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Markets in Transition | Episode 8
Robert Friedland, Founder & Executive Chairman, Ivanhoe Mines

We continue our *Markets in Transition* series this week by welcoming back Robert Friedland, Founder & Executive Chairman at Ivanhoe Mines. David Greely sits down with Robert to discuss the state of the energy transition, which metals are truly critical, and how we need to work together to re-engineer our energy system.

Robert Friedland (00s):
If Western governments got behind the miners, if we had access to limitless government funding, we could mine the metals we need for an energy transition readily. No problem. We can do it, and we can do it in a greener way. And we can make this total change in the next 10 years.

Announcer (19s):
Welcome to SmarterMarkets, a weekly podcast featuring the icons and entrepreneurs of technology, commodities, and finance ranting on the inadequacies of our systems and riffing on ideas for how to solve them. Together we examine the questions: are we facing a crisis of information or a crisis of trust, and will building smarter markets be the antidote?
This episode is brought to you in part by Abaxx Exchange, where trading in centrally cleared, physically deliverable LNG and carbon futures contracts is now underway, ready for SmarterMarkets.

David Greely (01m 01s):
Welcome back to Markets in Transition on SmarterMarkets. I'm Dave Greely, chief economist at Abaxx Technologies. Our guest today is Robert Friedland, Founder and Executive Chairman at Ivanhoe Mines. We will be discussing the state of the energy transition, which metals are truly critical, and how we need to work together to re-engineer our energy system. Hello Robert, welcome back to SmarterMarkets.

Robert Friedland (01m 28s):
Thank you, it's a great pleasure.

David Greely (01m 30s):
Well, it's a great pleasure to have you with us here again. You know, it's been too long. We just had our 200th episode and you are our guest on the very first episode of Smarter Markets and across all those episodes in between we have had many conversations on the energy transition and its implications and I wanted to talk with you today about how you see the current state of the energy transition and I thought we could start with the supply of critical minerals and metals. We know it will take a lot of these minerals and metals, you know, including copper, nickel, lithium, to meet the needs of the energy transition for a more electrified energy system powered by low carbon renewables and nuclear. We've seen near term oversupply in markets like nickel and lithium that send prices crashing. So I guess I wanted to ask you first, where do you think we are today in terms of being able to supply the amount of critical minerals and metals that we will need for tomorrow?

Robert Friedland (02m 29s):
It's a very big and very important and fundamental question since we started this podcast and 200 have gone out into the universe now we have been subjected to an absolute blizzard of misinformation and disinformation about what constitutes an energy transition and what critical raw materials we need to get there from here. So we can separate out the existential question, what the two words energy transition means, then we can settle on the critical raw materials. We will just note that the Mediterranean Sea was hotter last summer than ever recorded. There are over 600 water tornadoes in the Mediterranean Sea. We will take it as a given that the anecdotal experience of the hot weather the last few years globally supports the thesis that we have anthropomorphic global warming and that we need an energy transition. However, for a billion people, an energy transition is for the woman of the household just to be able to cook with natural gas rather than wood.

Robert Friedland (03m 34s):
So let's set aside the words energy transition for a moment. We should probably come back to that and talk about critical raw materials. If you want to electrify the world economy, if that's what we are talking about in energy transition, clean electrical energy, electrical energy, that does not generate global warming gas and that does not exacerbate or trigger an even more critical cycle of the earth warming itself because as it gets to a certain temperature, we could melt the polar ice caps, we could release huge amounts of trapped methane that are frozen in northern Russia, for example, into the atmosphere. And we could get into a reinforcing cycle where global warming gets even hotter because we trigger sort of a greenhouse effect. Setting all that aside there is essentially an ocean of disinformation and misinformation about the critical raw materials required. So let's go into that and let's peel that onion and get some people to understand a little bit about it.

Robert Friedland (04m 41s):
First of all, as we talk today, we are burning as much crude oil per day as we ever have as a species. We are right near our all-time highs at about 103 plus million barrels per day. So we have spent trillions of dollars on windmills and solar farms and it has not reduced materially the amount of crude oil we're burning as a species every day and we are still burning vast amounts of coal. There's been no actual reduction because we are still using more and more energy in the world and while the percentages come down, maybe a percent increase in renewables. The denominator got so big, the demand got so big that we made zero progress. And if you want to add on top of that, data centers now big data and military demand for big data. We are fooling ourselves if we're talking about any material improvement in anthropomorphic global warming.

Robert Friedland (05m 41s):
More importantly, people are beginning to understand the importance of mining and critical raw materials. If you want to come up with a, a holistic scheme to stop burning crude oil or stop burning coal, which are at the core of the issue, that's what human beings do. We really need to look at the supply chain and about 99.9999999999% of the time, the media has it wrong implicit to get into your question, no, we don't need nickel for the energy transition and we certainly don't need lithium carbonate or lithium hydroxide and so the list of critical raw materials that are lumped together in the mass media are virtually always wrong. They are repeated by journalists that have no idea about the supply chain and no idea of the fundamentals of physics, physics or where things come from or where technology is going. So there is no shortage of nickel and there is no shortage of lithium.

Robert Friedland (06m 42s):
Lithium is an unbelievably common metal in the crust of the earth. It's widely available. There are supply chain issues, there are antiquated technologies, but there are no shortages of nickel and lithium whatsoever and you see that reflected in their prices which have collapsed and will continue to collapse as technology addresses these issues. Lithium is the lightest metal in the known universe. There may be other universes, parallel universes, but it's the third element in our periodic table and it's everywhere. If we want to find a lithium deposit, it's everywhere, including in the oceans, waters and new technology is allowing humanity to collect that lithium into metallic form in one step from brines oil field brines that are globally available. There's no shortage of lithium at all. The problem is that the media thinks the energy transition equals electric cars. No, not true. We can't green the world by building 10, 20 billion electric cars.

