The Great Simplification

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[00:00:00] **Scott Tinker:** What humans do is we move stuff around, Nate. We, we move ourselves. We move our food. We move our pets around. We move our products around. It's all about movement. You start cranking up the price of that transportation fuel and the price of everything goes up. If you really can't move, you can't afford to move things around.

[00:00:19] Everything stops. The gears of the global economy grind quickly to a halt.

[00:00:28] **Nate Hagens:** This week I'm joined by Dr. Scott Tinker, who is an energy educator and geologist. For a wide ranging overview on the state of energy and Oil and the importance of energy literacy for everyone, everywhere. Following a career in the energy industry, Scott became a professor of geology at the university of Texas at Austin, as well as the director of the Bureau of Economic Geology and the state geologist for Texas.

[00:00:57] He is the CEO of Tinker Energy Associates, as well as chairman and CEO of the educational nonprofit Switch Energy Alliance. Additionally, he hosts the energy and climate talk show energy. PBS, while there are some areas where Scott and I disagree, which he and I, touch on and unpack in this conversation, he and I are highly aligned on the importance of making discussions about the future of energy and our environment widely available and understandable for the average person.

[00:01:31] So we all can have an informed say on what we'd like for the future of our world and energy's role in it. With that, please welcome Professor Scott Tinker. Scott Tinker. Welcome to the program, Nate.

[00:01:45] **Scott Tinker:** It's great to be with you. How are you

[00:01:47] **Nate Hagens:** today?

[00:01:48] **Scott Tinker:** I am doing well. You know, there's a lot going on in the energy world, so it's fun time.

[00:01:53] **Nate Hagens:** There's a lot going on in the world. Full stop. so we have a lot to talk about, even though we've recently just, just been introduced to each other. Let me start with something I expect. We fully agree on that our culture in the United States and globally generally misunderstands energy. let alone the foundational role that energy plays in the past, current and future human societies.

[00:02:23] And this is a central theme of this channel, the great simplification. but you're a long time energy educator. You have the, energy switch, show on PBS and you get presentations all over the world. I'd like you to give me your, Outlook or your explanation of how important energy is and why we, neglect that fact in our culture.

[00:02:50] **Scott Tinker:** Well, I, we do agree on this. and it's probably a lot of reasons. I don't know, certainly all of them, but, we are under educated when it comes to energy. And I think it starts with the, you know, kind of in the schools, Nate, where we really don't have a lot of energy education in schools. And what we get is fairly limited and reasonably biased, candidly towards certain things and away from others.

[00:03:17] And I'm talking about in the kind of, I'll call it the rich world, the developed world. As you push throughout the globe, and you said worldwide, we see, gosh, the need for education at all in parts of the world. There's woefully lacking in the really poor world of the United States. Evolving world and emerging world, and then in the developing world, which is the big chunk of our planet today, education is a mixed bag for sure.

[00:03:48] So energy just doesn't surface there, and the challenge with that, I think, is we get educated with so many other things, and they're important. Hell, everybody learns about food. We somehow by the end of elementary school, I know what the food pyramid looks like. I, I know what I'm supposed to eat and not eat.

[00:04:06] It doesn't mean I do it, but at least I understand what calories are and sugars and breads and cheese and meat and protein and all these kinds of things.

You know, I don't, we don't get that with energy. And, and so it leaves us in a place where we all have strong opinions about it with, with very little knowledge.

[00:04:28] And that's, I think the great challenge, that energy IQ, how do we raise that IQ to a point where we each have a base level that we can talk from and if we can get there and that's one of my passions is truly. Probably yours too. Getting us to some base level of physics and economics based knowledge, not emotion and passion.

[00:04:50] And I think our leaders both in corporate America and corporate world and in political world would be better served and they'd probably be happier if they had an energy educated public, they'd probably be able to do some things that. They can't do now because their base doesn't understand what they're asking for.

[00:05:10] I think it helps everybody in the long run, and that's why I've pushed all in. I think just recently meeting you, as you say, but from doing a little quick look at you, it seems like you pushed into that as well.

[00:05:22] **Nate Hagens:** Well, the, the central thing, I mean, there is energy education that says this has a kilowatt hour worth of energy.

[00:05:29] And, you know, they talk about thermodynamics and electricity and wind turbines and coal. And the fact that our entire civilization is dependent on energy. 85 percent of which is fossil energy, which our culture is treating as if it were interest, but it's really a bank account that we're drawing down from geologic times.

[00:05:54] That's the thing. That's not taught.

[00:05:57] **Scott Tinker:** Yeah. Yeah. There are a lot of terms out there as you said them, but quite often your eyelids close when you what the hell is a kilowatt hour compared to a kilowatt. You know, and those are very different things, or, you know, a barrel of oil compared to an exedule, et cetera, what's a TCF, a gas, et cetera.

[00:06:18] These are, we don't know, these and, and I think there, there is fossil energy, as you said, things that come from natural processes that form coal or oil or natural gas, through time. And they're very different things, by the way, those

three things are very different. Or, yeah, but they're natural and they're free, they're a free resource on the earth.

[00:06:43] Now it's expensive to get it. Okay. you know, the sun and the wind are natural too, but it's expensive to get them. Okay. And this is, this is where I think we need to begin to comprehend. Batteries are cool. I have them in all my gadgets, but it's expensive to get the stuff, the metals to make the batteries and it isn't without.

[00:07:05] Impact on the earth, so that's really what we have to start thinking about is the is the budget, if you will, of the earth to provide energy. Now we may differ here, I, I don't think really there's any practical limits on. So called energy for human use. I don't, I think we're far from

[00:07:26] **Nate Hagens:** limits on those things and I, and I think there's a, an interesting way to, to present that.

[00:07:34] and I'd love your, your input, but firstly, there's a, the recent graph from, a couple of months ago now, ExxonMobil showed their global oil, supply forecast out to 2050 and it's roughly flat, but. It shows a for the existing wells and fields in the world, there's a 15 percent annual decline rate, which means that if we stopped drilling today in the world, we would drop by 90 percent in our production plus or minus in the next 20 or 30 years.

[00:08:10] So we have to make up for that with investment in existing fields and new resources and projects needed for. So you, my understanding is you were the head of the American association of petroleum geologists, you were the head geologist for the state of Texas. So from a geologist perspective, how do you describe this, this graph and, and what is your, kind of middle of the road projection for the next 30 years?

[00:08:38] **Scott Tinker:** Sure. Yeah. Been involved with lots of different organizations and, and that's always been that way. It just probably people don't know that. Physics determines the decline rates from the subsurface. So when you go down and drill a well into the subsurface, you start to release pressure because there's a lot of pressure from the rocks above the reservoir that push on that and,

and you poke a hole in that, like popping a balloon almost, and that's what allows for fluids and gases to flow up to the surface through a wellbore.

[00:09:14] And you immediately start to decline, pressure decline. And the energy to lift that oil or those liquids and those gases begins to decline, and that's just natural. So you see a reservoir usually come on strong at the beginning and then decline through its life through some amount of time. Conventional reservoirs have big pores.

[00:09:37] They're not big, they're little pores, but they're big relatively that are reasonably well connected. So all those liquids and gases flow to the well bore along with a bunch of water, old salt water from old oceans. And the oil and gas business is a water handling business in it. And it gets some oil and gas along with it to be candid.

[00:09:56] They handle a lot more water than oil and gas.

[00:09:58] **Nate Hagens:** Let me interject there. So you said it comes out with salty water. Is that literally water from the old oceans? That's been sitting under the ground for as long as the oil has.

[00:10:10] **Scott Tinker:** Yes, longer, because when those rocks, when those sediments are buried and we're talking about, let's think about a beach sand or a turbidite sand out in the deeper abyss or carbonate reservoirs like reefs you might snorkel around, those are all deposited in oceans.

[00:10:29] And sometimes you have rivers or lakes, but most of these things that produce oil and gas are sedimentary rocks. Those sediments get buried, again, mostly oceans, and, and with time they become rocks, they become lithified. So, you start to bury those sediments and they go deeper into the earth, and they get cemented together, the little grains, and they mostly rock, but some little holes between those grains, just like on a beach.

[00:10:56] And, And the old ocean is buried with them. The old salt water. So you're producing old oceans when you tap into that. And it's just like the oceans of today, only it's had a lot of time to have other things get into it as well. So they can be

kind of nasty, the produced waters there. But all of the sedimentary rocks in the Earth are filled with old oceans.

[00:11:20] I actually looked for oil and gas back in the 80s and I found plenty of salt water and ate. I was really good at it, but it qualified me to be a professor. I didn't find much oil and gas. So, the oil and gas is only in a some limited places really, think about. The oil and gas comes from organic rich sedimentary rocks, they're called shale.

[00:11:44] It's sediments that get buried with a bunch of plants. And deep into the earth and they get concentrated, the organics, and heated up, so cooked if you will. And they go from being old plants to hydrocarbons. The organics come off as cooked hydrocarbons essentially. And just like when you drop oil or gasoline on water, it floats, it's lighter, it's less dense.

[00:12:10] So in the subsurface, what happens is the, the oil and the natural gas, which are lighter than the water, tends to want to float up through those pores toward the surface. And that's what it does. It gets stuck along its path, trapped between kinds of rocks that it can't flow through. They're called seals.

[00:12:29] So you end up trapping oil and gas in these Hydrocarbon reservoirs, you have a reservoir with little holes that are open and some seal on top of it and, and you have water, gas and oil in an ideal sense, stratified like that. And it's quite interesting, you know, it's, it's quite fun to think about all the physics of that, but it's all under pressure.

[00:12:52] So at the end of the day, when you, when you poke a hole into that reservoir, you'll produce a bunch of the water and you produce some oil and you might produce some gas as well. And through time, the pressure declines, and that's happening all the time. That physics, and it is 10 to 15 percent annual decline.

[00:13:16] So in order to continue to produce the amount of oil we consume in the world today, let's call it whatever, a hundred million barrel a day, you have to keep finding it. You have to keep replacing it. And so you'll have people who don't really understand that very well say, look at the decline. It's over.

