Nate Hagens (00:00:00):

Greetings. Welcome to the inaugural episode of Reality Round Table, which is going to be a monthly discussion with mostly former guests on the Great Simplification, maybe some new people. We're going to run these the second Sunday of every month. This first episode is with my colleagues Simon Michaux, Pedro Prieto, and Arthur Berman, on the topic of electric vehicles. We've got many of these scheduled in upcoming months with lots of former guests, and I think there's a different dynamic when three or four or five people, who have different perspectives on the same issue, interrelate, cross pollinate their ideas. This was a great discussion on the opportunities and constraints of electric vehicles as it pertains to our upcoming energy, economic, cultural transition. I hope you enjoy the show.

(00:01:07):

Greetings, my biophysical colleagues and good friends.

Arthur Berman (00:01:24):

Hi, Nate.

Pedro Prieto (00:01:24):

Hello.

Simon Michaux (00:01:25):

Hello.

Nate Hagens (00:01:26):

With us today is Art Berman, Pedro Prieto and Simon Michaux. Missing this inaugural Reality Round Table is Olivia Lazard, who is one of six of my friends who, in the last couple days, had their flights canceled or delayed to and from Europe, she couldn't make it. I will briefly speak in her stead on what I expect she would've presented here. We have a lot of repeat guests on the Great Simplification. This is a deep and complex story. I would like to start doing these group conversations more often. This is the first one and there's many topics that these three gentlemen could speak to. The one we've chosen for today is, what's the real biophysical story, the limits, constraints, opportunities, challenges, and eventual roadmap, for electric vehicles?

(00:02:32):

So I think the format that we'd like to do is each of the three of you will have five minutes to present a slide, or tell a story of something that is perhaps misunderstood by the general public about scaling EVs to replace internal combustion engines. And then, we'll just have an open conversation. So I'm really looking forward to this. I should point out that the three of you have been friends of mine for a long time, and two of you have never actually seen each other face-to-face, although we've probably shared thousands of emails.

(00:03:12):

Okay, let's kick it over to Simon, who, you have the mic, and can you explain to us the numbers on your slides?

Simon Michaux (00:03:25):

Okay. So there are four slides. On slide one is a graph, and what I've done is a calculation that looks at the amount of metal that we will need for the complete phasing out of fossil fuels, this is the global calculation. In this calculation, there is the number of vehicles, with an understanding of how many of them are electric vehicles, and some are hydrogen fuel cells, how big they are, how much work they did, how much extra electrical power is needed. Also included in this calculation is the number of solar panels and wind turbines and stationary power storage.

(00:04:03):

Now, on this graph, it's a log scale, the red is the total metal needed, including a 28-day buffer, for wind and solar. The blue is the same, but now we're going to cut the buffer back to 48 hours plus 10%. The yellow is the stated global reserves, and the black is the global metal production in 2019. Now, this is a log scale, so what this is showing is the needed metal that we have far exceeds the reserves that we have in the ground, and it also far exceeds the mining production that is possible. So you're actually looking at the ability for the mining industry to deliver on the green transition.

(00:04:50):

So we're going to take this a step further now, slide two, if Europe was to achieve a 30% market share by 2030. Now, this is something they've already agreed upon. It's actually described in the next slide, we'll get to that in a moment. But if they were to have a 30% phase out of fossil fuels by 2030, as they have already promised, by 2030, six years and six months away, the graph now shows just what Europe has to do.

Only now, I've actually included in pink a six-hour buffer for stationary storage, and this still shows material shortfalls for copper, nickel, lithium, cobalt and vanadium.

(00:05:37):

If we were to do this, in Europe alone, in the next six years and six months, 76.6 million EVs will be constructed, with 3.4 terawatt hours of batteries. 1.7 hydrogen fuel cell trucks will be constructed. The capacity to annually produce, transport, and store 2.94 million tons of hydrogen will be produced. An extra annual 892.1 terawatt hours of non-fossil fuel electrical power generation will be created, and stationary power storage will be developed. Now, if it's 28 days, that's 52.46 terawatt hours, which I believe is actually too small. So if we were to do this, and apply an energy split that was put out by the IEA for what they believe 2050 would be, we're talking about, we're going to build 14,941 average sized power stations, in Europe alone, or an installed capacity of 565 gigawatt hours in the next six months.

(00:06:52):

Slide three. The reason I've actually picked this target of 2030, 30%, in 2016, the Paris Accords were signed, and the IEA put out a sustainable development scenario, what would happen if we were to meet that Paris Accord. And they would suggest that by 2030, there'd be a 30% market penetration for electric vehicles, and 30% of the power grid would also be electrified. If we were to do this, again, we've got the graph, but now we've also got some numbers about how much metal we need.