Robert Friedland (07m 56s):
That's a ludicrous proposition and has nothing to do with the energy transition. It's just everybody wants to get rid of these belching internal combustion engines and assign a huge market valuation for anybody that looks like they can make progress towards that enterprise. But we will not green the world by building tens of billions of electric cars. No, we won't. Not going to get there from here because everybody can confuses electric cars with energy transition. We really need to slow down and parse this discussion Energy, transition energy is a word we could discuss endlessly, but for the purposes of this discussion, let's say energy is electricity that we want to use for a good human purpose without generating global warming gas. When Ben Franklin had a kite and a lightning bolt hit his kite and he started thinking about electrical energy, there was no, was no global warming gas associated with that lightning bolt.

Robert Friedland (08m 58s):
There are many forms of electrical energy that we can generate that do not generate global warming gas. But the first fundamental proposition is we need to run this world primarily on electrical energy, not chemical energy, not burning coal, not burning oil. I think that's what most people think about as energy transition using electrical energy for useful work. So we have to talk about how we generate energy and how we transmit energy and how we utilize energy and electric cars are a subset of that utilization, but they are not the whole story. They are not the whole story at all. So if you want to change the way we generate electrical energy, that has

nothing to do with lithium. If you want to build a nuclear power plant, if you want a fusion reactor, if you want to develop geothermal power that's the first step of the transition, generating clean energy.

Robert Friedland (09m 58s):
It has nothing to do with the so-called shortage of lithium or even nickel. If you build a nuclear power plant, there's a lot of stainless steel and that power plant and that stainless steel requires nickel to make the stainless steel. There are forms of stainless steel that don't use nickel, but lumping all of these elements together by journalists as critical raw materials is completely idiotic. And by the way, if we have to rely on extremely bizarre or arcane elements that the media keeps rhapsodizing about, like rare earths which are not rare and are not earths, are never going to get there from here because people have no idea of what they are talking about when they sort of mouth politically corrected words about energy transition. And of course the more you learn about it, the more you realize the popular media is just dead wrong from Elon Musk's side, maybe it's all just woke nonsense.

Robert Friedland (11m 00s):
From a plasma physicist point of view, it's definitely possible for humanity to change the way we generate power, transmit power, and utilize power in a way that we really and truly stop burning 104 million barrels of oil per day and burn an astronomic amount of coal to generate that power in the first place. Anybody should know that if you live in the United States and you buy an electric car, it's approximately 50% a coal burning car. Our grid still generates massive amount of electrical energy by burning coal. It has nothing to do with lithium. Forget about the lithium. We are just burning coal to generate electrical energy and China is still adding as many coal burning power plants per year as exist in Spain or some years as exist in England every year in new coal burning power plants, even though China is doing more to jump into an energy transition than any other major industrialized country.

David Greely (12m 10s):
You know, I wanted to ask you about that because it sounds like you are saying we got too much focus on the use of the electricity, the batteries, the getting it into cars. We're not focusing enough on how that electricity is being generated and being able to replace coal fossil fuels in the power generation side. And you know, China's made some pretty impressive strides with the increase in solar they are using for generating the power. What do you think we need to be doing to generate that electricity and what minerals and metals are critical to that or what technology do you see as critical for generating the electricity?

Robert Friedland (12m 52s):
David, here we go again, generating number one, transmitting number two and utilizing the energy. Number three, everybody forgets about number two, if there is no transmission, you don't get from generating to utilization. Okay, we're so far away from getting this right and yet it is so attainable, it is so doable. It's just we have to look at the amount of effort our species puts into war and the preparation for war and the medals required for war. We have to redirect those human energies towards truly having a sustainable energy transition. And in theory, this is something our Chinese brothers agree about and our Chinese sisters, they're just like us. In fact, they've made a bigger effort than the United States relative to the scale of their society. So solar power definitely will not work and wind power will not work. They are laughably wrong. As you know, the sun does not shine 24 hours per day and solar cells have a very low energy density.

Robert Friedland (14m 05s):
So they're nice. You can generate hundreds of gigawatts of power, hundreds of nuclear power plants equivalent. But how you integrate that into the grid, how do you utilize that is a huge problem. You need storage of energy in the grid and as you know, the wind doesn't blow all the time. And we are learning these windmills don't have the life we thought they're going to have. They wear out, they are management intensive, sometimes they collapse and as you know, they chew up birds prodigious and the wind doesn't blow all the time. Europe learned that a few a few years ago. So I think a thousand years from now, we'll look back at our species if we are still around and writing it and we will look at these as just ludicrous early attempts at energy transition and we won't be using windmills and we won't be using solar cells, we won't be paving all of mother earth with solar cells.

Robert Friedland (15m 02s):
But the intention is good, you know, the industries are large, the intentions are good, we tried, but the engineering is very poor because our grid simply can't take these variations easily. Now some progress is being made to integrate solar into industrial use. I just had a very enlightening meeting with Huawei in China to hear about their efforts to utilize solar power and intermittent power to convert that into 24 hour stable electrical energy, say for a data center or for a mine. It's possible to do that, but it's nowhere near as elegant as other alternatives. But we really need to examine what are the rational alternatives and what critical raw materials do we

really need to get there from here. So I can assure you as a miner, and I think we know everything there is to know about almost nothing we know about mining. We know about our supply chain.