[00:13:35] That's one extreme. And then on the other extreme, you have people saying, well, it's unlimited and it's neither of those. So you see that natural decline, through time and these reservoirs and you have to replace it. So, you know, the reservoir is declining. I've got to find that next wedge and that next wedge.

[00:13:55] And if you do that effectively, you end up building. A reserve curve that's always up and to the right. Okay. And the oil and gas industry globally. And by the way, so called big oil, the Exxon, the BP, the shell, you know, the chevrons of the world. They're only a small part of the. Global oil industry. They're not big oil.

[00:14:19] The big oil is Aramco in Saudi Arabia and Petro China Petrobras in Brazil the state owned oil companies. So state owned

[00:14:26] **Nate Hagens:** oil companies are like 85 87 percent of global oil production Something like that. Yeah, and

[00:14:32] **Scott Tinker:** they sit on on their own reserves. And so Exxon can't go into Saudi Arabia and explore, but, but Aramco can come to the U.

[00:14:40] S. You know, there's just a lot of interesting dynamics with all that. We can go into it if you want to, but back to this thought. So yes, always replacing the production and trying to grow it. The graph you have from Exxon shows that. If we don't do it, if we don't invest in that industry, if the industry is not allowed, I mean publicly doesn't have to invest, just let the private sector continue to do its work and it needs to not only drill wells, but it needs to be able to produce the oil and gas and then separate the gas at the surface and remove the oil and refine it in another location and get it to markets.

[00:15:23] It takes pipelines, refineries, tankers, all sorts of infrastructure needed, that the private sector pays for, by the way, it's a very expensive business, to get the oil and gas to markets. And, and so, if you hinder that, if you don't allow for pipelines to be built, or drilling in the offshore, or onshore, or refineries to be built, It's going to be tough to replace that, at least with the quote, big oil companies.

[00:15:51] Now, don't kid yourselves to think that that means the oil and gas industry will go away in the world. It won't. It just will be done by others and the state oil companies that I mentioned. So if you feel more comfortable with OPEC

countries and companies and Asian companies and countries owning the oil and gas in the world and Carry on, you know, but I'm kind of more comfortable with a diverse portfolio of companies that are at least publicly traded and sec regulated being part of that game.

[00:16:21] **Nate Hagens:** So I have a ton of questions on this. So you mentioned, pricking a balloon or, or drilling all over the United States. Is it true that the United States has more wells drilled than the rest of the world combined? In history,

[00:16:38] **Scott Tinker:** it might be, it might be, I can give you some statistics that I'm reasonably confident in.

[00:16:43] Texas alone has plus or minus 1 million wellbores drilled through time. And last time I checked the whole country of Mexico had less than 50, 000.

[00:16:56] **Nate Hagens:** So if oil comes from ancient oceans and seabeds, which we know, I mean, there is a finite amount of ancient seabeds, in the world and in the United States was particularly blessed, with oil and gas resource.

[00:17:13] how do we know that the rest of the world, isn't full of similar formations to the United States?

[00:17:20] **Scott Tinker:** Well, we, we know a lot these days. I think in the past we knew less, but it doesn't take it. Too many oil and gas wells and seismic, which is, a remote sensing approach, sending sound waves down to the earth and they bounce back and you can really resolve what the character of the rocks and fluids look like in the earth now.

[00:17:40] Seismic is incredible. So we know a lot about the global sedimentary basins in the world now, even though they haven't been drilled as much, we understand pretty well where the mature source rocks are that I talked about and, and the reservoirs, at least the conventional ones. And even the unconventional ones exist today.

[00:18:00] Now, they just haven't been developed nearly as much as have been the United States. So you go to the Middle East and there's incredible reservoirs there.

There's actually a much larger portfolio of, in the Middle East, of oil and natural gas. Which is why we have military bases all around there. It's part of the reason.

[00:18:20] Yeah. And it's part of the reason security of supply and men, you know, global partnerships. Russia has tremendous resources. The Siberian basin in Russia is larger than the state of Texas.

[00:18:33] **Nate Hagens:** Okay. So from a biophysical standpoint, our current cultural conversations and narratives are about money and technology, but from a resource.

[00:18:43] Standpoint, energy and materials that are non renewable on human timescales, Russia and other places have enormous things in the bank account, so to speak.

[00:18:56] **Scott Tinker:** Yeah. Yeah. And yes, and so does South America, and Africa. When plate tectonics has been active for, you know, billions of years, actually, but when South America separated from Africa and formed the South Atlantic Ocean and the North Atlantic as well, you know, then then South America fits right into the horn of Africa, you pull those apart, you see identical rock sequences on both sides of the oceans and paleo successions and similar sedimentary basins.

[00:19:28] Flooding in there and oil and gas and there's tremendous production offshore Brazil on the east and in Africa on the west and for those reasons. So there's quite a bit of oil and gas around the world. We have certainly not tapped the limits of it yet now that is driven by. Continuing to advance technologies, and it's driven by price.

[00:19:53] And it's important, when you hear the word resource, that is intended to describe the total amount of oil and gas in the tank in the earth. And we do an okay job of estimating the total resources in the earth. When you hear the word reserve, That means what you could produce from that resource, what you could produce from that tank with today's technology and today's price.

[00:20:15] Technology changes, it improves, price is volatile. So reserves kind of come and go, they go up and down. Quite often they go up, reserve growth,

because of advanced technology. We're able to get oil and gas out of rocks that we couldn't get it out of before. And that's why when you hear this concept of this static thought of Well, the oil and gas, that's it, you know, we're on decline and that's it.

[00:20:41] Well, that's it. If we were to stop the technological evolution, but we don't, well, at least we haven't today. And I don't think we will. That's not what drives that evolution. What drives it is the demand for that product. So as long as there's a pull of demand for oil and natural gas, then there'll be an incentive to continue to.

[00:21:03] push technology forward. And that could lead into a conversation if you want to go there now about production. Those are called conventional reservoirs, what we've been describing, and they're unconventional reservoirs. They call it unconventional oil, unconventional gas. It's, it's the same oil and gas.

[00:21:18] It's just stuck in different kinds of rocks. And we are the leading producers of those unconventional reservoirs in the United States, or in shales. We lead that.

[00:21:27] **Nate Hagens:** Unconventional reservoirs deplete much more rapidly, so, and our, like, 50 to 60 percent of our oil right now is unconventional, the shale plays, so our average Decline rate is much steeper than it was 20 years ago of the total amount of oil.

[00:21:45] We produce

[00:21:46] **Scott Tinker:** on a per well basis. That's true.

[00:21:48] **Nate Hagens:** On a, all the 20, the 13 million barrels we produce spaces.

[00:21:54] **Scott Tinker:** it's steeper per well. And when you aggregate those wells, it would be steeper. Yes. So what you're saying is correct. You have to continue to drill wells more frequently and. And in a denser way than you would with conventional reservoirs.

[00:22:11] A conventional reservoir might last 20 years. Peaks, starts to draw down, but has a much gentler slope. And, producing oil and gas well in a shale would be

peak, and then it comes down quickly, 2 or 3 years, and then has a long tail on it. So you have to drill more wells, but The flip side of that, Nate, is important, too.

[00:22:32] It used to be pretty hard to find the oil and gas. We didn't have great seismic sensing in as many wells. Hard to find. But once you found it, You could produce it. It came out of those bigger pores. Now I'm going to, let me just take a quick side trip. When I say pores, it's the holes between the grains, conventional reservoirs, those holes might be about the size of the head of a pin, a little pinhead or smaller, but those are big and they're connected.

[00:22:59] You know, room to room, hole to hole, that's called permeability, that connection, porosity permeability. In a shale, those holes are teeny. They are in the nanometer scale, and let me tell you, what would that be? The Barnett Shale was one of the first shales to produce here in this country. You could fit 200 of those holes, nanopores, in the Barnett across the width of one human hair, okay?

[00:23:28] That's how little they are. They're getting down to the molecular size. So it's hard to connect those little holes. It's hard for molecules to flow out of them. a methane molecule, CH4, or hydrocarbon molecules, which are more like supertankers compared to the little, you know, smart car of a methane molecule in scale and size.

[00:23:46] So it's hard to flow out. you gotta crack the rocks to make the connections to create the permeability for that to flow. That said, the shale, we know where the shales are, we know when they're mature, and so there's a lot less risk of, of discovering oil and gas. Then there was in the past, the risk in the past was you could drill a very expensive well, go down there and you didn't find economic oil and gas.

[00:24:14] So the whole cost was sunk. Zero came out. It's not like building a factory where you, Oh, your margins aren't quite as good as you hope. No, it's all gone. As opposed to shale, you go down and you drill these wells. And you're pretty sure you're going to get production out of those. In fact, you kind of know you are it's just whether or not you can produce it economically.

[00:24:36] It's more of a farming approach and you can take the technology now allows you to drill. Multiple wells, dozens of wells from a single 10 acre pad on the

surface, down a mile or two, horizontally, one, two, three miles horizontally, so you go down and you turn this piece of steel and go horizontally, you can steer it, remarkable technology, in multiple directions, and keep it within a 10 foot radius.

[00:25:03] Vertical window, like this height of my ceiling here. Okay. And you can do that at multiple levels. Now you can go down at one level and I can go down at another level. So you're literally farming or mining almost, but with wellbores, whether than the open pit mines, the oil and gas out of these shale reservoirs.

[00:25:23] It's a much, it's, I think it's a much more predictable. In that sense, you're absolutely right on a per well basis, they decline quicker, but you're aggregating a lot more of them together to build this supply curve, if you will, or this reserve curve. And I hope that makes sense. And I'm happy to say more if it doesn't.

[00:25:41] **Nate Hagens:** I have a lot of questions. I want to, I want to move back to the global macro and the concept of, of peak oil and how everything fits together. So, this concept of peak oil, the idea that there will be an all time high and then a permanent decline in oil production is coming. and gone, in the mainstream energy conversations.