(00:07:29):

There are three scenarios, 28 days for the buffer, 48 hours for the buffer, and six hours for the buffer, up against global mental production in the year 2019. And 2019 was the last year before COVID, so it's the last sensible year of data we'll see for some time. If we were to do this, we're talking about five, this is for the 28-day buffer, five years of global copper production, 17 years of global nickel production, 280 years of lithium global production, 60 years of cobalt production, and 175 years of global production, but this is just a resource Europe.

(00:08:13):

Slide four. So they have actually made it a stated target. The 10% of what we need will be actual be mined by European minds, 40% will be smelted and refined in European territory, and 15% will be recycled. So this fourth slide now has the graph, but now it's got three tables. If 10% of the metals that we would need was mined in

European territory, that doesn't do any mining at all, and looking at the 28-day buffer, in the interest of saving time, 28 years of global lithium production has got to happen on European soil, the equivalent of 28 years of global production of lithium, just in Europe. If 40% of this was refined on European territory, 112 years of lithium global production would have to be refined, just in Europe, and we would have to recycle four years of global lithium production, just in Europe.

Nate Hagens (00:09:25):

I thought that we would now all ask Simon questions about his presentation. I'll start with two. Why is the 28-day buffer what you assumed, and is that reasonable, and do other reasonable people agree with you, or why is that important?

Simon Michaux (00:09:50):

So as it turns out, no one agrees with me. So in the literature-

Arthur Berman (00:09:56):

Not no one, Simon, I agree with you. I provided you data to support your perspective.

Simon Michaux (00:10:03):

Actually, yes. Now that you mention it, you did actually, yes. So in the literature, they have got five to seven days of power buffer, and they've come to that conclusion by looking at the differences between peaks and troughs, supply and demand, on a day-to-day basis. And they found that, looking at data over the last 50 years, five to seven hours, plus some other technologies, is all that's needed. They did not look at the difference between seasonal variation. Now, this is a very controversial statement: the sun in summer is stronger than the sun in winter.

Pedro Prieto (00:10:40):

Wow.

Simon Michaux (00:10:41):

Oh, no. So the massive difference between summer and winter has not been included in that calculation. Now, the way we balance our power systems at the moment is we balance them externally, as in we just dial up more power from an external power system, usually fossil fuels. Like in Spain, they use coal and gas, in Europe, they use

mainly gas. If they need more power, they just send more power. A solar and wind system will not be able to do that because we won't have those fossil fuels to use. But also, they're so massive that they can't actually be balanced off something else, they have to be internally self-sufficient.

(00:11:21):

So I found a reference that said one month buffer was all that was needed to actually balance the system through the seasonal variations. It wasn't a very sophisticated study, but it was a reference. Looking at the solar radiance of somewhere like Germany, one month is not going to be enough. Now, the US Department of Energy did an internal audit based on my work, and they found that wind and solar did indeed underperform four months of the year, at the seasonally worst and most inconvenient time. So we will need a buffer of some sort, it will be much, much more than five or six hours. Now, I picked 28 days, it was a conservative estimate, but it's not the real one.

Nate Hagens (00:12:05):

So follow up question to that is, I could imagine for a hospital or for a factory, we need uninterrupted power, and that's why you chose a 28-day thing.

Simon Michaux (00:12:18):

Yes.

Nate Hagens (00:12:18):

But what if the sun was weaker or there were low output of intermittent renewable energy, that there could be carpooling rules, or no one's allowed to drive by themselves, or demand side issues, meaning that we wouldn't really need 28 days of buffer, and therefore we wouldn't really need orders of magnitude more metals that you presented? Is something like that a middle path feasible?

Simon Michaux (00:12:50):

Nope.

Nate Hagens (00:12:51):

Why not?

Simon Michaux (00:12:54):

So our technology requires clean sinusoidal power to be smooth, same frequency, the same voltage, the same current, 100% of the time. Our whole technology is based around that, so that's why we need to do this. The size of the buffer at 28 days is something like 2,192 terawatt hours a year. Compared to the electric vehicle fleet, that is about 30 times the size of the electric vehicle fleet, assuming all the heavy vehicles are actually going to be hydrogen fuel cells. So the problem is so large that if you actually co-opted all electric vehicles into such a scheme, it still would not be enough.

Nate Hagens (00:13:39):

So I have one more question, and then I'm going to let Pedro and Art ask you some things. Do the people planning the 30% EV penetration in Europe truly believe that? Do you have any evidence to that effect?

Simon Michaux (00:13:58):

No.

Nate Hagens (00:13:58):

Or is it a story that has to be told because it matches up with some other political initiatives, et cetera?

Simon Michaux (00:14:05):

You have to remember that everyone is still operating like fossil fuels are still here. Everyone attends this conference on an airplane, they'll drive there in a car, they'll use computers. All of it is run by fossil fuels, and so the whole thing of the green transition so far has been ideological, it is not tethered to reality at all. What they believe is when their arm waving is finished, that this is someone else's problem.

Nate Hagens (00:14:31):

So by the way, sorry, one last question, the impetus for electric vehicles in Europe and globally isn't because we're passing peak oil and because of fossil fuel depletion, it's because of decarbonization of our transportation system. So the goal itself is reducing CO2, not having a replacement alternative when fossil fuels begin their inexorable decline.