Robert Friedland (16m 05s):
Don't lay awake at night worrying about a shortage of lithium. This planet has plenty of it. Don't lay awake at night worrying about a shortage of nickel. This planet has plenty of it. Worry about the intelligent way we use those metals. We have never been able to find a way to engineer around aluminum or copper. They are absolutely fundamental to any effort at energy transition and there are a number of themes that need to be emphasized. So please understand, we have to generate the power, we have to transmit it and then we have to store it. When you put it in a battery that electrical energy is chemical energy that's something completely different. How you store that energy in your battery. And then there is the fear of the supply chain for example, you're probably guilty of having one of these hand phones in your hand.

Robert Friedland (16m 59s):
Most people are. We've become cyborgs, we are sort of addicted to our hand phones if we lose our phone, the mind body process experience panic, maybe the kind of panic that another caveman was chasing you. But we are, we are addicted to these hand phones now. They've been weaponized the pagers and the walkie talkies that Israel exploded shows you that you can put a chemical in a battery, the phone will act normally, it will be just fine until somebody calls your numbers and it blows up next to your head and that means that in the near future it's gonna be very hard to carry your phone, you as a cyborg onto an airplane and you won't be able to bring your iPad or your personal computer because, because all forms of chemical stored energy can be weaponized and are very dangerous. So our world is changing very fast.

Robert Friedland (17m 57s):
You remember when we had the first attempts to blow up aircraft with people carrying a bomb on a plane? Well guess what every electronic item has now been shown to be convertible into a bomb. And that's chemical energy. That's chemical energy in that pager battery in that walkie talkie battery in that apple phone battery. And now you know the technology's out there, people can weaponize it. And so we live in a very rapidly changing world and 200 podcasts is enough to make the difference between a very primitive and early understanding of energy transition and the much more sophisticated and realistic understanding we need today. Virtually everything you're reading in the popular press is laughably wrong. So we need massive amounts of copper. We've spoken about that. Copper conducts electrical energy better than anything on the periodic table except for gold and silver. They do an even better job of conducting electrical energy.

Robert Friedland (19m 06s):
They're just too expensive and rare and aluminum conducts electrical energy and also lightweights things. Things need to be lighter in a transportation world, everything needs to be made lighter. Aluminum and copper, there is no short term way to engineer around it. There's some good work with graphene. We work with graphene, excellent way to transmit electrical energy, but it's brittle and it doesn't transmit heat like copper does. So certain metals are absolutely fundamental to this transition. You've got a headphone on, there is copper in those headphones, you are talking to a microphone, there's copper in that microphone. I am on the other side of the planet, you are in New York, I am in Singapore. We are 12 hours apart but copper is absolutely fundamental to be able to talk to each other so that one we can engineer around and we are short copper on this planet. If you're really going to have a transition now even to maintain 3% economic growth without an energy transition, we're short copper.

Robert Friedland (20m 14s):
That's absolutely fundamental. We have to be copper miners. If we're not copper miners, we're just not gonna get there from air. We can cheerfully keep burning coal and we can cheerfully keep burning oil. The FT just quoted JP Morgan saying a lot of these assumptions are unwarranted unsustainable. We are seeing it. The Japanese have been saying we need hybrid cars, we need to have combination of a electric car and a hybrid car. We need to really get the fleet changed. But I want to repeat a hundred times over. Electric cars does not equal energy transition. It just doesn't. It's a nice thing to do, but the amount of mining you have to do to make every single automobile old and new run on electricity in a sustainable way in order to generate the power to that car and to transmit the power to that car is beyond your wildest imagination and now comes data centers and now comes war and these competing demands on electrical energy mean that we really need to get sober and get real about what we are doing here. Otherwise our adversaries just laugh. I mean we are all on this planet together. If Russia doesn't stop burning crude oil, if China doesn't stop burning crude oil, it really doesn't matter what you do in the United States.

David Greely (21m 44s):
Yeah, and I wanted to ask you about that. You know, you mentioned being in China and if you look a lot of the production of some of the other metals like nickel and lithium, you know, have been coming out of China, Indonesia, and we are seeing like this kind of growing say like east west tension over mineral security, metal security. Is it being responsibly sourced sustainably sourced you know, it seems like we're finding new fault lines instead of ways to cooperate. How are you thinking about the way geopolitics is shaping up around countries trying to make sure that they're able to secure the metals that they believe they need and that they're being sourced in a secure and a sustainable way?

Robert Friedland (22m 33s):
We are experiencing a tremendous balkanization of the world economy into warring organized camps. The camp composed of say Western Europe in the United States, or let's say the anti-whatever is the opposition to a Russia and China and Iran and North Korea camp, we are balkanizing the world economy and it, that process has been accelerating and we need to stop the acceleration. We need to get to an equilibrium and we need to look at where we can compete. The macro trend in that direction is frightening and will not and cannot possibly to a good end when it comes to the question of global warming or the potential for anthropomorphic global warming. As you know, we've just had two big hurricanes in the United States that went through Florida and the damage in North Carolina might be enough to affect the American presidential election. The rains were that bad because politicians like to blame each other for not doing enough hurricane relief.