[00:26:02] From my perspective, peak oil has never been about predicting or naming a certain date, but rather acknowledging that at some point there's going to be an inflection after which we're not going to be able to match such a scale of infusion of ancient sunlight into human economies again. So, so what is your general take on the concept of peak oil and what is your The Scott Tinker baseline forecast, on below ground, oil production base case the next 30 years globally.

[00:26:32] **Scott Tinker:** You know, big questions. I used to be invited to, I have good friends that were part of the peak oil societies and that kind of thing. And I would be invited to speak and they would, aha, here's our guy who doesn't think peak oil is happening yet. And it turns out. It wasn't, but it did, you know, M. King Hubbert was a guy who worked at Shell.

[00:26:53] My dad worked at Shell. He worked with King at the research lab. He kind of called it right in the U. S. only in the early 70s for peaking and rolling over for those conventional reservoirs and those technologies. But what he didn't

anticipate was the innovation of drilling and production and hydraulic fracturing and things that went on.

[00:27:14] So we created another whole oil production peak, if you will. From shale in this country, higher than it was even back then. And so it's twin peaks. You could picture that. And will there be a third peak? I don't know. We're down in the source rocks now. I want to be real clear here. We've only produced a very limited amount of the oil and gas from the shales in this country.

[00:27:39] Those wellbores decline. And we might get 30, 40, 50 percent eventually out of a shale gas wellbore. But out of the whole system, that shale system, we're probably in the 5 to 10 percent production range so far, Nate. And. And so that means we're leaving 90 percent of that down on the earth still, and that's a big number.

[00:27:59] It's a lot. It's a big target. It's hard to get. It's stuck down there in those little pores, but never underestimate technology if there is a demand for it. So my concept or thought about peak oil or peak gas is one more related to the demand for it. When will the demand for oil or natural gas, and they're very different.

[00:28:21] So let's talk about oil first. Oil is used for all sorts of products, not just transportation. But it's largest use is refining it and putting it in motors, engines, engines really, combustion engines for all sorts of things to move ourselves around. Okay, you could argue if that's a good use of it or not, and I could argue both ways, but that's what we do with it.

[00:28:42] And a bunch of other stuff, petrochemicals and fertilizers and everything. so when will the demand for that slow down? In history, the demand for things changes when something better comes along. So I've often heard the cell phone analogy. You know, well, the cell phone came along and the developing nations don't need landlines anymore, they just use cell technology or Space, space, correct, because this is better, you know, when I was in high school talking to my girlfriend, who is now my wife through the one phone in our house with a curly cube cord coming out of the closet where I was hiding, you know, this is better.

[00:29:25] It did replace that technology. What's better than dense gasoline and jet fuel and diesel, really? We'll talk about EVs, but what's better than that? And this is

why the demand, you put, I put 20 gallons of gasoline in a car. I can go for, you know, 400 miles more, 500, depending on your miles per gallon. One fill up three minutes.

[00:29:52] And, and, and I, when it's done, I go to a gas station in three minutes, I fill it up and do it again. And the. The emission is CO2. Not good for climate, but not a lot else coming out of there. It's remarkable, really. So what's better? And that's, that's the big challenge is when the demand for oil and the demand for natural gas, which has a whole suite of other uses, when it's replaced by something better.

[00:30:19] I think that's the struggle we're feeling, the dynamic we're feeling. The EV world is suffering mightily right now, in case people don't know it. But, but, but, you know, so the demand. Is going to drive that. And at some point, if the demand continues to pull too hard and there's nothing better, yeah, we might, we're going to see tension between supply ability to supply and demand.

[00:30:42] And when that tension happens, good old economics kicks in and the price goes up and it doesn't just go up a little, it's not just OPEC screwing around or blah, blah, blah, by the way, big oil. Companies don't set the price of oil. They don't, the U S ones, they don't control it. They, they live with it, but they don't set it contrary to what Congress wants to say, eh, when they bring them up there as witnesses, they don't, they don't.

[00:31:06] that's a whole different suite of things. So, but when you, if you start to see demand continuing to pull, cause there's nothing better and we can't supply it, price goes way up and then. Then, invention happens, Nate, you're paying, let's say you're paying 10, 12, 15 dollars a gallon for gasoline at the pump.

[00:31:29] Other options are going to really accelerate and new technologies that will be as good or better are going to happen. And that's the classic driver of, of, of kind of economics, technology and resource supply.

[00:31:41] **Nate Hagens:** So I don't think people understand the magnitude if, if gasoline was 10, 12, 15 a barrel, the crushing impact that would have on society

[00:31:52] **Scott Tinker:** a gallon, 10 to 12, 15 a gallon.

[00:31:55] Oh yeah, it's, it's crushing. Europe is paying. What six, seven, eight bucks. A lot of that's just taxes in order to support those kinds of, of government approaches to economies. A lot of taxes in there. California pays more than we do in Texas or the Midwest. But no, you start cranking up the price of that transportation fuel and the price of everything goes up.

[00:32:21] **Nate Hagens:** Exactly.

[00:32:22] **Scott Tinker:** Because everything in the world, what humans do is we move stuff around. We, we move ourselves, we move our food, we move our, our plants in our gardens, we move our pets around, we move our products around, I get something delivered on an Amazon truck, a toothbrush. You know, hey, I got a toothbrush today.

[00:32:43] It's all about movement, and if you're not able to move Society just comes to a grinding halt. Look at COVID, COVID 19. We shut down the world economy for a little while. Things weren't moving as well, although I still expected my groceries to be delivered in the rich world. Okay. Now who's doing that? But if you really can't move, you can't afford to move things around.

[00:33:08] Everything stops. Just the, the, the gears of the global economy grind quickly to a halt.

[00:33:15] **Nate Hagens:** So I want to, I want to eventually get back to the discussion about, the, the geologic limits and also the above ground limits, which we haven't really brought up here. but on the demand. So you said that technology, at least historically has, Shown up via market forces to develop alternatives when the price signals are high enough, but there is a growing theme, especially with the International Energy Agency that calls that oil.

[00:33:48] The end of the oil age will not be because of reservoir depletion, but because we won't need it anymore. The peak demand thesis. So maybe you could give me your thoughts on that whole line of thinking.

[00:34:02] **Scott Tinker:** Yeah, IEA is an interesting group, quite good historically, has become a little bit more of an activist organization, candidly, under Fatih Birol, and, and he works for Western, you know, Western Europe leaders.

[00:34:17] That's who pays the bills in the U. S. So they are putting out some fascinating reports, a lot of my friends around the world who I consider really truly energy. Agnostic, but energy experts are questioning some of those reports these days to be candid with you and your viewers. so yes, demand, the fossil energy age, for example, China, China has been a growing economy, more vehicles.

[00:34:46] On gasoline, China doesn't have a lot of oil and gas that it produces itself. It's trying, it's looked hard, but they don't own a lot of resource. They aren't blessed with that, like their neighbors to the north in Russia, or in the Middle East, or even Southeast Asia, Africa, etc. So they need options to oil.

[00:35:06] And same with natural gas, so what have China done and it's brilliant, by the way, I think it took a lot of foresight and a lot of investment through the belts and roads initiative and other initiatives ahead of that one, China went out in the world and started investing in buying the rights to the access for metals.

[00:35:27] In Africa particularly, but all over the world, lithium, cobalt, copper, polysilicate, other kinds of things for building wind turbines and solar panels and batteries. And all of those things require a tremendous amount of mining to build the collection systems to collect the sun and the wind, the heat and the light from the sun and the motion of the wind, and to make the batteries in giant chemical manufacturing plants, and then to put them into vehicles.

[00:36:05] All right. So China is moving towards a more quote, those solar and wind are called renewable. They're not for the reasons I just described, all the stuff to collect the sun and the wind comes from the earth. We make it into collection systems and we dump it back into the earth when it wears out and it wears out in about 10 to 15 years.

[00:36:24] And then we need to rebuild another one over and over. It's not renewable. Okay. Sun and the wind are, but not the stuff. But neither

[00:36:30] **Nate Hagens:** oil and gas aren't renewable either on human timescales. No.

[00:36:33] **Scott Tinker:** There's nothing renewable on human timescales in that sense. Maybe that's upsetting. I said in a TED talk to 1100 kids, there's no renewable energy after building Y and they got the big eyes, but you know.

[00:36:46] The sun and the wind are renewable, Well, so are, you know, yes, but you can't put them in your car. Right. Right. Right. Right, so all the stuff to collect the sun and the wind, and by the way, it takes a tremendous amount more stuff to collect the sun and the wind, and this isn't a judgment statement, it's just the physics.

[00:37:11] we're going off on a little tangent here, but this is a really important concept about energy density. So if you look at the, let's call it the energy per unit area. That's called surface power density, watts per meter squared, how many watts on a square meter of earth. The sun and the wind are on the lowest end of that other than biomass and batteries are way over there somewhere.

[00:37:36] so compared to say, oil, coal, natural gas, and nuclear, hundreds and hundreds to thousands of times denser. So, it takes a lot more stuff to collect the sun and get a unit of energy than it does to collect a thousand cubic feet of natural gas for the equivalent amount of energy. Just more stuff. And that's not judgment.

[00:37:57] That's physics. So when you, when you look at creating an electric car, for example, electric vehicle, it's about 600 percent more metal than in a combustion engine vehicle. It's not the vehicle, it's the fuel, the batteries themselves. Solar and wind take 500 percent more metals than coal and natural gas to make electricity on a kilogram per megawatt generation basis.

[00:38:23] So it's, it's, it's a lot. It's, these are big numbers and mining and manufacturing and, and then moving all the stuff to where it's collecting and then dumping it and doing it over and over as it wears out. So this is the reality of the impacts of all forms of energy. I'm not judging one or the other.

[00:38:40] They just have. Impacts on the earth, humans impact the earth, not a renewable process, and I'm a geologist. I don't mind mining. I really don't, it's not green. Nobody in my audiences, and I speak to thousands and thousands every

year, have ever said mining's green, you know, nobody, it's not, but we have to do it for so many other kinds of things, so back to China.