Simon Michaux (00:15:01):

Correct. They're not prepared to discuss out loud the dependency on fossil fuels at all, let alone anything like peak oil or what peak oil might become. It is all about decarbonization.

Nate Hagens (00:15:15):

Right. Art, Pedro, would you like to follow up with Simon's presentation?

Pedro Prieto (00:15:21):

Yes. I've heard that Simon has been talking also about hydrogen vehicles and hydrogen fleet. I don't know how much, or how did you balance hydrogen with electric vehicles in itself? Because hydrogen vehicles could be both electric, from the conversion of hydrogen into electricity within the same car, or could be also thermal vehicles from hydrogen. I don't know because we are talking about just how many angels are able to stand on the top of a pin. This is still very unrealistic, but how did you make this balance of resources?

Simon Michaux (00:16:07):

I looked at a number of scenarios. In my original report, there were six scenarios. One scenario was a complete electric vehicle system, another scenario was a complete hydrogen system, and I was able to compare like-with-like, and I found something unexpected. What I found was the mass of the electric vehicle battery was 3.2 times the mass of the hydrogen fuel tank of the equivalent H-cell vehicle. So what that meant was, a H-cell vehicle could go three times further or last three times longer, so anything long range or anything that was very power consumption should be hydrogen fuel cell.

(00:16:45):

All right, but hydrogen is not an energy source, it's an energy carrier. You've got to make the hydrogen, and if you're not allowed to use gas and you've got to use electrolysis, so I looked at what was involved with that, and I got some conservative numbers. If it takes about 50 kilowatt-hours to produce one kilogram of hydrogen, and about two and a half kilowatt-hours to compress that gas into a 700 bar system, a tank. And then, when you actually put it through a PEM system, you get 15 kilowatt-hours of electricity out the other side. So with that in mind, you actually are

using 2.5 times the electricity to produce the hydrogen, compared to charging the equivalent electric vehicle. And so, that puts a hell of a stress on the power grid, because we're not talking about a small application here.

(00:17:44):

So you put those two together, any heavy vehicle, the entire maritime shipping industry, any diesel freight train that goes between cities, and trucks, I made the assumption that they're all hydrogen fuel cells. Now, there are EV technology apparently that can do that, just as there's a hydrogen fuel cells that can do all vehicle classes as well. This is purely a logistics split and it's very crude. All heavy vehicles are hydrogen fuel cell, all short range vehicles, like passenger cars, vans, buses, delivery trucks, anything that has a range of 100 kilometers or less, or is in a city, that should be an electric vehicle. Yes, it's not realistic. We are angels dancing on a pin, but I had to put the cut somewhere.

Pedro Prieto (00:18:37):

Okay, that's good. May I have a second question?

Nate Hagens (00:18:42):

Yep.

Pedro Prieto (00:18:43):

Because, you've mentioned that the networks will be so stressed if we try to put all this energy into the electric vehicle fleet. Yesterday, there was information in the German newspaper, Der Spiegel about the problem that this is going to be created, they say that the German network is already having experience some stress. Have you already dimension - I have some preliminary information that probably I will deliver later on what about the Spanish grid - but do you have any idea of how much the electric networks should evolve to be able to deliver this energy to the 100% electric vehicle fleet in the world?

Simon Michaux (00:19:33):

So this is an opinion, but if our society was petroleum driven before, but now we're going to go to electric, much, much more stress is going to be put on the electric system and it's going to have to be upgraded. The entire system, on a worldwide basis,

is held together with chewing gum and positive thinking. They have not been doing their maintenance. And that is in every country around the world with various different degrees of, "Oh my goodness."

(00:19:59):

So if we are going to go that path, then we're talking about a comprehensive rebuild and restructure of the entire electrical grid. So we'll actually be able to take not only the extra power, but be much more reliable, because it's constantly breaking down at the moment. We just aren't keeping up our maintenance, we're just not spending the money. And so, I think a fundamental rebuild would have to be a necessary part of the equation for everyone.

Nate Hagens (00:20:32):

Just a quick anecdote there. In one of my academic papers, we showed that the correlation between electricity stability and GDP was extreme, over 99%, that even small brownouts and blackouts severely handicapped a country's economic output. And the more lack of electricity and instability, there was really upheaval, so that's an important point. Art, do you have some questions for Simon?

Arthur Berman (00:21:07):

Yeah, I sure do, Nate. Simon, I'm just backing way off of this thing. What percent, let's just take Europe, for instance, or any example you like, but in your scenario, what percent of total electric power do electric vehicles use compared to the total consumption?

Simon Michaux (00:21:31):

So I've got we need 37,000 terawatt hours of extra capacity. About four and a half thousand terawatt hours will be required to charge the electric vehicle fleet. So what's happening there is the hydrogen economy is doing most of the work. So what percentage would it be? It'd be about 20%, I suppose, something like that.