Robert Friedland (23m 35s):
And we've had the hottest temperatures ever recorded in the Mediterranean Sea ever, which is resulting in water. Tornadoes, which have a tremendous amount of energy. Water weighs a metric ton per cubic meter. Imagine a tornado made out of water, how much more energy it takes to lift that water miles up into the air that's formed by hot water in a big bathtub called the Mediterranean Sea. The problem is that long ago the Chinese are a 5,000 year old society, centrally planned, intelligent people involved in the planning process, looking at the whole situation. They long ago concluded they could not be dependent on crude oil from the Middle East. They did the sums. If you have 1.3 billion people, that's a huge advantage and if you have 1.3 billion people, that's a huge disadvantage. If you, if everybody in China had an internal combustion engine and I mean everybody and they had to rely on oil from the Middle East, they knew that they could never get there from here.

Robert Friedland (24m 39s):
The United States Navy is too proficient. China has only five deep water seaports and the Chinese military, and I am talking about a generation ago, 30 years ago, said, that's not viable. You know, we just, we are never going to be able to be a middle income country and get everybody an internal combustion engine. So they said, well, you know, the sun shines, let's build a solar industry and the wind blows from Mongolia from the north, it's cold, so it has a high energy density. Let's build a will, a windmill industry to try to reduce their dependence on crude oil from the Middle East, which had to be brought in through five deep water seaports. They could be bottled up by American nuclear submarines. So the energy transition was just based on originally in China, on national security grounds. Nothing competed with the US Navy and they don't have a lot of seaports.

Robert Friedland (25m 32s):
America's got seaports on two coasts, right. We got the left hand coast and the right hand ghost. China doesn't have that and China did not win the lottery when it came to crude oil endowment. So it was really based on national security that they started thinking let's electrify our economy. Plus they had very bad air pollution, they are burning coal smoking out their kids. The particulates in the air were first announced by the US Embassy in Beijing and then when you got your hand phone, you could see the particulate index in real time and that was embarrassing and the leadership said, well then we're gonna lead the world in the electrification of the economy and they are still doing that. It's just that the task is so gargantuan. You know, they need hundreds of nuclear power plants. They have to do geothermal power on a massive scale and even with all their solar and wind, they need to do energy storage on a massive scale.

Robert Friedland (26m 36s):
We're involved in a grid scale battery business there so that you can absorb solar and wind into batteries. But it's very important for the people listening to this podcast to understand the immensity of the task and the disruption it has on critical raw materials. Because if a raw material is super rare we will never get there from here. There just isn't enough of it. If you think about the movie avatar, the bad guys were the miners. They were mining unobtainium. This unobtainium existed on some rare planet where the locals held hands in a circle and chanted ohm in a beautiful, idyllic nature-based society and the miners went there to get that unobtainium. We need to separate out what is obtainable and engineer that in a transition that genuinely results in a reduction on a global basis and global

warming. Yes, and you know that at COP 28, it's blatantly obvious, we are approaching a mathematically zero chance of holding global warming to one and a half degrees if in fact human beings are responsible for this warming.

Robert Friedland (27m 51s):
If you buy those models, you believe those models by our own models, we have already lost the one and a half degree target. We're probably looking at three degrees, four degrees, five degrees. We're looking at a potential runaway greenhouse effect and we're all gonna get punished for it. As a species, you saw these hurricanes, you don't normally get 20, 30 inches of rainfall in a day, but it's the same thing's happened in China. There have been these bizarre weather aberrations. And then when you go mining let's say you wanna mine some stuff for the energy transition, you build a tailings pond, that tailings pond, one of those big rainfall events comes along and it fills the tailings pond and the tailings pond bursts and you lose the market capitalization of the mining company. The existential risk of a tailings pond bursting means you can't go mining the unobtainium in the first place because the environmental liability for mining is so high.

Robert Friedland (28m 49s):
If that tailings dam burst, you know, vale in BHP had a tailies dam that burst in Brazil, that one failure resulted in over $40 billion of liability and they are trying to get a settlement in the $20 billion range that hasn't been accepted by the Brazilian government. And so the major mining companies have these legacy tailings dams. They are scattered all over the planet. As the earth gets warmer, some places actually get more rainfall and some places actually get less rainfall. The global pattern changes and if you've got a tailings dam in a place with a lot of rainfall, that tailings dam can fail and if that tell you Sam can fail, you wish you never tried to mine whatever it was you were trying to mine. So we have a interlocking, nested set of engineering dilemmas how we re-engineer this planet. Now Elon is anxious to get some human beings on Mars and to make them sustainable in his fear that we're going to eliminate our species, that we have to become interplanetary because we have learned so much.

Robert Friedland (30m 02s):
We have so much information. What a shame if we blow each other up and all this accumulated knowledge is lost. I kind of agree with them. It's a rational thing to worry about and we can get to Mars for sure but what about the 8 billion of us that are sitting down here on the planet and the beauty of our nature and all the other species that enjoy our planet. We really seriously need to talk to our adversaries and find a way to coexist without getting to the three letter word that the most obscene of all words, war, war, war, nuclear war. We should go back and watch the mouse that roared all the early fears about nuclear war. All the old songs that were written about nuclear war because we're simultaneously hurdling towards warring camps run by artificial intelligence and warfare driven by drones and androids and robots.

Robert Friedland (31m 08s):
Now AI uses astronomic amounts of electrical energy. If you do a Google search and all of us are guilty of doing Google searches, you use the quantum of energy it takes to run a hundred watt bulb for about 10 or 12 seconds Every time you go.you did a Google search. But there are billions of Google searches per day. They are not free, they are paid for by advertising but the quantum of energy that's used in those Google searches is astronomic. There is nothing green about it. Now when we go to an AI search and you ask chat GPT to write a Valentine's poem for your wife or girlfriend and you do a GPT search, you are using the quantum of energy to run that light bulb for two or three minutes and you know, with humanity uses a lot of its energy on stupid things like writing poetry or pornography goes out throughout the universe, a lot of energy involved.