[00:39:05] They've brilliantly, they don't own those metals because those are all over the world, but what they've done is bought the rights to process them. So those things get shipped to China or China's in the country with their own processing facilities as part of the investment agreement. China now controls 80 percent of the world's processing of all these key metals for solar, wind, and batteries.

[00:39:30] 80 percent Nate. So this is, this is a security discussion. I lectured recently at the Naval Academy and blah, blah, blah, talking about security of supply or energy security. We have to recognize that OPEC isn't real secure for oil, but we're going to move our, and that's for transportation. Are we going to move our transportation dependency to China for batteries?

[00:39:57] 80%? And, and is that secure? Because we don't mine here in the U S much, we don't open new mines and we certainly don't open these big processing facilities and all the other kinds of things that nobody wants to do. So this is the, this is the challenge. China and the EU, okay, don't have as much oil and gas.

[00:40:20] Part of it is they won't develop it in Europe, and part of it is they don't have it naturally. So they need these options and that's why China and the EU alone, just the, you know, the EU and China are building 85% of the world's electric vehicles, 85%, just those two regions. The rest of the world, 15%, they need 'em.

[00:40:42] And that's fine. I get it. But we got to, again, is it better? Is it worse? We can talk about that. I'm happy to. Is an electric car better or worse than a gasoline engine? there's pros and cons to both as you start to think about that. So what happened with the IEA is they looked at China and said their demand for gasoline is going to go down.

[00:41:01] And it is starting to plateau because they are going in the EV world, and they're really good at it. They make them very cheap, and they're putting them out there on the global markets, and we're having to put tariffs on them here in the U. S. A hundred percent tariff, because they make them so much cheaper than we can.

[00:41:16] So, the IEA correctly said, hey, the demand in China is going to be a little less, and OPEC, for the first time, Saudi Arabia and OPEC had to kind of downgrade their Oil demand forecast. They haven't ever done that before. It's happened a couple times now. That's a very interesting dynamic going on in the world.

[00:41:35] But I don't think that we should read that to be the whole world is going to electrify their vehicles. Some parts of the world are doing it, for reasons I've just tried to explain, and others aren't. So it might be, it might not be growing as aggressively. What are the upsides of that? The upsides are companies, not just the national oil companies, but the international publicly traded companies can work to replace their reserves as we were talking about earlier at a little bit different pace, perhaps, you know, trying to make that work for a longer timeframe and it buys time.

[00:42:12] yeah, I think your question continues, I think I'm hearing, won't we eventually run out of oil and gas? No, that's not my question at all. That's

[00:42:21] **Nate Hagens:** not my question at all. Let me, let me, let me ask one thing about your point right now and I'll get back to the, the peak oil question. So the IEA reduced their forecasts for oil demand because they saw a little bit of a change in trend and in China, for gasoline demand, however, internal combustion and electric vehicles.

[00:42:45] Are made with metal and plastic. They drive on cars made from asphalt, both plastic and asphalt precursors also come from oil. Gasoline is just one of 6, 000 products from oil

[00:42:58] **Scott Tinker:** tires

[00:42:59] **Nate Hagens:** and tires. So, so they're just looking at the gasoline component and maybe with some really expensive refinery switches, we could shift some of the gasoline fraction, into the, the other fractions.

[00:43:16] A, an increase in or a decrease in demand for gasoline doesn't really mean a de a less demand for oil globally.

[00:43:23] **Scott Tinker:** Not necessarily. It might be a rate of growth because transportation is a big piece of the demand for refined oil products. Right? But you're right. It, it could be, it could be slowing rate of growth demand or using.

[00:43:37] Oil for things that are, it's harder to use other products for, you know, refined products, petrochemicals, plastics, as you've mentioned, and other kinds of things as well. So it might be a little more intelligent use and just burning it as a fuel. And we could slow that down a little bit and that would help with emissions.

[00:43:56] **Nate Hagens:** Well, let me, let me ask you that. you know, we are a clever, ambitious, curious, driven species. but if we knew now. if we knew 200 years ago or in 18 fifties, what we know now about the unbelievable magical powers on human time scales that are in the embodied dense carbon energy and oil and gas and the environmental impact, I wonder if we would have done something different.

[00:44:27] **Scott Tinker:** So would we have done something different if we knew in 1850, could we have, or was

[00:44:32] **Nate Hagens:** this just all momentum and metabolism of a social species finding this bolus of energy dense stuff? I mean, the

[00:44:38] **Scott Tinker:** first, the first grand discovery, the one that really changed the world from being agrarian and purely, Slow growth rate was coal.

[00:44:48] You know, coal is the thing that the carbon embodied in coal that nature Cooked up on its own and made into a largely carbon solid fuel is so much more dense than wood or or hay or You know, cow dung, which people were burning, et cetera. So that's really when we figured out we could harvest coal and burn it and create a bunch of heat for a variety of things, including boiling water, making steam, turning a turbine, running a generator and making electricity that changed the world.

[00:45:22] And that was early 18 hundreds. We started to see. The big ships were coal, you know, the trains were feeding coal into them, et cetera, et cetera, transportation as well as other kinds of things. So that's, that's the first carbon based fuel, so called fossil fuel, if you will, that changed the world. And it wasn't until later we found hydrocarbons or oil, let's say liquid hydrogen and carbon.

[00:45:48] 19 0, Spindletop, early 1900s in Texas and, and earlier than that in Pennsylvania. You know, that's when those liquids came along and we said, wow, there's a lot of embodied energy there, as you call it fossil sun, because it had to grow the organics and good description. And those were even denser, those liquids, we could refine those and put them in vehicles on a, on a, on a per unit weight basis, specific density there.

[00:46:18] That's different from. Surface power density, the area, but, you know, on a per unit weight basis, and then along came natural gas and, and it seems like gas wouldn't be dense, but on a weight basis, gas is even denser why it has more hydrogen in it. Methane, what we call natural gas is CH4, one carbon, four hydrogens, and that hydrogen is a very impressive fuel.

[00:46:43] You know, I think at the Hindenburg, it, it, it burns and, and so. Natural gas became the next big fuel and it has grown tremendously in the world. It has about, it's about to replace coal as the world's leading fuel. it's at an, it was about 40 percent gas to coal ratio 60 years ago. And today it's 90 something percent gas to coal and we'll pass, it'll pass coal.

[00:47:10] And so that's been a pretty interesting carbon coal, hydrocarbons, oil, carbon and methane. You know, hydrogen, I mean carbon, hydrogen, methane. Transition. And that's been happening naturally because it's a better fuel and it doesn't have as many other bad things as the sulfur and the nitrogen, the mercury, the particulates, and other kinds of things that solid fuels or liquid fuels have.

[00:47:31] So let's not kill gas because it's a quote fossil fuel. There are a lot of benefits to natural gas. It's not perfect. It makes CO2 when you burn it and it itself is a greenhouse gas. So on a climate basis, got to work for that, but it has a lot of other environmental impact things that are much better.

[00:47:49] **Nate Hagens:** So I take it your answer is no, we wouldn't have left it in the ground.

[00:47:52] I don't think we would have left

[00:47:53] **Scott Tinker:** it in the ground. No, I mean, the minute we found something, yeah, my answers are paragraphs, sorry, but, but we wouldn't have left

it in the ground because it is just a better fuel that allowed for human civilization to do what it has done. And the great advances, the great industrial advances have come in the last couple hundred years.

[00:48:16] Prior to that, we were, we were basically. Limited to things that animals could do for us,

[00:48:24] **Nate Hagens:** right? Well, my, my thesis, which I think you agree with is the finding of carbon and eventually hydrocarbons lifted the ceiling on what we were able to do combining them with machines.

[00:48:36] **Scott Tinker:** Yeah, it wasn't limited to one person or one animal.

[00:48:39] Thing right now, we can do useful work at a scale that doesn't require a one for one with a human being.

[00:48:49] **Nate Hagens:** So I don't believe that the issue is that we're going to run out of oil and gas. I believe the issue is. That we're going to run out of affordable enough oil at the scale that the global economic and financial system is dependent on.

[00:49:09] And once that becomes an issue, there is a phase shift in international agreements, in geopolitics, in bricks versus. Unipolar world and all those things. And the other aspect, what you described with the different shales and the depletion rates and the below ground resources that if everything else is kept stable, you believe that we won't have limits because technology will continue to get a higher percentage of the original oil in place out of the ground for human consumption.

[00:49:43] **Scott Tinker:** Let me correct myself. if I said that. There will be limits, but I don't think they're going to be in the timeframes that people are concerned about. I think we'll see what you see already. Let me say it this way. The shales that we're producing from in the U S we're not the only country with mature source rocks.

[00:50:03] Shales, you find mature source rocks, wherever you find conventional oil and gas, that's the source of the migration in the Middle East and Russia and

South America and Africa. So there are mature source rocks in all these places in the world. They are quietly testing all of those with our developed technology here.

[00:50:28] And I know this. and, and so we haven't even opened up the tap on the source rocks in the Middle East and Russia yet. The shale, the shales there, they haven't even come to market yet, Nate. And, and why? Well, because they're more expensive to develop. So Russia and the Middle East would love to see, be able to sell their cheaper to produce oil and gas at a good margin and good arbitrage for as long as they can before they can.

[00:50:56] Okay. Bring these other sources onto the global market. In fact, if you go back to the early fracking days, you know, a lot of films, so called documentaries, which were not 70 percent false, and even dramas like Matt Damon was in, you go chase the money. Russia was funding some of those. So was the Middle East to scare people from fracking.

[00:51:17] And, and, you know, it worked a very powerful movement, to get people worried about hydraulic fracturing, which had been happening for five or six. decades, but all of a sudden it became mainstream. So it's going to be a while before oil and natural gas globally, including from the source rocks are, are not available, but it's, I think what it does in my head, a little slightly different take maybe than yours.