Arthur Berman (00:21:59):

Yeah, it's more than I thought it would be. But it's because hydrogen is doing the heavy lifting, right?

Simon Michaux (00:22:04):

That's right. In fact, so the hydrogen fleet was only 30 million vehicles, but the electric vehicle fleet was 1.39 billion. But the hydrogen fleet was using more than twice the electricity to service its needs for physical activity. That's interesting.

Arthur Berman (00:22:28):

Yeah, right.

Simon Michaux (00:22:28):

And in fact, the elephant in the room, and I haven't actually gone down this path yet, what happens if we take coal off the board? Because all our manufacturing depends on coal, and the Chinese do most of it. We're not part of it, we don't see it. But if you remove coal, what happens?

Arthur Berman (00:22:44):

Yeah, that was my next question. And so, the electric vehicle is, by weight at least, is largely steel and plastic. And I'm not aware at the moment that there's any technology we have, short of recycling with some electric arc furnaces, which is first of all a small percentage, and second is a hopeful thing in the future, we don't really know how to make steel or plastic without fossil fuels, and we don't know how to make concrete to drive the vehicles on without fossil fuels. So there are a million externalities that I'm sure you've included.

Simon Michaux (00:23:34):

Some of them. Only some.

Arthur Berman (00:23:34):

Ah, okay.

Simon Michaux (00:23:37):

I did a very crude calculation, Art, and I've been flamed mercilessly for it, but I wound up with a 1000 page report, but I was told to take a cold shower.

Arthur Berman (00:23:49):

Right.

Simon Michaux (00:23:49):

So the Swedes are developing a way of steel producing in a hydrogen atmosphere, but they didn't think about producing the hydrogen first. And so, they think they're going to do it that way. It's not as efficient, it uses much more energy calorifically in the hydrogen, and producing that hydrogen is going to be a very serious problem, and so they don't know how they're going to get around that.

(00:24:17):

So to make a silicon wafer for a solar panel, this was supposed to be the next piece of work, so we'll see how that goes. To make a silicon wafer for a solar panel, you've got to heat it to 2,200 degrees Celsius, and you've got to use very, very pure metallurgical silicon to do it, which there's not that much, really. So at the moment we use coal, take coal away, what is actually possible getting to that heat level? And all we've got is some specialist biofuels, we can use hydrogen in some applications, or an arc furnace. But if we were to telescope up the amount of coal being consumed for manufacture, and if we were to get that same amount of heat and deliver it with biofuels or any of those other options, the scale up would be enormous.

Arthur Berman (00:25:11):

Yeah.

Simon Michaux (00:25:12):

Far more than the planet can actually deliver. And so, at some point, it says, "Is this sensible?" And that question is now on every frontier of the transition, and it's the best argument for degrowth. Is this sensible?

Arthur Berman (00:25:30):

Right. So back to the criticism of your work, which I feel obliged to say something about, you mentioned, somewhat briefly, recycling, but I believe that one of the arguments against your analysis is that we can do an awful lot more recycling of metals, and therefore your estimates of the resource needed are exaggerated. Could you discuss that, please?

Simon Michaux (00:26:04):

Yep. Here's the funny part. Okay. My work is to look at the first generation only, a straight replacement of what we have. Less than 1%, or no, we're at 1.1% of the vehicle fleet are electric vehicles. 98 point something percent are not. Renewable energy accounts for, what is it, four or 5% of the primary energy pie. Whatever it is.

Arthur Berman (00:26:28):

Five.

Simon Michaux (00:26:31):

My point is the non-fossil fuel system is yet to be constructed and the sorts of metals we want, cobalt, lithium, vanadium, they're all very exotic, and we do use them in the current system, but they're trace elements, they're not used very much. So, don't actually don't have the volumes of metals we need of the exotic metals that we want in play, and so you cannot recycle what is not yet constructed. So the first generation at least will have to come from mining. And so this is back to the old conundrum. Minerals are the new oil, but which ones?

(00:27:11):

So let's say we do get to the first generation. We somehow find the metals, we dig down to the core and we... Yeah, or whatever. Some of the ridiculous things I've been hearing. In fact that there are four basic myths that are shot at me on a regular basis, and we can have a laugh on those in a moment if you like. But let's say we do get to that first generation. Recycling at the moment, the technology is pretty good and it is getting better, but the real problem is getting collection. The biggest problem in the recycling world is how do we get the right residue, to the right process plant, to do it consistently enough to actually run that process plant?

(00:27:54):

So, like I say, your mobile phones, for example, when they run out, we don't recycle them. We put them in a drawer. 95% of mobile phones are sitting in a drawer somewhere. And when they do recycle, they just put in the trash. And most mobile phones are not designed to be recycled, so they just wind up being put into the furnace and we just kiss goodbye to all those rare elements. So the problem is how our society fits together socially, and our relationship with raw materials, makes recycling very, very hard to do in any large scale. So that's a social contract change.

