actually went back and we tried to attribute how much of the cost reduction of wind or solar or batteries was the result of capital and energy. And then how much was the result of, you know, a plug for all other factors. All the other factors, has been basically pretty stable. And the main driver, I think 85% of the driver of the reduced costs, over the last decade has been cheaper money and cheaper power. So what happens when those start to move higher again? You know, people are tripping over themselves to say how fast the cost of wind, solar, and EVS can fall... What if they rise? And I think that's what you're starting to see now. So, the constellation project offshore, Massachusetts is already forced to renegotiate its power tariffs, you're starting to see Duke dominion, several other major major guys write off billions of dollars of their solar fields. And this is all within eight months basically, of capital costs and energy costs rising. So I think, looking back, the huge boom in wind and solar in the past decade will have been more than anything else an artifact of cheap capital and cheap energy. Longer term, if we want to address carbon, we need to go nuclear. And I think hopefully, that's beginning to resonate with people more and more.

Erik: You know, you just read my mind... My next question was going to be boy, if you and I are anywhere close to write about energy, this is setting up to force a nuclear renaissance, and I think there's going to be an awakening to nuclear. How do you guys look at it? How do you see it playing out? What's the timeframe for nuclear? Do you think it's likely or certain to happen? Do you think it's still a question mark? How do you think about the nuclear future?

Adam: Yeah, so what's nice is that if you're a uranium investor, and you're long term, and lots of people say they're long term, and they really aren't, but if you really are long term, and you're

willing to take a view of several years. You know, the uranium markets quite tight. We have not invested in a new uranium mine and you know 30 years basically. We have two primary uranium producers. One up in Canada, Cameco and one in Kazakhstan, Kazatomprom. BHP produces a lot of uranium as a byproduct from its Olympic Dam mine in Australia. That's it. So how bad was the bear market? Well, in 2018, uranium prices got so low that on a cash cost basis cameco couldn't produce profitably from its flagship mine. I've never really heard and they shut it, you know, it wasn't just talk, they shut it to save those pounds for a future date. So how bad were things? I've never heard of a bear market so bad that a duopoly can't manage to make money. And that's how bad things got... Uranium prices fell from \$150 a pound down to \$18 a pound at the end of 2018. So you actually don't need much of a Western Renaissance to have a bullish outlook on uranium. And when we made our investments, we did not make any assumption on a Western nuclear renaissance. We were talking only about the new build programs going on in China right now. I think they're building like 30 new nukes a year. The Chinese and the Koreans are basically the only people that can bring a nuclear reactor online on time and on budget. So that's kind of the near term story.

The longer term stories... what you're saying and that's exactly right. That now Europe and the United States are both warming up to the idea of nuclear power again. They're both beginning to have a newfound appreciation and that could send demand numbers much, much higher. And not only that, but if you're a sort of an optimist, that could also lead to a huge period of energy abundance, they used to talk about nuclear power and its potential being so great that you wouldn't even have to meter it. It wouldn't make sense, it would be too costly to send somebody meter the electricity. It kind of be like how we have water today in our residential buildings, just kind of, here's the water bill. And it's not based on usage, that's what they thought nuclear power can deliver. And if you let it do its thing, it definitely could. So I'm very, very hopeful that that there's a newfound appreciation there. This is not, when you're talking about the West, this is not a near term story, this is going to be 2030 before you have major new reactors coming online in this part of the world. But they should be some of the most exciting fourth generation nuclear reactors that are being designed right now, by some very, very smart people with extremely good pedigrees and backing and things like that. And that stands the potential to be incredibly energy efficient, twice as energy efficient as today's nuclear, which in turn is three times more efficient than natural gas and coal, and 15 times more efficient than wind and solar. So this could be a huge, huge, huge step forward. Generate effectively no waste whatsoever, and be walkaway safe and cheap. So this is all kind of on track for the late 2020s, early 2030s. And it has a huge potential. And I should say, there's a lot of people out there that talk about these small modular reactors. And frankly, they don't know what they're talking about. It's a really complicated area, I have found it extremely difficult to find any good reliable information on any of these new reactors that people are building. So about a year and a half ago, Leigh and I decided to go out and just meet all these companies and understand what they're doing and go to their labs and go to their factory floors, and actually see this all for ourselves. And what we came away with was that there's some really interesting stuff happening, some really interesting technologies, not all of it is... some of it is, sort of incremental improvements. Some of it is groundbreaking, and really, really exciting. So I think you should stay tuned, but it's not going to be a near term story.

Erik: Let's talk about how nuclear can make a comeback in the West because as you just said, with the real problem that we've always had with nuclear has never been nuclear energy itself. The problem is large, bespoke public works projects in the United States and in Europe end up with massive cost overruns, not getting what they're supposed to get done, done on time, almost ever. And we literally have the cheapest form of electrical energy production, resulting in the most expensive electricity. Because the absorption of that massive capital investment, to go through all the cost overruns to build a nuclear plant makes that energy so many times more expensive than its actual cost of production. The only way we can ever get out of that is if we can somehow figure out how to create nuclear energy in the United States and other developed countries without screwing it up. And as you say, maybe the South Koreans have a leg up on us, and maybe we should take study of that. But we haven't so far. So is a revolution around small modular reactors, going to be the way we solve this problem that we can't seem to build large nuclear plants without cost overruns or are we going to get better at building large nuclear plants?