[00:51:44] There's a time, there's five to ten decades of time in here where other things that are better will come along. And what will those be? There's other kinds of ways to move ourselves around besides just batteries or hydrocarbon sourced fuels. there, there, there are some pretty interesting things.

[00:52:05] Nuclear for big movement. You know, we do them in ships and submarines. Why not other places? fuel cells with hydrogen in them. Sort of, electricity carriers, if you will. Compressed natural gas. A pretty interesting combustion engine for certain kinds of uses. There's other There's other technologies for the transportation sector that can become part of that blend.

[00:52:28] And I think that's, what's going to start. I'm an optimist. I think that's going to start to happen over the next, again, five to 10 decades of time. I don't, they're going to be volatility within that. Don't get me wrong. There always is for a

lot of reasons. The price of oil really fluctuates, not so much because of fundamentals, but because of all these super positions of things that humans do in the world from wars, et cetera.

[00:52:51] Yeah. So it's there. The resource base is there. The reserves will be there. The technology evolution and then nuclear to, to put the electricity into some of those vehicles. Nuclear is just look today. What's happening in the U. S. Nuclear is coming back every week. There's a new old, an old plant that's going to be.

[00:53:12] Put back into, into production, whether it's Microsoft and three mile Island and Iowa, they've announced one Michigan. That's because

[00:53:20] **Nate Hagens:** we have this huge demand for AI and power, but that's electricity. It's not liquid fuels that, that transport heavy ships and airlines and cars. So it's an energy quality argument there.

[00:53:32] **Scott Tinker:** Yeah, yes, maybe cars, but you know, you can do, you can electrify cars at some level, but you're right on the bigger things. You don't want to be electrifying those.

[00:53:43] **Nate Hagens:** So let me, let me get back to this, original premise. so you had. you, you said that the reserves, that historically the, there's always been roughly a 10 year, reserve, to production available.

[00:54:03] Like at today's technology and at today's price, we always have at least 10 years. ahead of us, but what's happened is during that time, we've grown our debt to be almost 400 percent of GDP globally. So we have more and more monetary claims on around 10 years of reserves. And so all these above ground factors of geopolitics, of debt, of war between NATO and Russia, between Israel and Iran and, and others.

[00:54:33] So the, the perception is. All the, the rising tide of global growth, and adding more and more of this fossil hydrocarbon to the global economy to power our machines over the last 40 years, that as soon as that musical chairs moment shifts, all this stuff of what's technically capable of. The shale and source rock in the Middle East or in Russia is not necessarily going to be purchasable by the

global economy in the peaceful letters of credit dollar as the reserve, as, as it has been the last 40 years.

[00:55:10] And, and then the other aspect that I'm curious is what do you think is, yes, there's a huge amount of energy resource out there. For instance, oil shale still exists, but that has about the energy density of a baked potato. And if we get to 200 oil, we'll be able to develop that. Or when we get to 300 oil, but the global.

[00:55:32] Cultural and institutional arrangements that we have today do not function at 200 oil so we can imagine these things that can be developed if the price gets high enough, yet if the price gets high enough, it will destroy our current cultural arrangements. This is why I did my PhD on measuring the cost of energy in energy and water and other natural resource terms instead of money terms.

[00:55:56] Because as you're aware, we're printing money and going further into debt, even in a growing economy. me that all of that dollar bills in the digits in your bank account when they're spent, they're spent on things that require hydrocarbons and other energy. So I'm worried about the above ground implications of once we even stop to grow oil, because as you've indicated how potent and incredibly important is to the global economy, what are your thoughts on all that?

[00:56:27] **Scott Tinker:** Well, they're all, I agree, Nate, I think. What you just said is very complicated and complex, and I agree with a lot of that. It's, I don't know if I said there's a 10 year reserve. I think I was saying you have to continue every year to replace these reserves or you start to fall off on a global basis. If you shut down big oil companies, the so called international oil companies, I think the internet, the national oil companies will do that for a while.

[00:56:55] They won't do it as efficiently. So we'll be okay there for a little while, maybe a decade. It may be less or more than that. I think we have longer than that. If we are willing to build the infrastructure and stop trying to. Essentially shut them down for philosophical or emotional reasons. the complexities of the above surface.

[00:57:17] I agree. Couldn't agree more. I, I struggle. I've got three, four kids or adults and grandkids now, but I worry about the world in the U. S. We're leaving.

We had a trillion dollars here, a trillion dollars there to our national debt and act like it's just something, you know, it's, it's incredible to me. And for the first time since the second world war, our, our debt is as high as our GDP.

[00:57:46] Again, a hundred, it used to be a hundred and going down to the thirties and forties for seven, eight decades. It's back up there again. So, you know, we're, we're pushing the limits of that. And how good is our currency, global currency, if you will, when energy is such an important piece of that? It's a very, it's a very worrisome thing.

[00:58:07] And wars have been fought over energy for a long time, both overtly and covertly. And subtly, energy has been weaponized many times, you know, don't kid yourself when, when Russia and Germany, who used to trade a lot of gas or move a lot of gas stopped, that was a big deal. If it wasn't for us LNG going into Europe, Europe would have been in a much tougher place the last couple of years, people attack nuclear power plants.

[00:58:38] There was a lot of agreements that had to be made to keep Israel from going after Iran's oil facilities. Right. And we'll see what happens there. The story I think is still unfolding. So yes, energy is a massive of massive importance to our global economy and all that goes into it. Superimposed on that is the reality that somewhere around 6 billion people out of 8.

[00:59:08] 4 now. Don't have secure energy. And, and I said 6 billion, and that might, might shock some of our listeners here and not the 1 billion that don't have any that exists. And we've made films about that switch on. We went into look at energy poverty around the world at different levels. But there's this whole group of 4 to 5 billion who don't have secure energy.

[00:59:31] It comes and goes. The power comes and goes. The fuels are coming and going. We have a this is a really neat. Just happened. We're conducting right now our annual international case competition at switch energy alliance with student college students around the world, 30 countries looking at energy poverty in paired countries.

[00:59:53] How do you define that energy

[00:59:54] **Nate Hagens:** poverty?

[00:59:57] **Scott Tinker:** energy poverty means you don't have a, Affordable, reliable energy consistently, and it's so that's different from no energy.

[01:00:07] **Nate Hagens:** So that's, that's, on an, on a country basis. So the United States doesn't have energy poverty, even though a lot of people in the United States have energy poverty.

[01:00:16] **Scott Tinker:** There are on a individual basis. There are people with energy poverty all over the world living in. In energy poverty, as you start to aggregate into geographical systems, does the country or some region have access to affordable, reliable energy? and, and by the way, the individual matters the most in all of this, of course, but some countries are living, let me give you an example, about a quarter of the countries in the world on average.

[01:00:45] The individual, the per capita average in about a quarter of the countries in the world consume less energy than my refrigerator every year,

[01:00:52] **Nate Hagens:** right? It's amazing. It's mind boggling.

[01:00:54] **Scott Tinker:** It's mind boggling.

[01:00:55] **Nate Hagens:** This is the thing that people in our country don't understand. Correct. Is the absolute magnitude of energy riches that we take for granted.

[01:01:05] **Scott Tinker:** Oh, yeah. So, you know, 500 megawatt, We're up in the nine to 10, 000 per person, the rich world and, and us. So there's a kilowatt, not megawatt kilowatt. So then there's this big group in between there that, that ranges in kilowatt. And, and that's tied so closely to economic wealth and economic poverty.

[01:01:32] It's not causative necessarily, but there's a really tight correlation between access to energy, affordable, reliable, and your economic wellbeing. So you see this. Big group of countries in the world that are trying, let's call them the developing,

and they're trying to become developed, rich, like us. And, and, and struggling to do that, it takes so much to get there.

[01:01:55] And that's where I think we are, we are missing this whole sector of the global populace that are speaking now with a pretty consistent voice saying, Hey, we're going to have. Energy, it may come from coal, look at China, India, it may come from oil, some natural gas. We might build some dams like in Africa.

[01:02:19] Sure, we'll put up some wind turbines and solar panels and maybe some nuclear if they have the wherewithal. But whatever it is, they are going to get it. And they should. This is the thing. This isn't, oh, no, this is absolutely should grow the global energy wealth. And economic wealth, we have to accelerate into that.

[01:02:43] And the reason for that, this is, to me, fundamentally important and something that's taken me a long time to understand. Energy underpins healthy economies. And it's healthy economies that invest in the environment. Not poor economies.

[01:02:58] **Nate Hagens:** Unless you have to burn hydrocarbon energy in order to be a rich economy.

[01:03:03] And the atmosphere is running out of sink capacity and we're already running into massive climate impacts around the world already today. Let's come back

[01:03:13] **Scott Tinker:** to that. Okay. I want to talk about that, but let's just talk about the land, the air and the water to start. Okay. The, the built the environment where people who don't have much energy are living polluted waters, polluted soils, local air pollution.

[01:03:28] Got it. You know, and they can't afford to clean it up.

[01:03:31] **Nate Hagens:** Well, I would argue that rich countries, are also enabled to have an environmental ethic. If the United States wasn't as wealthy as we were, I don't think we'd have as many climate activists. Probably

[01:03:44] **Scott Tinker:** so, probably so. But if you look at the particulate matter, say for not the climate, not atmospheric emissions, but local air, the local air.

[01:03:53] That the lowest particulate matter countries in the world that best air to breathe or where it's rich. There's maps of this rich countries have the best and cleanest water because we can afford the systems and we regulate it and we find people who don't, you know, do it right. And they're always bad actors.

[01:04:11] But and our polluted soils, we used to dump stuff in the rivers and. Soils in this country, but we've largely stopped doing that. We're regulated. Now you've got to accelerate these poor economies into that kind of wealth to a point where they can afford to clean up their environments as well. And we can talk about the atmospheric emissions.

[01:04:30] **Nate Hagens:** Given what you just said, if you were in the role hypothetically of leading a developing countries, energy development, how would you begin to approach that project? How would you frame it while keeping environmental constraints in mind?