Arthur Berman (00:28:34):

What do we do about all the internal combustion vehicles that have to be similarly put in the trash, or recycled, or whatever, to make space for even the 30%, much less higher, later percentages of EVs?

Simon Michaux (00:28:52):

I don't know. I've not heard anyone actually take that on. And when I asked the same, they just gave some vague arm waving stuff, "Oh, we'll just send it to Africa and then they can sort it out." Come on, guys.

Arthur Berman (00:29:08):

Really? Yeah.

Simon Michaux (00:29:09):

Yeah. But see the ICE, they're full of valuable materials, and alloys, and even the tires on the cars. Each tire contains seven liters of oil. At the moment the plan is to, what they call valorize them, they'll crush them up, shred them, and do something where they recycle some bits out of it, like some copper, some aluminum, some steel, but the rest gets land-filled outside Europe.

Nate Hagens (00:29:39):

I want to move on to Pedro, but before we lose it, if you could just very briefly tell what the four myths are, just a brief recount, Simon, since you mentioned it.

Simon Michaux (00:29:52):

Okay. So this one here is to actually make Art laugh. So-

Arthur Berman (00:30:03):

I need a laugh today, Simon.

Simon Michaux (00:30:04):

Okay. This actually came up in a meeting today. Four myths that are regularly shot at in our direction, or at least my direction. Myth one, the Earth crust is enormous. There is so much material we could mine all the way to the Earth's core, and there is an infinite number of resources down there, we will never run out.

Arthur Berman (00:30:24):

Wow.

Simon Michaux (00:30:26):

Oh, it's funnier. It gets funnier. Myth two. We are an innovative species.

Arthur Berman (00:30:31):

Oh yeah.

Simon Michaux (00:30:32):

We have always innovated out of our problems in the past and will do so again.

Arthur Berman (00:30:37):

Right.

Simon Michaux (00:30:38):

And so, its almost as if, if you are not having the idea and you're not having it now you're too late, because we're out of time and money. Okay. Myth three, substitution. If we run into any sort of resource blocks, that's fine, we'll just substitute it with some other material, like it's easy. In a plug and play, it's like Lego. Take one piece out, put it back in. Yeah, it's fine. Substitution. And the fourth one, and this is the funniest one, and Pedro, you might die laughing here. We in Europe are a geopolitical power. We will ensure that if we run short that we'll get supply before anyone else.

Nate Hagens (00:31:18):

So all four of those-

Simon Michaux (00:31:19):

That's it.

Nate Hagens (00:31:23):

There's a theme that runs through all four of those. They're all completely energy blind.

Arthur Berman (00:31:29):

Yeah.

Simon Michaux (00:31:30):

I was going to say delusional, but that is actually usually, if-

Nate Hagens (00:31:36):

Yeah, if we understood the importance of the up slope of the carbon pulse and how it's subsidized our institutions, expectations and lifestyles, and the rules are going to change even when it's flat, let alone declining, all four of those myths would be laid bare in my opinion. So Simon, thank you. That was excellent. I want to move on-

Arthur Berman (00:31:57):

Really good, yeah.

Nate Hagens (00:31:57):

... to our next EV expert, Senor Prieto. Pedro, we will highlight your graphic. Can you explain what we're looking at here?

Pedro Prieto (00:32:08):

Thank you. First of all, probably I should make a disclaimer saying that I'm not working for the fossil fuel industry, or that's just, I'm not against the renewables, per se. I'm just looking at the limits. Sorry. And I would like-

Nate Hagens (00:32:27):

What you just said is true for all of us. Go on.

Pedro Prieto (00:32:31):

Previous introduction and general considerations about the passenger car, or private car, that when going massive about one century ago, and when it was coined the word for this, no matter if it is internal combustion engine, or if it is now a electric car, they have created, according to Howard Kunstler, "The greatest misallocation of resources in the history of the world."

(00:32:57):

I know that you, the North Americans, are very fond of cars and we, the Europeans, too. And most of the world as well because it gives comfort. But this is really a craziness. A car it consists in a complex and costly machine that weighs about 2000 kilos, or 4,000 pounds, that is designed for four, five people, but usually carries 1.2 people in the US per car, or 1.9 in the European Union, per vehicle. Each one weighting about 70 kilos or 140 pounds, and is a self transported being.

(00:33:32):

So what means is that the ratio, useful load versus tare, is the worst in the transport sector, or for mobility purposes. It spends five to eight liters of valuable precious and limited fuel, or 25 kilowatts hour per each 100 kilometers of transport. So the present cities and urban sprawls were designed now in the last 100 years based on this concept. So today it will be really hard to move back to a different type of societal mobility. There are about 1.2 billion cars, and about 300 million buses and trucks worldwide for eight billion people. In some countries, like Luxembourg or somewhere else, there are more than one car per person, or in the United States it's 0.85 cars per person. The annual production before the pandemic, were around 80 million new cars per year, about half of them are scratched every year.