Robert Friedland (32m 14s):
But imagine when that energy is used to drive a drone. My drone is coming to kill you. It knows what David looks like. It can recognize you with facial recognition technology. Maybe there is a hundred of them looking for you and there's a latency to the control of that drone from a satellite, say a low earth orbiting satellite and the data that drives that data, that's AI and so if my drone is a billionth of a second faster than your drone, you die. I don't, you know, that great book Flash Boys about how people move their commodity trading center close to the Comex of the NYMEX, the little jump in time on electronic trade. Well it's the same thing with drone warfare. If the controls on my drone go through 6G wireless to kill you faster than you can kill me, and we automate this thing and we turn it over to robots, I thought we are going to be very careful about how we use AI.

Robert Friedland (33m 15s):
But apparently open AI is now going to be a for-profit organization. After all, there's some really terrifying trends going on here that are crazy energy intensive. I think we're a lot of people are admitting just AI is gonna require an 8% increase in America's electrical load. Do

you have any idea how much energy that is for AI? Like with what, how are we going to generate that power because in AI it can't be solar, it can't be wind, it can't be intermittent, it's got to be 24 hours a day. So people are looking for now old nuclear power plants to start them up again just to run their data center. I mean it's insane. I mean, and how are we gonna start burning oil and gas if everybody's running around building nuclear power plants just to run their data center. Like let's get real here.

David Greely (34m 08s):
I grew up outside Philadelphia. So when I saw the announcement that Three Mile Island is being reopened, you know, as the site of the worst commercial nuclear disaster in the US and it's being reopened to supply power to Microsoft for data centers and I was curious, do you see this as potentially a good thing or a bad thing in terms of if we need to find these other more sustainable types of ways to generate electricity, we still have the transmission issues are we going to see a nuclear renaissance, a different type of reactor than the past geothermal? If you had to place your bets, like what technology for creating the power that we are going to need, do you see as potentially there or do we just have to realize we're not gonna be able to supply all this power

Robert Friedland (34m 55s):
A hundred percent for sure. Humanity can generate all the power we need and we can stop burning hydrocarbon and coal and not only can we do it as a species, we have to do it. It's just a matter of how much pain we take and how much damage we do to each other before we get there from here. Or alternatively we have to live on Mars and you know, 300 of us will carry on the species, on another planet. Now, in a sense, nuclear power is terrible and nuclear power is wonderful. It was developed based on uranium fish and power is based on uranium because it made the beautiful byproduct of nuclear weaponry. When we set the whole thing up, we used uranium rather than thorium. We could have based all the on the thorium cycle, but it never would have generated nuclear weapons. So it's not just that you have to mine uranium, you have to convert it into control rods and you need, you need the graphite control rods, you need the uranium to be upgraded so that you can use it in nuclear power plant.

Robert Friedland (35m 57s):
So that whole cycle is archaic and generates atomic weapons as a byproduct and we can continue to build nuclear power plants, they're fine but what are they made out of. They are made out of these same metals. You need astronomic amounts of copper and you need nickel for stainless steel. You need specialty metals like niobium for the containment vessel of those nuclear power plants and America long ago lost the capability to build nuclear power plants. We don't build them anymore. The Chinese build them, the Koreans can build them, the Russians can build them fairly efficacious. Russia less so know that they're under sanctions, but the Koreans can build them efficiently. China can build them efficiently running on the uranium cycle with all of the national security risks. As that technology proliferates, depending upon how ardently concerned you are about global warming, a lot of environmentalists are falling in love with nuclear power.

Robert Friedland (36m 56s):
Again, not that many people died with 3 Mile Island or the Fukushima disaster. And it just depends. Do you want to die in heat? Do you want to die in cold? Do you want to freeze in the dark? Do you want to be boiled in oil? Nuclear power is definitely 24 hours a day. It can power data centers. If you want to make money in the data business like Microsoft or Google, it's probably the least worst alternative right now is to go back to Three Mile Island despite the disastrous brand. Imagine Google brought to you by Three Mile Island, Microsoft brought to you by Three Mile Island. Terrible idea. But maybe the least worst alternative. But as you know, and we have talked about this in previous podcast, mother Earth is a nuclear reactor. The core of the earth is almost the temperature of the surface of the sun from a naturally occurring fish in reaction in the core of the earth.

Robert Friedland (37m 56s):
And so geothermal is an obvious answer and as you know, our private unicorn eye pulse is revolutionizing geothermal power by finding a better way to drill. There are others doing this, working on this problem, but once humanity has a faster, cheaper, better way to drill in hot rock, we can generate power 24 hours a day, 365 days a year forever from Mother Earth's own natural heat with no global warming effects and if you look at the cost of, let's say the Gulf War, you remember shock and awe when America mind, we bombed Saddam Hussein. There's a multi-trillion dollar cost to that war. It wasn't just a trillion or so that we spent bombing the place and finally finding Saddam Hussein and separating his body from his head. But the price of oil went up worldwide for all of humanity. And so the indirect cost was multi trillions of dollars.

Robert Friedland (39m 01s):
You could probably build a case that costs two or 3 trillion just the Gulf War and so you think that humanity can't figure out a way to drill geothermal wells all over the planet and generate the electricity of course we can, but we'll never get there from here when the media is so hopelessly misdirected that the garbage they are talking about, nobody has any basic idea about how to re-engineer the planet. Now, electric cars are great for other reasons. When you live in an urban environment like New York City or Beijing and you breathe the air from internal combustion engines, there are these sub 2.5 micron particles of heavy metals get into your bloodstream and go beyond the blood brain barrier and they are probably a principled cause of dementia, Alzheimer's cancer, heart disease, growing to the World Health Organization. So even if we didn't reduce global warming, it's a great idea to have all cars be electrical.