[01:04:44] **Scott Tinker:** And this is what our competition does, and it's fun to watch these teams of four students.

[01:04:49] They pick a pair of countries, and it's not fairy dust, it's real. What are the resources? What's the current political system? How educated is it? you know, what, what access did they have in terms of economic wealth? Where are they tied to, Shipping lanes or oceans or are they land bound, et cetera, they start to dig into this and the quick story I want to tell before I come back to that we this week, their final projects were due and we have 200 volunteer judges.

[01:05:21] It's just a phenomenally emotionally powerful thing. I think you would love judging it or being a mentor. We have mentors for each team. The Nigerian teams kept losing power the last two weeks. They literally couldn't keep their work. Energy systems going long enough to record their, their answers.

[01:05:40] They're the little video they have to make, which is ironic

[01:05:43] **Nate Hagens:** given how much oil they have in that country, but boom, boom.

[01:05:48] **Scott Tinker:** And, and so they wrote downhearted because they had missed the deadline. We extended it three days last night at 1130. I could show you this email came in from one of the team leads and he was so upset.

[01:06:02] Cause the power, they had seven hours without energy and he couldn't upload their thing. And we of course let him. So the irony is we're studying energy poverty and countries living in energy poverty, even though they may be a resource rich, some are not, and yet. We don't get that many teams participating from the rich world because we, as you said early in our dialogue here, we just don't understand.

[01:06:27] We do not have a clue how, lucky, spoiled, entitled we are to affordable, reliable, secure energy. Everything we do depends on it and we always have it. So this is the great dilemma, I think, in the world today is accelerating into that so that. Everyone in the world, energy access for all and energy poverty can begin to do the kinds of things, the, the environmental protection, as well as the human flourishing.

[01:07:02] It's, it's together, Nate, and, and, and they got to both happen or they will both fail.

[01:07:07] **Nate Hagens:** We've been talking mostly about the energy supply side. but don't you think a critical part of the energy transition, which so far has not been an energy transition. It's been an energy addition will actually come from a change in demand.

[01:07:24] in effect, the expectations and consumption and habits of people in our country, in the United States and the global north. Can can you imagine us? In the coming decades, consciously using less or, or not,

[01:07:41] **Scott Tinker:** I could imagine it, but I don't think it'll happen.

[01:07:43] **Nate Hagens:** I don't either.

[01:07:44] **Scott Tinker:** Yeah. So, and I don't know that it has to happen.

[01:07:49] I mean, energy efficiency. I like in the sense of. Doing more with less on a per unit basis week, we waste so much energy

[01:08:00] **Nate Hagens:** swamped by, by the backfire effect, rebound

[01:08:04] **Scott Tinker:** effect. Yeah. Yeah. I mean, gosh, in the mid 18 fifties, an economist figured that out. And, and so. I don't have one refrigerator anymore, you know, and yes, my computer chip is more efficient, but how many chips do I have now?

[01:08:19] And how many cars are the rich world? It just, the rebound effect is so real. So I can't imagine us in a world where we are in. We've tried it, parts of Europe and where, you know, you're kind of gone into these austerity measures and it doesn't last very long. I don't think it has to. Again, I think if we go away from this idea that the transition, and this is really important and probably for us to define, and this won't make maybe listeners very happy.

[01:08:51] By the way, there's, there's

[01:08:52] **Nate Hagens:** nothing that makes my listeners happy, but go on.

[01:08:55] **Scott Tinker:** Yeah, well, I won't, but the transition isn't from. Coal, oil, and gas to solar and wind and batteries. I think a lot of people think that's the transition. And that's not the transition. That's going from dense to less dense. That's going backwards in time of physics.

[01:09:14] And in many ways, economics. And I mean that. Solar and wind, you hear are cheaper, they're not. The levelized cost of energy or electricity, the number that's quoted, the Lazard number, is incredible, by the way. Solar and wind have come way down in price. Weigh down, but that's again, where the, where the electron is generated.

[01:09:34] It's not to get it to you or me to get it to you and me, because we want it 24, seven, three 65, always on. And unfortunately, solar and wind are not always on. That's just physics again. So you've got to have something sitting there ready to

come on. Redundant, expensive to partner. Reliability is expensive, so it's not cheaper and it's not more reliable because of the, again, the challenges of intermittency.

[01:10:03] So we're not going, the transition isn't from dense to less dense. The transition is from dense to more dense. Solar and wind have a role to play. I have installed solar, I think electric vehicles have a role to play in some settings, but we shouldn't mandate them. More, more options is good. I like diverse options in a, in a healthy portfolio of energy.

[01:10:24] So again, options are good. But we're headed toward, away from carbon only coal, hydrocarbons even, to methane and hydrogen and uranium and thorium and nuclear. These are really dense. On a weight basis, nuclear is a million times denser than coal. Wood, a million on a weight basis. So that's what, that's where the environment is headed, is generating a lot of energy from a little input, if you will.

[01:10:56] And an example of that would be, I use this sometimes, a uranium pellet that you stuff into a fuel rod in a nuclear reactor. It's about a centimeter tall and a half a centimeter wide, a little, it's a little cylindrical thing. You push them in there. The energy in that uranium pellet, the energy equivalent, could drive a car from New York to LA and back to Dallas.

[01:11:22] One pellet. Okay. Now we don't have nuclear reactors in our car. I don't want to have people go, what, what's this guy talking about? Just talking about the energy equivalent. That would take a lot of gallons of gasoline and gasoline is really dense. Okay. So. We're headed toward a dense world of energy, which by the way, happens to help when it comes to environmental impacts, including emissions, nuclear has no emissions at the source, and actually not that many, even along the full supply chain, hydrogen, et cetera, expensive, we can talk about hydrogen, but, but, That's kind of this transition that we're on and have been for a long time from hay all the way to nuclear and, and, and, and a diverse thing, a diverse portfolio of that, depending on where you live and what, what your resources are and what your government economy is like, and your access to moving things, et cetera.

[01:12:22] So there's going to be, you can't mandate a solution going to be all sorts of things that are messy around that in the world, but in a general sense, that's where the world is headed.

[01:12:31] **Nate Hagens:** I think if, if the above ground factors somehow hold together and we don't have war or an economic collapse, I agree with you, we will go from, from dense to more dense, but I also think for the average human being, we're going to go from more to less energy use per person is my kind of base case, but let me just ask you this because hold on

[01:12:54] **Scott Tinker:** before that you say that you're talking about a human in the rich world.

[01:12:58] **Nate Hagens:** No, I average in the world, the 8 billion people and the 19 terawatt global metabolism. I don't really see us being able to go to 25 terawatts. Yeah,

[01:13:11] **Scott Tinker:** but you would agree that more than half the world has to come up to some level.

[01:13:15] **Nate Hagens:** That is in the category of should, versus should not as opposed to what will have to happen.

[01:13:22] And I think the, the systemic reality is that that probably won't happen is I agree with you that ethically that should happen. I just don't really think it's going to happen.

[01:13:32] **Scott Tinker:** Well, that will, that will probably be. If we don't see several billion people in the world rise economically from severe economic and energy poverty, I think we'll have a different set of challenges and the environment won't be it.

[01:13:48] **Nate Hagens:** The environment is already it, though, for people that are going through these heat waves and floods, and we haven't even hit one and a half above preindustrial yet, technically.

[01:14:00] **Scott Tinker:** Let me bring one thing up, and I think it's an important thing. the, the IPCC. In a governmental, panel on climate change is the leading authority, I think most would agree, on climate related issues.

[01:14:14] Their AR6, their most recent, report, Working Group 1, they have several working groups. Working Group 1 really looks at the impacts, probably the least political of the working groups. Chapter 12, Table 12. 12. Go look at that table. And they, and And I'm, I'm just shocked at how little this is talked about because the IPCC itself has shown a table and in that table, it talks about the climate impacts that have happened already or have left, let's call it the chatter of what's normal in the last several hundreds of years.

[01:14:57] Okay. The things that have left that. And then it has, that's a column, and then it has another column of things that haven't left that yet. And then there's two more columns that show what could happen in 50 years and 100 years, in different scenarios. It was shocking to me when I finally looked at and studied this table a little bit.

[01:15:18] There's very few things that have left their historical window other than the temperature, both ocean and air, and CO2. There's a couple other things in that table, but they're not at At the 90 percent confidence level or 50 percent or below, which the IPCC requires for, but they put them in there anyway, everything in the next column that hasn't left it yet is everything we're hearing about floods, droughts.

[01:15:44] Typhoons, hurricanes, sea level rise, fires,

[01:15:50] **Nate Hagens:** wind. No, I, I, I generally exceed that point, but I will, I will say that there is a lag from the, the warming in the pipeline. So we don't, we don't see those things.

[01:16:02] **Scott Tinker:** Yeah. But their next two columns are showing, and here's what could happen, given our models with that lag.

[01:16:09] Here's what he thinks coming in 50. Here's what he thinks coming in a hundred. This is the IPCC. This isn't, I know, but there's a

[01:16:16] **Nate Hagens:** lot of other scientists. That, you know, that that's the least common denominator on something that they can agree on. And my critique historically in the IPCC is they believe there's way more fossil resources than will be affordably accessed.

[01:16:31] And I thought they were overly conservative there are overly aggressive. But on the flip side, we're already reaching a point where biological emissions from wetlands and permafrost and all kinds of other things are about to exceed human emissions. In other words, it's no longer in our control, even if we were to have a climate friendly policy.

[01:16:53] So I'm, I'm far less sanguine than you are on climate. you, I think that is going to actually impact our, our energy infrastructure and the minerals and materials that we need to get from the global South to help with, decarbonization and, and nuclear plants and all the complexity of our global challenges.

[01:17:15] **Scott Tinker:** Yeah. And we're different. We have different sanguinity. I would say. There's been that kind of worry for decades and decades and decades, and it's always ten years. I'm not being cynical there either. I just take that at face value because we take so much of the other IPCC at face value and use it to say.