(00:34:31):

So meaning that every year about 40 million new cars are thrown into the streets, or vomited into the streets, and flooding parks, streets, roads, and motorways. The total paved roads and motorways globally is about 65 million kilometers. In countries like Spain, there are about .45 kilometers of linear paved road per each square kilometer of territory. In the U.S. it's almost one linear mile of paved road per each square mile of territory. The question is where are the limits to this type of growth, if there is no limits to growth? And now some considerations about the electric vehicle. I will put the example of Spain because for Europeans is known, and for the Americans as well it will help to understand the context, because Spain is about the territory of California in extension, close in population to California, and 2.5 times less than GDP of California. So it's quite comparable. Spain consumes now 58 million tons of oil per year. All of them, they are imported. It has 25 million passenger cars for 46 million inhabitants. 0.45 vehicles per person, including children, elderly, handicap, et cetera. It has 11.7 million gasoline cars, and 13.2 million diesel cars and .12 million electric cars. But the total consumption of gasoline, and this is important, of 95, 98 octanes, and diesel represents only one fourth of all the total oil imports.

(00:36:11):

So the rest is going for kerosene for aviation, liquified petroleum gases, diesel for trucks, vans and machinery, agriculture, fishing, merchant fleet, fuel oil for boilers, heating furnaces, and other products like jellies and lubricants. And overall the most important thing is some heavy oil uses are for asphalts. If the aim of the electric vehicle is to decarbonize the economy, and to get rid of the fossil fuels as soon as possible, the move to 100% of cars to electric vehicles will only save, in the case of Spain, 25% of the imported oil.

(00:36:49):

So what about the rest? The 10 refineries we have in Spain, and probably Art will have much more information than me, cannot close, unless the products are replaced totally. Not only gasoline and diesel for electric vehicles, the fractioning towers in the refineries may slightly change the percentage of products that are living out from the crude oil, but cannot get rid of gasoline and diesel, and produce only the rest of the needed, refined products. So the question is on which asphalt we will expect to run the 25 million vehicles in Spain, or the 1.2 billions in the world, if we have no more asphalt and we close the refineries? Are we going to transform all the 65 million kilometers of roads with cobblestones, for instance?

(00:37:34):

This is ridiculous. We have to change and we have to think on these things. The electric vehicle to compensate the heavy burden, as Art has already lightly mentioned, the heavy burden of the battery, which is about 500 kilos, has more plastics than usual internal combustion engine cars. At present, they compose 50% of the car volume, but just weigh 10% of the total car.

(00:38:00):

So some of these plastics include structural security materials, so hard that they can resist in key parts of the vehicle. So the electric network in Spain has already 30 million contracts for electricity supply, but the average electricity contract is 3.45 kilowatts, monophase contract. That means that this is absolutely insufficient to recharge the electric vehicles at homes. Building an structure to recharge 25 million electric vehicles will imply to increase the electricity production, at least in Spain, in some 25%, which is not far from the Spanish grid capabilities, but will need to duplicate, at least, the existing network to warranty the power in each terminal.

(00:38:52):

Spain has about half of the vehicles that have no private or condominium garage, so they are sleeping in the streets. About 12 million cars are sleeping in the streets. Creating infrastructure to get a public recharging post for these users in the streets, which are the lower income ones, it's simply out of reach, as Simon has mentioned. The public recharging posts are much more expensive, as they need identification cards, the user, to charge him for the electricity consumed. And they are much more subject to vandalism.

(00:39:27):

Now we have another problem, which is the secondhand car, the secondhand market with the electric vehicles. In 2022, the last year, in Spain they sold about three million cars. From them 1.8 millions were secondhand cars in the market. So there are internal combustion cars with 300,000 kilometers, which are working perfectly, and they are being sold with less than 1000 euros, the car, and it's working perfectly.

(00:39:58):

So, the Mileuristas, which are the people that in Spain, there is a lot of young people earning less than 1000 euros a month, they could afford to buy today additional car with 300,000 kilometers. But how on hell are they going to buy an electric vehicle or a secondhand electric vehicle, if we consider that the average mileage in Spain is 12,000 kilometers a year, or 7,800 miles per year, and that the car runs about 35 kilometers per day on average, and 97% of the time is idle. Considering that the average price of a thermal car, new car, is 16,500 euros, or considering that the national fleet is 12.5 years old in average, and is growing in age. And considering that the best battery warranty of an electric vehicle is eight years, and the battery alone cost almost half of the electric vehicle itself, which means 1.5 to two new thermal cars, in equivalent.

(00:41:02):

So who will buy a second hand electric vehicle, which is 10 years old, considering that the vehicle costs two to three times in average than a new thermal one, and that the battery replacement is around the corner, assuming that is still a six in the old format? So considering that the usual recommendations are not to spend… Here in Spain, in the statistics, they say not to spend more than 25% of the income in a car, including credit amortization with 90% of the cars bought with credit, fuel provisions, insurance, et cetera. So if we crosscheck the average income salaries in Spain, of the 20 million

active workers, with the prices of the electric vehicles, about 70 to 80% of the people could not afford to buy an electric vehicle. So that's, I'm already finishing. I don't know how I am about time.