Robert Friedland (40m 05s):
And what Elon has achieved is fantastic, giving the traditional automakers a hot foot and forcing them to start building electrical cars. But don't fool yourself. You know, we've converted a tiny fraction of the global fleet from hydrocarbon to electrical cars. 50% of our electrical load is still generated burning coal. If you buy a Tesla in Quebec, it's primarily a hydropower generated car and same thing in Norway. If you buy an electric car in Norway, you are proudly driving a hydroelectric dam and the hippies used to lay down in front of hydroelectric dams. They didn't like the idea of flooding a valley and building a hydroelectric dam. Remember but New York City is running on hydroelectric power from Quebec and when the power line fails, all of New York City went black and a lot of babies were made that night. But there was a huge increase in crime in the dark.

Robert Friedland (41m 05s):
There is no simple answer here, but the least worst alternative, the best way to solve this problem is with geothermal power. No doubt about it. The heat is right underneath our feet. And the second best would be to generate nuclear power with thorium. And both India and China are working hard on the thorium cycle. Now a lot of people are talking about small scale nuclear reactors. They're okay if I am building a remote mine site on the North Pole, I would like a small scale nuclear reactor for the power. But they run on uranium and you know, if they are uranium based, they're less than ideal. They can be safe. We can engineer a better generation of nuclear power plants. But you know, they are too many lawyers in America, right and you understand the banana principle build absolutely nothing anywhere near anybody. So when you want to put that small scale nuclear reactor in Scarsdale, New York, just how long is the litigation going to take?

Robert Friedland (42m 06s):
And so maybe you could do it in China if the central government resolves to do it. They have a much shorter permitting process. But in democratic society where you vote for the least worst alternative for president where the presidency changes every four years and then policy changes every four years, you can't come up with a commitment of long-term capital to fundamentally transform the way we generate power and transmit it. You can do that in China, you could do that in Russia where you have, you know, a leader that's around for 25 years. You certainly can't do it in the United States. When the Donald becomes president after November 8th he says he is going to drill baby, drill right and if Kamala is the president, she would probably do the opposite. But this is no way to generate and change your energy transition system. If you believe in anthropomorphic global warming, America can probably transform itself faster than most societies.

Robert Friedland (43m 09s):
But we won't get there until the mass media understands we don't need lithium in the scale that people think we need it. It's not just about building electric cars. We have to start with how we generate electrical energy and transmit number one and number two come before number three and the miners are like the gods in this process. Without the miners, we can't even take the first step. Nothing is going to happen without the miners and so the legacy miners are a critical part of the system. Rio Tinto, BHP, Codelco, Freeport Mac brand, Gin Mining, the large legacy miners, they have to transform themselves and without their skillset. What's the plan, Stan. What are we going to mine? Why are we gonna mine it. How are we going to mine it sustainably. You remember, there is a big copper mine in Panama. Cobra Panama got shut down by environmental opposition in Panama that mine burns 300 megawatts of coal to generate the power to mine copper. Well, if we have to burn coal to mine, the copper, let's just give up before we start because the volume of copper we need is so far beyond your imagination.

Robert Friedland (44m 44s):
It's just crazy. We've mined 700 million metric tons of copper as a species. Going back to Mohenjo-Daro, go back 5,000 years. We've mined 700 million metric tons of copper. We are using 25 million tons a year right now. Where is that copper? Where is that 700 million metric tons. We have already mined. Well, 350 million tons or so is in the American electrical grid. It's in all of our buildings. If you want

to get it back, it's easy. Just tear down every single building and everything in America to zero, make it look like what the Sioux and the Navajo add before we arrived. Get rid of New York City and LA and Chicago and you will get your 350 million metric tons of copper back. And there's a hundred million metric tons in Great Britain and then there's Europe with another 150 million metric tons, but that's 700 million tons of copper is the modern world.

Robert Friedland (45m 44s):
Everything you touch, if you have ever gone into a room and turned on a light bulb or made a phone call or written in a car, or float in a plane. So we need another 700 million metric tons of copper in the next 20 years just to maintain 3% GDP growth globally without an energy transition. That's with no energy transition. That's doing things the way we have always done them. With Aramco, drilling oil wells and refining oil, the copper intensity obviously goes up when you electrify the world economy. Now if we go back to burning coal to run the copper mine, we should just give up. So environmental opposition, $10 billion was invested in that mine. Well, Leonardo DiCaprio didn't like the idea. Hollywood came out in opposition. The mine got shut down. We need that copper for the energy transition. We just have to find a way to mine it without burning coal.

Robert Friedland (46m 43s):
Now what's the alternative. I am building a hydroelectric dam. We're rebuilding a hydroelectric dam in the Congo to mine copper. But the rotor for that hydroelectric dam needs about 90 metric tons of copper. When you build a hydroelectric dam, you need the copper to make the power to mine the copper. You want to build a nuclear power plant, you need an astronomic amount of copper to make the nuclear power plant. You want to fly a more efficient aircraft, you want to replace a 747. There is astronomic amounts of copper in an aircraft and the widespread ignorance of the supply chain and where things come from, it leaves us miners breathless.