[01:17:36] So what I'm trying to do there is give us a little bit more hope that even that body, which is a bunch of scientists that work on that, Are saying we have a little more time than the existential threat of 10 to 15 years and humans are gone.

[01:17:51] **Nate Hagens:** Oh, I never said that.

[01:17:53] **Scott Tinker:** No, no, I'm not. I'm saying you do, but when I pull students, I speak at a lot of universities.

[01:17:58] Sometimes I'll get half the hands in a classroom going up saying humans are gone in 15 years, Nate. Yeah. That's

[01:18:04] **Nate Hagens:** shocking.

[01:18:05] **Scott Tinker:** It's shocking to me too. Yeah. But I'm telling you in those classrooms. It happens. And it's in the rich world. It's shocking to me, too. So the fear factor, so why are, well, you know, we're in a whole nother land here, but why are kids, more depressed?

[01:18:21] Why are they sometimes suicidal? Why are they not wanting to have children, even in Asia?

[01:18:27] **Nate Hagens:** I have some answers to that. I think climate's a piece of it, but I think it's mostly social media and comparing themselves to others and all that. There's, it's a complex world for

[01:18:35] **Scott Tinker:** sure. Climate's a piece. And you're exactly right.

[01:18:39] But I come back to that and say, let's come to the middle, you and I a little bit. And I, again, I'm not inventing climate stuff, isn't a worry. I'm just going to the report that we all look towards and a new one will come out at some point and say, maybe we have some more time. Then we think we do. And so that's a hopeful thing to me.

[01:19:03] And if, if what it does is it says, depending on where you are in that worry, I want you want to accelerate to things that will help decrease our emissions yet, not keep or capture them, but yet not keep half the world in poverty.

[01:19:22] **Nate Hagens:** It's a really thin. Thin, answer set to, to solution set to that. Let, let me ask you this, a couple of personal questions, Scott, and then to be followed by more personal questions, why is it, so in my network, I know hundreds of scientists, lots of earth scientists, scientists of all types, why is it?

[01:19:48] That petroleum geologists generally almost predictably are the people who are most sanguine about climate change and the most that don't believe climate change is one of our top 10 threats. What? Why is that?

[01:20:08] **Scott Tinker:** I don't know. You know, I think there's conflict probably of interest. petroleum geologists produce oil and gas.

[01:20:14] Okay, so it might be

[01:20:15] **Nate Hagens:** that simple.

[01:20:17] **Scott Tinker:** There's part of it. I would say You could flip it and say, why are, climate scientists, some, not all, some, the most worried about it. And because they say climate and solar and wind, you know, a lot of climate scientists giving lectures leave their world of expertise and start talking about energy.

[01:20:35] I agree with you on that. Okay. So if I, I'm not a climate scientist, I'm just, that's why I quote the IPCC. Okay. but the climate scientists shouldn't start pretending to be energy scientists. Maybe you ought to want to. Talk to energy scientists. Okay. Well, here's the issue though. I, you're, you're an energy expert.

[01:20:56] You're a petroleum geologist, but well, I'm not, I've been studying 20 years, all energy. I, I used to be in petroleum, but I, not for the last couple of decades.

[01:21:04] **Nate Hagens:** Yeah, it's hard to have people that can. Fly up high enough and look down at how all the pieces interconnect. And you're absolutely right that I think there's an empty set or close to it on how we can protect the environment and the stability of the Holocene, on our planet and provide the energy and resources to the, you know, energy, poverty, demographics of earth.

[01:21:30] I don't know, I don't know what to do, which is why I have this podcast to talk about the pathways.

[01:21:37] **Scott Tinker:** If we only come into it with a binary framing, which says climate and solar and wind. Okay. That's quite often what happens is climate change is real. And the answer is solar, wind and batteries. That's where the link breaks.

[01:21:58] **Nate Hagens:** Yeah.

[01:21:58] **Scott Tinker:** Climate change. is real. So is, we got to protect the land, the air and the water too. I'm not going to ever leave that behind and not solar and wind aren't that friendly on the land, to be honest with you, the mining, the sprawl, the burying when they wear out, et cetera, but they make sense in some places.

[01:22:18] But climate is real. And there are some really dense forms of energy that would accelerate us into no emissions. Why are we not doing that? The exciting thing to me is young people, again, where they might say existential threat 15 years, very few young people I've ever met are worried about nuclear.

[01:22:39] They're very supportive of it. They say, let's go! Most of them Support accelerating into nuclear

[01:22:47] **Nate Hagens:** real quickly. Could you give us the base case and the wildly optimistic case of nuclear, let's just say in the United States, in the coming 20, 30 years,

[01:22:57] **Scott Tinker:** I think base case we're at now. I think we're probably at our nuclear power generation low right now.

[01:23:04] We've been coming off it for decades after three mile Island and then compounded by Chernobyl a little bit effect there and Fukushima Daiichi. But we were able to make, so we were shutting down reactors, but we were able to extend the life of them and make them more efficient. But now we're seeing them reopen.

[01:23:22] So when places like Michigan and Three Mile Island start to reopen, and then small modular reactors, and some maybe in between, underpinned by a pull from Hoonate, The tech sector. So in the tech sector, who has a lot of sway for a couple reasons, one, it's tech. We all need it. Two, there are some leaders there that are very well respected.

[01:23:45] The Bill Gates and the Jeff Bezos and all those guys, are pulling on it because they know they are the largest consumers of electricity by far of any industry. And you want to talk about where to Really think about impacts. It's not so much the production, it's the consumption side. And they're saying we need, we need reliable electricity to power all this stuff.

[01:24:09] And it isn't just AI and data centers. I mean, take a look at Amazon. Okay. They're driving trucks. All over the planet, delivering things, and some of them are being electrified now. So when those folks, those industries are pulling, saying we need nuclear, I think we're going to accelerate back into nuclear growth again.

[01:24:30] The US is behind. Europe is behind. China and Russia are building 70 percent of today's large nuclear reactors. 70%. And they are building plenty of them, by the way. There's four nuclear reactors in the UAE. Okay? The oil and gas center of the world. Nuclear. So I think it's coming. I really do, Nate. I think we're going to see that Renaissance of nuclear again.

[01:24:54] And I'm not a nuclear guy. I don't, I'm not conflicted here in any way. I think it's just, it just makes so much sense from an energy density and emissions, a low land use perspective, a reliability and affordability perspective, et cetera. When I get people that say climate, no nuclear, I think, well. Really?

[01:25:17] You know, where's your real framing here? If you, if this is your biggest concern and here's a pretty good chunk of an answer, what are we really talking about? Okay. And, and, and the same with, hey, you can flip it on its ear and say the same, there are. All coal all day people, you know, and I'm really, what do you really talk about?

[01:25:41] Well, it's affordable and reliable. Yeah, but it has all these other things. Aren't there options to that? So I think nuclear is coming. I think we're seeing it grow in places that need it a bunch. And I think we're going to start to see it coming back pretty quickly in the so called Western world, or you said global North.

[01:25:59] I call it the rich countries, you know, that the top

[01:26:02] **Nate Hagens:** billion or 2 billion of us. And I want to move on to another topic, because of our, our time constraint, my, my caveat there is nuclear is a cost issue and that we, use fossil energy to, you know, we get 10, 000 units or five to 10, 000 units of fossil energy combined with the machine to replace things that we used to do manually.

[01:26:25] And if the cost doubles or triples, we get massively fewer economic. Benefits. And I think that's going to be the limit of scaling nuclear dramatically, but I could be wrong. It could be. I

[01:26:37] **Scott Tinker:** mean, real quick on that though, Nate, the cost, the cost to build. yes, if it takes 10 years to get permitting and building, and then you might still get it killed.

[01:26:47] Very expensive. And a lot of CEOs won't do it, but it's getting built very quickly in China and Russia. There's communism. Part of the cost problem is

[01:26:56] **Nate Hagens:** our permutation and our red tape here in the U. S. is what you're implying.

[01:27:01] **Scott Tinker:** Some. Yeah, some, and just, we haven't done it in a while. We don't have the expertise anymore.

[01:27:05] We don't have the, the supply chains like we used to have. It takes a while to get all that ramp back up again. When it does though, and there's a lot of young people going into nuclear energy. We had Grace Stanky on our PBS show two seasons ago, nuclear engineering, major university Wisconsin. And she was Miss America that year, you know, and she was out for a year as Miss America talking about the pros of nuclear.

[01:27:31] So. It really is. It's a, it's a mindset and a perception. And I think that is changing.

[01:27:39] **Nate Hagens:** Let me, let me ask you a personal question. So I, in preparation for this interview, I know actually six or seven people who know you personally and have worked with you. I think you know one of them, but they all hold you, in incredibly high regard your intellect, your ethics, your integrity and such.

[01:28:01] but to a man and yes, they're all men. They told me that your temperament and your personality, just your, your natural self is so optimistic and hopeful as a human being that sometimes that bleeds into your analysis or what, what are your thoughts on that?

[01:28:21] **Scott Tinker:** Well, I don't take that as a criticism. but I'm a scientist and I am a skeptic, so I think scientists.

[01:28:33] By definition are skeptical. And if you were asked to people that really know me, I'm a skeptic. I'm not a cynic cynicism is, is corrosive, but I'm quite skeptical of many things. I'm not defending my optimism, but I am optimistic. If I look at. The, I think the thing we haven't really talked much about, Nate, is what seems to be in short supply right now is, is, well, common sense, but the ideas, the human ideas, the, the drive towards invention, the drive towards creation, thinking new thoughts were really important.

[01:29:10] We're really fear. We've been, we've been encased with fear the last decade or two by some very powerful forces and voices are young people particularly scared of the future. And I think that is not only devastating. I think it's wrong. I think it's, it's wrong to do that. And I try to work with young people and say, yeah, there's a big challenge.

[01:29:33] It's not simple, but it is solvable when you yeah. When you understand the complexities of some of these things, but the power of our analysis, our analytical capabilities today, we mentioned AI from electricity demand side, but the power of of our abilities to take. Disparate things that we could never combine and put them together today and begin to address some of these challenges is phenomenal.