Nate Hagens (00:42:01):

Well, time wise, you're fine. I just am smiling because our podcast curator, Lizzy, is going to have to spend a whole week doing show notes on your last five minutes of statements, so-

Arthur Berman (00:42:18):

Agreed.

Nate Hagens (00:42:19):

Mucho gracias, Pedro. So basically what you're saying, I think, is we have reductionist experts who are planning these decisions, without looking at the whole system.

Pedro Prieto (00:42:36):

Yes.

Nate Hagens (00:42:36):

And another thing that I'm hearing is that optimizing for carbon, reducing carbon, in the transportation sector is not going to reduce our demand for a barrel of oil, of which gasoline is one product. Art and I have talked about this before on podcasts, because we still need the asphalt, the diesel, the plastic precursors, et cetera.

(00:43:05):

And then thirdly, I think you're right, as things get worse economically, the vast majority of people won't be able to afford a car the way that we did the last 30 or 40 years. And so transporting humans from point A to point B is going to probably have to be done differently than internal combustion engines, electric vehicles, it's going to have to be more buses, trains, bicycles, and walking. What do you think about that?

Pedro Prieto (00:43:42):

Yes, you're right. I think we have to think completely in a new transport system, at a global scale. I'm talking about Spain, which is the 14th country in the world in GDP. I'm

not talking about the 200th countries in the world, most of them, which are far from even reaching the heights we have reached in the United States and in Europe. It's something incredible. And it's not only that, it's a huge problem. It seems that the people that is designing, that is financing the new transformation into electricity of our economy, they are starting the house by the roof, instead of starting by foundations.

(00:44:28):

I wonder why they didn't start electrifying the heavy trucks, for instance? We are in the fourth years of delay of the Tesla Semi, which is not going to work properly. And we have no still any heavy machinery for mining, or for civil works, or for tractors in the agriculture. Why don't we electrify agriculture first, if it is possible? So perhaps we will realize that it's not so possible to electrify many of the things we have now at hand. Or if we think about using the energy carriers, as Simon has mentioned, we will then understand how bloody expensive is just to get one kilogram of hydrogen, and to put it at 700 bars of pressure.

Arthur Berman (00:45:16):

So, I think that one question that maybe many of the viewers want to ask, so I'll ask it for them, is isn't it true that the price of electric vehicles is going down all the time? Your points are well-made, Pedro, that right now the EVs are too expensive for many working class people, but with the price of EVs going down, the fact that solar and wind are believed to be by far the cheapest forms of electricity, don't you think that there is technological reason to expect that a lot of what you said will change?

Pedro Prieto (00:45:58):

This is a good question, they have posed many times. The ever decreasing prices of electricity, and the ever decreasing prices of the renewables. Because if we are thinking in producing electricity with just 100% of renewables, then we have a problem in believing that everything is going to go down on permanent basis. Now, few days ago, Spanish magazine called Energías Renovables admitted that the price of wind turbines has increased 40% in the last two years. So it's not going to go down forever. It depends very much on the price of materials and the difficulty of extracting materials, as Simon has already mentioned. It's a huge problem. We are not going to have a decrease in price for everywhere, at every moment. This is not true.

(00:46:50):

It's reasonable. Probably what is more reasonable is that we should start thinking in electric motorbikes, like the Chinese are doing in most of the cases. Most of the mobility now of the Chinese in the cities is being done by motorbikes, very light motorbikes, which are working quite well within certain distances. But it is not to replace the car park we have now of thermal vehicles in the world, the 1.2 billion. If you look at the problem of the Thanksgiving Day, or Christmas, or a bank holiday in the United States or in Europe. In Spain, with eight million vehicles going out to the countryside to enjoy the weekend, and thinking the simultaneous charging of the electric vehicles in the electric stations, instead of the petrol stations, they have not dimensioned anything.

Arthur Berman (00:47:45):

Yeah, I was recently in Vietnam, and I was told that in Ho Chi Minh City or Saigon, there are something like nine million motorbikes, in a city whose population is… Well, nobody knows exactly, but let's just say it's 15 million people. So I think that in developing countries where money is really scarce, the attractiveness of motorbikes is very high.

(00:48:14):

But that leads me to my other question, and that is the psychological factors involved in selecting vehicles, cars, as the number one target for decarbonization. In the US, there's a lot of controversy, don't take our guns away, which I know Europeans think is silly, and so do I actually, but it's real. But if we had a similar movement to take your cars away, guns would be trivial. So my question, Pedro, is is the psychological factor for personal transportation as strong in a place like Spain, or in Europe, as it is, say, in North America?