David Greely (47m 21s):
And I wanted to ask you one last question. So we don't have nearly enough copper. We got to refocus. Refocus on copper, refocus on aluminum, refocus on how we are going to generate the electricity and have the ability to transmit it and I wanted to ask you back to the geothermal piece, because that seems to be where you would be focused or where you would recommend that the world focus, its attentions relative to say, solar or uranium. Nuclear. If we were to pursue geothermal in a serious way, what do we need to do? What are the steps? Do we still need some technological breakthroughs or is it more investment dollars and certain resources?

Robert Friedland (48m 10s):
Not only can we do it, we are doing it right now. I'm extremely optimistic about our species ability to solve this problem. If you take a look at what Elon has managed to do, launch a very large booster into outer space, lifting most of the mass that humanity is sending to outer space, and to bring that booster down backwards and to land it within a half a centimeter of where it took off from and to grab it with arms before it touches, that proves to you that our species can do virtually anything. But you need that kind of thinking. You know, you need that kind of completely out of the box thinking to get there from here. And the problem of liberating geothermal power, we have solved it. We're doing it right now in a private American unicorn. We have major institutional investors. We started with breakthrough energy ventures, which is a fund that Bill Gates put together.

Robert Friedland (49m 10s):
There are a lot of prominent billionaires in that fund. If you go to their website, you will see their names and then the European economic community invested and then BHP, the largest of the miners invested. They're followed by Rio Tinto, the largest of the miners. The Newmont, the biggest gold miner came along. Gold is an a nominal all-time eye, but we don't need it for an energy transition. All the gold miners want to be copper miners because they know that they'd rather mine something that we need. We used to put gold in our teeth. We don't do that anymore. So the major mining companies have to be given credit that in their senior management, they sincerely realize their critical role in any potential transition. And they realize what they need to mine and how they need to mine it, which is why everybody wants to buy copper.

Robert Friedland (50m 05s):
BHP was bidding for Anglo to get their copper assets. I have been spending time with maximal Pacheco. He is chairman of Delco. He's my new best friend and we sit around all night long talking about how we can as an industry, save the planet and all of the burden of this noise about global warming rests on our shoulders and it's a scale problem. Just look at the scale of the money that goes into armaments. How much money goes into nuclear submarines, intercontinental ballistic missiles And I am not saying we shouldn't build nuclear submarines. Maybe we should. The other side is building them. Maybe we should build more ICBMs. The other side is building

them. You know, we live in a very dangerous world before we blow each other up, threatening each other with mutual assured destruction, where you desperately need to find something we agree on.

Robert Friedland (51m 10s):
And I'm firmly of the view at my age that China and the United States must establish a set of rules under which we can compete rationally. Like the rules for rugby. You can bash into each other and you can break each other's collar bones. But according to a set of rules where we work cooperatively, because we are truly all in this together. And I, I've talked to a lot of my Chinese friends. In fact, I was in Shanghai Day before yesterday. I just came out of Beijing in Shanghai and we need to reestablish communication post COVID person to person with the Chinese and we need to find common ground. Even as we balkanize the world into two war in camps, you know that the war in Israel and Gaza is directly genetically related to the war in Ukraine. Ukraine, they are one conflict. Iran is building sophisticated drones and is sending those drones to kill civilians in the Ukraine through Russia.

Robert Friedland (52m 10s):
And now North Korean troops are said to be going to go kill Ukrainians on behalf of Russia and so, you know, this feels like the years before World War II, where the Germans and the Japanese ended up on the same side of the conflict. But in that conflict, the Chinese were America's ally, the Chinese were America's ally against the Japanese. How quickly we forget, we forget that the Chinese name for America is me, which means the beautiful country. How can we go to war with a society where everybody in that society refers to the United States as the beautiful country and so let's try our best to increase interspecies communication. Let's have Chinese speak to Americans and let's focus on what we need here. Because the military demand for copper is exactly what is making the energy transition more difficult because the military demand for copper is the same copper we need for the energy transition.

Robert Friedland (53m 20s):
And let's stop filling the airways with all kinds of nonsense about lithium mining and paving the earth in lithium mines. There is much better ways to mine lithium. There is much better ways to store chemical energy. LFP batteries already got rid of nickel and graphite and cobalt in the batteries. Like just LFP batteries don't use any nickel. They don't use any cobalt. So there is a choice of chemistries in batteries. Pure lithium, a startup in Boston has developed much better battery chemistry for chemical energy that doesn't use any nickel, doesn't use any cobalt. It uses lithium metal and a and a new valence of vanadium as a better battery, humanity can invent a better battery. So all this endless listing of nickel and cobalt as being necessary for the energy transition is nonsense. We do not need cobalt for the energy transition. We do not need prodigious amounts of nickel.

Robert Friedland (54m 22):
And there's plenty of it around and thank God. But what we need is government policy to avoid war and to put all that liquidity into a real reasoned energy transition. Could be a renaissance of nuclear power, could be more rationally. Geothermal power could be solar and wind as an interim measure utilizing better storage technology, you have to store that energy in the grid and of course natural gas as a transition fuel, it's just less worse and it's rational to use natural gas as a transition of fuel. It's going to take some of everything. So going back to your question, no, it's not exclusively geothermal. It's not geothermal instead of natural gas or LNG. No. The energy requirement to keep everybody fed and clothed is so great that we have to kind of make a transition. You may have seen my analogy before that I have interviewed over 50 male billionaires and not one of them that I have found jumps into his pant legs both legs at a time.