[01:29:58] And I have a great, faith and hope and, and promise for this generation, mid career and, and younger career to address these things once they can peel away the fear, that has been imposed on them and get after it. So yes, in that sense, I'm an optimist. I, I, I'm, I'm, I'm a believer in humans and, and, and humans to not ruin our own nature because we want to survive and live, but also in humans to, to work together and quit doing such great.

[01:30:35] False battle, almost. It's not, it's not natural gas against solar and wind. It's not coal against nuclear, parts of the world still need coal to, to accelerate through where they're going. These things are all needed. Let's bring them together and it's not peak everything. And we've got to use half of what we use today.

[01:30:57] I don't believe that. On the other hand, we can't just keep consuming ourselves into oblivion. So it's that radical middle. It's finding the. The trade offs and the compromises and the common ground to move forward. And we won't always be right and we won't always win and that's okay, you know, because there are a lot of people out there way smarter than I am, everybody.

[01:31:21] And, and, but let's work together. Let's think through these things in a way that we can address them. And that's. In that sense, I guess guilty as charged. I'm optimistic that we'll do it.

[01:31:34] **Nate Hagens:** So what can someone listening to this episode now, and my listeners are not energy blind, they, they understand the importance of, of, of energy to our lives and the environment.

[01:31:45] What can someone listening to this episode do today, this week, this month to help address some of the issues brought up on this podcast, or is it all up to politicians and leaders?

[01:31:56] **Scott Tinker:** I think your listeners are the leaders. Okay. Politicians are followers. They follow the vote. It's happening in this country right now.

[01:32:06] So the leaders have to allow the politicians to do the right things. So your listeners, your leaders, we need to start to speak up. You're not going to agree with everything I say. That's fine. You know, Aristotle, the mark of an educated mind to be able to entertain a thought without accepting it. Wouldn't that be great?

[01:32:26] Just entertain some thoughts. Don't accept everything. That's fine. But your listeners, they probably already are, but get engaged. You know, that's why I do what I do with switch. Everything is free. Our films, our slides, our PBS show, the stuff in the classrooms and switch classroom. All this stuff, these are, are there and available, go to a classroom, talk to kids, a scout troop, a church group, a civic group, you know, begin to, to speak the multiplier effect about that is phenomenal and do it to the extent we can in a way that, that looks at, looks at it.

[01:33:10] As I said to Joe Manchin's climate hearing, a few test under testimony a couple of years ago, not just completely factual, but factually complete, try to be as factually complete as we can. The pros and cons of things, those trade offs, when you start to share that with people, they trust you. They say, well, God, this guy's yeah, yeah, he was in the oil business and he kind of likes oil.

[01:33:33] There's a lot of good reasons for that, but he's not just an oil person. You know, he sees the downsides and the climate impacts, share those things. Let's get out there, the people with the expertise and start to share it. Otherwise the voices that are carrying these messages, Nate, are very passionate.

[01:33:53] They're very emotional and they're underwhelmingly undereducated with regard to what it's going to take. And that's where we all have to lean in and step up.

[01:34:04] **Nate Hagens:** I agree with all of that. so you mentioned your Switch Energy Alliance classroom. more broadly, what specific recommendations do you have for young humans in their late teens, early twenties, who become aware of the stakes and, and all the, the chaos, in our political system, in the environment, and in our economies?

[01:34:28] What sort of advice do you give to that age group?

[01:34:33] **Scott Tinker:** stay positive, keep learning, whatever industries or careers or educational systems you're in say yes a lot. I look back at my life and I said, yes, yes, yes. Oh yeah. I'll try that. Let's do that. And you might learn something you don't want to do and that's okay.

[01:34:53] But when you say yes enough, pretty soon you end up. You know, with a camera in your face and a coal mine 3, 000 feet down in Vietnam and you're, and you're seeing why coal exists still in Vietnam. And I say that actually, but metaphorically. So don't think today that you are fully aware of where your career is going to take you.

[01:35:16] You're not. And that's exciting. Say yes to a lot of things, try a lot of things and keep learning. And then. You'll be a lot more equipped, younger people, younger listeners to that future, and you'll be pulling these things back in throughout your career, the experiences that you've gained in that. the other thing I would say is, I know it's really hard.

[01:35:39] It's hard to, especially in social media, in the online world, to speak up. It can be, frightening. Takes a lot of courage to say what you understand. Because you could get attacked, but you got to do it. You have to start to speak up. You and thousands like you are kind of quiet because you don't want to get canceled or attacked online or, but the more that collect and do that again, with this kind of radical middle thinking, not all the answers, but Hey, look at all the components to this.

[01:36:19] It's more complicated than you might think. And here are some of the solutions. The more you do that. Then we can take the fear and push it out to the edges and let the real voices that are just passionate about one thing only, whatever that might be and do their thing, but let's grow that middle where all the real challenges.

[01:36:43] Lie, the big problems of the day and where the solutions are going to happen, the complicated economic, environmental energy spaces there, where the solutions are going to happen, get in there, join that group, join that radical middle. And there are plenty of folks, places you can do that. Switch is one of them.

[01:37:00] We have a growing, you know, group of young people around the world that are enjoying the switch. Alliance, if you will, and, and all sorts of places you can begin to do that. But I would say do that, you know, it's, it's remarkably empowering. it can be a little terrifying, but a lot of fun too, as you build those networks.

[01:37:21] So, and you know, let us hear from you. I'm happy to help point you in some good directions.

[01:37:26] **Nate Hagens:** What do you care most about in the world? Scott Tinker. Oh, my family,

[01:37:31] **Scott Tinker:** right. And, and. So I bring it right back home, but I don't think that makes me unusual. I think we all care about our families and, and then what's their future going to look like?

[01:37:44] I've got a couple of grandkids now and what's their future going to look like? I do care because I've been fortunate, Nate to go into 60 countries and not airports into them and to see people. Who are living in circumstances that you and I wouldn't think possible today. You might, you know about them, but many wouldn't think possible.

[01:38:07] And there, yeah, there they are. And I worry, I care about that because that's not sustainable. That kind of disparity in economic well being is just not sustainable. Every time it's happened on different scales in the world, there have

been revolutions. And they are not pretty. So we have to begin to address that in a very real way.

[01:38:32] And I see them so hopeful, you know, I get, get in Kibera, the largest slum outside Nairobi. And I'm with these little kids who have been in, they're in this church that doubles as a school with two light bulbs dangling in uniform coming across mounds of pollution to school every day. But they're hopeful.

[01:38:49] They see their future in front of them and that I care about that. And then. On the flip side, I care about young people in the rich world protesting capitalism or, or democracy or things that they're conflating things that upset them with the systems that have allowed for this to flourish and happen.

[01:39:12] So I really care about getting those groups together. I'd love to see young people in the rich world. Began to create movements like they've done with climate around energy, poverty, and energy, poverty, and economic poverty. It'd be so powerful if Greta Thunberg would lead that because not only would address the human condition, it would help with emissions.

[01:39:37] You, it would have another consequence to it. So I really care for my kid's future, in a selfish sense about the kids in the world and what their future looks like.

[01:39:50] **Nate Hagens:** If you could wave a magic wand, and this is a question I ask all my, my guests, and there was no personal recourse to your situation or reputation, what is one thing that you would hypothetically with this magical wand do to improve human and planetary futures?

[01:40:06] **Scott Tinker:** This is going to sound a little fairytale ish, but I think I've been, Like I say, all over the world, I was in the Soviet Union in 1982, you know, this is pre breaking up of the Soviet Union, spent several weeks there, as a, after college and, and I've never been in a country where on an individual basis, people were just not good people.

[01:40:30] They were, they were good people. They had similar dreams and desires for their families and, and their countries. And so if I could wave that wand, it would be to have all the young people in the world have some mechanism for getting together and having these conversations about their futures, their

economic and energy futures, the environmental future of the world, their educational futures, world health, and having them able to do that.

[01:41:01] In a unconstrained way, a way that got all the old grumpy folks like me out of the way and the political leaders and industry leaders and everybody else that kind of constrains those things. I think they, I think unconstrained we can address so many issues. So that would be my magic wand is to be able to transport.

[01:41:22] Somehow this global dialogue and in a small way, I'm trying to help you do that, but it's impossible, but I'd love to see that happen, Nate, because I think the solution set that would come out of that would be phenomenal.

[01:41:36] **Nate Hagens:** Thank you for your time and your continued work on energy awareness with your PBS program, energy switch and all the other work you're doing.

[01:41:45] Do you have any closing thoughts for our viewers today, Scott?

[01:41:49] **Scott Tinker:** Boy, we've covered a lot of turf and I appreciate you. lot of turf, but only briefly on each piece. Yeah, there's a lot more to say, for sure. But again, you know, be hopeful. I would say my last thoughts are, don't be down, don't try not to be, try not to have despair, you know, be hopeful about the future.

[01:42:10] It's a remarkable world we live in, a remarkable opportunity that we all have to make a difference. And. And as you do, you know, again, in every little thing that you do, do it, do it as well as you can, and it will become part of that global whole and who knows where it ends up taking you. I think, I think that's the only way to address all this is working together in that way.

[01:42:34] So that's my last thought. again, and, and reach out. I'm available to people and to you, Nate, and look forward to carrying this dialogue forward. We can, we can do it if we work on it together.

[01:42:48] **Nate Hagens:** Thanks so much, Scott. Great to talk to you. You too, Nate. Thanks. If you enjoyed or learned from this episode of The Great Simplification, please follow us on your favorite podcast platform.

[01:42:59] You can also visit thegreatsimplification. com for references and show notes from today's conversation. And to connect with fellow listeners of this podcast, check out our Discord channel. This show is hosted by me, Nate Hagans, edited by No Troublemakers Media, and produced by Misty Stinnett, Leslie Batlutz, Brady Heine, and Lizzie Sirianni.