Adam: It's such a paradox, because you're absolutely right, when I look at how much energy is required to generate a unit of energy, for renewables, it's five to one. So you put in one unit of energy, you get five units out the other side. For oil and gas that's 30 to 1, so you put in one unit of energy, you get 30 out the other side. And if you look at the if you translate that back into dollars, that basically tracks right. Oil and gas ends up being cheaper than fully backed up unsubsidized wind and solar. But this really strange one and lots of other technologies slot in in the middle. And then the really interesting one is nuclear, which is one unit and 100 units. A 100 to 1, it's the best, most efficient source of power we've ever known. And yet it's the most expensive and it's a bit of a paradox. It's a little bit strange. I think part of the problem is we obviously command a huge amount of safety from our nuclear facilities. And I think that, on the surface that makes certainly a lot of sense. You know, if you said to me, do I want the nuclear power plants to be more safe or less safe, I'd say more safe. However, I would point out that, you built a lot of these things back in the 1960s and 1970s. And they've been running operationally without incident, ever since so we did plenty safe before and the idea of nuclear safety is a little bit of a myth, because nuclear power is by far the most safe form of electricity, if you measure it any way you want to do it, you know, people, deaths attributable, to accidents per kilowatt, whatever it's going to be, I think you have a couple 100 people die in Coal train accidents every year compared to effectively, you know, nobody having died, other than in Chernobyl, which was a military installation, and not really comparable. So I think that our fascination and fixation on safety, while appropriate, is probably gone a little bit far. And it's resulted in, effectively checking things to the point and then having to replace things over and over and over again, but I'm okay with that. I mean, probably should have that.

But we've just lost the skill and the ability to be able to do some of the more complicated installation procedures on these nuclear plants. And in particular, now, I'm going to get really granular here, and I don't want to lose people. But I think it's important when you think about the new small modular reactors, we seem to have lost our ability to do the highest specification welding that's necessary in a third generation nuclear reactor, that tends to be where you see,

every time these cost overruns is because they come in and they inspect the weld joints, and they're not to the specifications, and they have to tear them out and start all over again. And that obviously adds huge expense and time to the project. So the question should naturally be well, did the small modular reactors address those weld joints? And the answer is some do and some don't. The reason that the weld joints are so difficult, and so problematic, is that the pressures that you're dealing with in a pressurized water reactor for a nuclear power plant is really, really high. So, the reactor generates heat at about 500 degrees C. Water boils at 100 degrees C, so you need to keep the water that's flowing over the nuclear core, under pressure, otherwise, it's going to boil away, and you're going to have a meltdown in your core. And so you do that and you pump very high pressure water at a fast rate to cool the core.

Because of that, the pressure is so great that you need to ensure that all your welding is extremely high integrity. Some of the new small modular reactors, particularly the ones that use sodium as a coolant instead of water have a much higher boiling point. And they don't have to have any pressure at all. So if you look at like a TerraPower for instance, they don't use any high pressure in their systems. It's all kind of atmospheric pressure. And so all of a sudden, your weld joints are no longer such an issue. Again, that might be a little bit too much in the weeds. But I do think it's fascinating. Again, it's one of these weird questions where everyone knows that the cost overruns and the time overruns in nuclear is a big problem. But nobody really knows why. And nobody really knows why we're running so far behind schedule and over budget. And when you really dig in weld joints of all things, something that we should have been really good at by this point. We've been doing them for 200 years. But, weld joints tends to be where we really fall down.

Erik: Well Adam, I can't thank you enough for a terrific interview. But before I let you go, I want to talk a little bit about what you do it [Goehring and Rozencwaig](#) particularly what's on the website at [gorozen.com](#) A lot of people think you guys are a research firm because you have such an excellent reputation for Commodity Research. But there's actually more to the story, isn't there?

Adam: Well yes, there is and thank you for saying so. We put a lot of time and effort into our research and the research is at the center of what we do. But we're ultimately at the end of the day, we're fund managers and have been for the case of Leigh 30 something years and I've been doing it for 17. So, we manage natural resource equity portfolios. We do that in a variety of ways. And we use the research that we love to talk about and share with everybody to formulate our investment decisions and ultimately build a portfolio that we think will do well over a long cycle that we see coming. So we put everything that we do on our website, we're very transparent. You started this episode by talking about all the things that we got wrong and we don't shy away from that either. It's important for our partners and our clients to understand what we get right and what we get wrong. And it's more fun to get things right but you know, it's important to realize when you get things wrong as well and talk about why that is so we leave everything up including our bad calls or good calls all that and is all available free of charge for anyone that has interest.

Erik: And that is at gorozen.com. Patrick Ceresna, Nick Galarnyk, and I will be back as MacroVoices continues right here at macrovoices.com.