Robert Friedland (55m 35):
Everybody puts one leg in and stands on that leg and then sticks in the other pant leg. We need that natural gas. It's less worse than coal, it's less worse than oil as part of a transition to something and the something has to be well engineered and well thought of. If all the world's governments cooperated on geothermal power, we could have distributed power all over the planet, clean and green at a fraction of the cost of the Gulf War. That's what's so frustrating about all this at a fraction of the cost of the Gulf War. But it's gonna happen, David. It's really and truly going to happen. If you see a guy like Elon who has repeatedly done the impossible the world is going to breed a lot more Elon's. They are going to come out of India, they're gonna come out of China, they are gonna come outta the United States, and there's sufficient capital sloshing around.

Robert Friedland (56m 35s):
We don't need half the money in the world. We need 1% of the money in the world and we can re-engineer this planet and I am a 100% percent certain it's doable and I'm sure it's going to happen. Providing these warring camps we're creating stop rushing headlong into a nuclear conflict and so smarter markets implies smarter policy. Now I think Donald Trump has said some very good things. He said, I

don't care if the Chinese sell electric cars in the United States. I don't care if China sells electric cars in the United States as long as they built them in the United States. That's very pragmatic. I think it's possible to make a deal with him. I think he's listening to Elon Musk, Elon's a hell of an engineer. There is hope. There is hope in any quarter. Not really necessarily true that the Democrats have all the answers about how to green the world economy.

Robert Friedland (57m 33s):
We have to get beyond partisan politics. We have to live through this election season. And then we need the United States of America to get intelligent people to sit down with the Chinese and the Indians and the Europeans and all the Africans and all the South Americans, and map out a realistic plan to prevent this planet from warming to 3, 4, 5 degrees because we have made no progress so far. We are burning 104, almost 104 million barrels of oil per day today. It's an all-time eye after trillions have been spent on incipient steps on solar and wind, not good enough and don't worry, the miners can mine what we need. We can do it. We need more capital and we need government support. The Chinese miners have government support. They are not tied to net present value models. The Chinese miners are allowed to go out and given the capital they need.

Robert Friedland (58m 33s):
Za Jin has grown into a company bigger than Nma Barrack in a few years with Chinese government support. If Western governments got behind the miners, instead of beating them to death with a club, if we had access to limitless government funding, we could mine the medals we need for an energy transition readily. No problem. We can do it and we can do it in a greener way and we can make this total change in the next 10 years. In the next 10 years, we can do it. Now it's looking more and more like Indiana Jones in the Temple of Doom. That movie where the walls are squeezing in and this great big giant stone ball is coming down a track to crush you and you have got to dive underneath a door like a guillotine coming down. It's gonna be very close because it's getting hot out there.

Robert Friedland (59m 32s):
And these hurricanes, these rains, these heat waves like Phoenix experienced this year. Phoenix had 110 days where it never went below a hundred degrees Fahrenheit. Even at night. This never happened. Record heat wave in Phoenix, Arizona. What about water? What about agriculture? What about food? We need smarter markets. We need smarter people running smarter markets and we need to get this podcast into the heads of policy makers and I am an optimist. I think we can do it. I think I pulses is going change the world because we have already changed the miners. All the miners are fighting to get involved with our technology. Without it, we won't be able to mine the copper. You need to have the energy transition or the other ancillary metals and the military wants those metals anyway. So mining will revolutionize itself. The major mining companies are talking to each other and recognizing the scale of the problem.

Robert Friedland (60m 36s):
They're all making good steps at varying speeds. Of course, the biggest miner is BHP and BHP is led by a visionary. CEO. He is invested in what we are doing and then Rio Tinto came along number two, you know, CIDELCO big in copper roll talking to each other. First the miners have to get organized and then we will save the world. You know, at the Colorado School of Mines, which is probably generally considered the world's best mining school, there is a lot of great schools for mining but Colorado School of Mines is a big deal. They have two bumper stickers that were very popular there the last 20 years. The first one was stop mining, let the bastards freeze in the dark. So if you shut down all the coal and oil that's being burnt today, the bastards freeze in the dark stop mining and then the other one was earth first.

Robert Friedland (61m 36s):
We'll mine the other planets later. Well that's exactly what Elon is proposing to do. He's gonna take a 3D printer to Mars and start mining in Mars so that our species can live on in the event we blow up this planet. Now, I'd rather stay here. I would rather do what we can for the 8 billion people and the limitless species on this planet and I would really like to play a role in educating the average person who hasn't got a clue about the supply chain that we have got to start screaming about how important it is that we really make a realistic engineering attempt with things like geothermal power or a Renaissance in nuclear power. And we need all the billionaires to help and we got to stop beating up the billionaires with a stick. 'cause Some billionaires are better than others. You know, some billionaires are better than others.

Robert Friedland (62m 28s):
At least Elon's making an effort to be part of the solution, not part of the problem and there are plenty of other billionaires to go around. Now we don't need billionaires if governments would put up the money, but generally the billionaires make all the choices and

make things happen faster. So I know this is a long and bizarre rant, but I'm frustrated that the 200 Smarter Markets podcasts we have made already, haven't saved the world. We have started a conversation and there are people in the financial markets interested and now this affects their money that's true. But as a species, we have not even made the first baby steps towards exchanging how we generate power, how we transmit that power to the point of use, and then how we change the way we convert that power to chemical energy in a battery for an electric car and so we really need to educate everybody about the scale of the problem. This massive undertaking should lead to world peace, not World War.

David Greely (63m 39s):
Thanks again to Robert Friedland, Founder and Executive Chairman at Ivanhoe Mines. We hope you enjoyed the episode. We will be back next week with another episode of Markets in Transition. We hope you will join us.

Announcer (63m 57s):
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