Pedro Prieto (00:49:09):

Yes, it is very strong. This psychological factor, very, very strong. It's not only because here, for instance, in our country it's between 10 and 13% of our GDP is because the automotive industry. So that is about two million jobs. So it's an important thing. It's about 10% of the active population is involved in that. So you think in garage, you think many things, and it's about almost one century of selling a market in the private car, as Marvin Harris, the American anthropologist used to say when talking about his

famous book about pigs, witches or cows, and something like that, to talk about the sacred cow in India, because the Americans or Europeans many times do not understand why the Indians are not killing the cows. And he said, "Well, the cows are the tractors of India. They are the fertilizers of India. They are many things in India." And he said, "But if you want to see really a sacred cow, go out of your home and see the family car." He was writing the book in 1970.

(00:50:25):

He should have said today, "Go out and see the personal cars of all the family." So we have been living for one sitting.

Nate Hagens (00:50:37):

I have two questions and then I'll kick it over to Simon to ask you questions, Pedro, you have in the past mentioned, and this is digressing a little bit from electric vehicles, the importance of Spain as a tourist destination, which also uses a lot of carbon and fossil fuels. And if that were to stop, the implications for Spain's economy and all those cars, et cetera, would change dramatically, right?

Pedro Prieto (00:51:06):

Yes. That's my favorite question, because I've made presentations in both the Canary Islands and the Balearic Islands, and these are archipelagos which are 90% powered in electricity by fuel oil, or gas. So when they say that they have no emissions because they have an electric car, they are lying. This 90% of this electric car is consuming fuel oil or gas. So that's one thing. The second thing is that each of these archipelagos has about, in Canary Islands, there are two million inhabitants, in the Balearic Island, two million inhabitants, but we receive 16 million tourists per year, both in the Balearic and the Canary Island. So this is a huge traffic by plane in the Balearic Island, mostly from Germany, and in the Canary Islands from all the rest of Northern Europe. They are 5,000 kilometers long trips, long haul trips, and they are just an average of one week stay there. And the GDP for tourism in Spain is 15%, but for these archipelagos is 30%. So the day that the planes are going or flowing there because they become so expensive for the tourists to go, there will be a real crisis there in those archipelagos.

Nate Hagens (00:52:32):

But they have electric cars.

Pedro Prieto (00:52:34):

Yes. 90% powered by fuel, oil, and gas.

Nate Hagens (00:52:40):

So a second question, especially with what's happening with Ukraine and Russia, do you get the sense that the focus on low carbon energy transition with electric vehicles as a core pillar of it, is starting to shift towards energy security and a stable availability to energy? Or is that not yet happening?

Pedro Prieto (00:53:08):

It's a very difficult question. We have lost almost all the Russian gas in Europe. It was... we were importing about 120 billion cubic meters per year from Russia, out of the 160 billion we were consuming in Europe. Spain is a privileged country because we have seven regasification ports then we are bringing most of our gas now from LNG tankers. So we have not such a big problem. But the rest of Europe has a big problem with the lack of Russian gas.

(00:53:47):

And there is no anything foreseen in the horizon that we can recover that gas. We may change for a while, bringing LNG tankers from everywhere else, Trinidad, Tobago, from Qatar, from everywhere else. But this is not going to solve the problem. As somebody I think is, I don't know whether Simon or Art have mentioned, there is no problem as far as we can have money in Europe to buy, then let the others go to hell. Let the Africans or Southeast Asians go to hell and we will continue getting gas, but it's not so easy. Even regasification ports are a key problem. They have a bottleneck, and we have a bottleneck in Europe for the regasification ports, and this is not going to be built up in one year.

Nate Hagens (00:54:35):

Simon, do you have any follow up questions for Pedro?

Simon Michaux (00:54:41):

Not so much question but a statement in support. For start, the Ukraine war has kicked things along towards thinking about energy security, but we're not there yet. All our policymakers are taking the runabout, wave your arms, scream and shout

approach, not actually thinking yet, but that's coming. Also, all studies in the past, that I've looked at, have assumed market forces will fix everything. And they think there's going to be like a U-shaped curve for costs. They're going to go down, down, down, down, and suddenly it's going to be cheaper than everything else.

(00:55:20):

And they believe magic happens, and that seems to be the basis of their resource and commod… They've misunderstood what the commodities industry really is. Pedro, listening to you, it really highlighted to me what is missing. When I first came to Europe in 2015, and I was listening to this for the first time, everyone was banging on about electric vehicles, but they were focusing exclusively on passenger cars. They weren't talking about trucks. No one's talked about ships yet, they're now starting to talk about electric airplanes. But there were no numbers.

(00:55:57):

And so what needs to happen, and what you've just highlighted the need for, is a scoping study followed by a pre-feasibility scale study, to phase out fossil fuels, on a nationwide scale. And that's got to happen in every nation. And at the moment, that doesn't exist. And Art has the numbers, or has the knowledge to really nail, right? Everyone's talking about gasoline, but when we lose diesel, and we lose all the heavy bunker oil for marine fuel and asphalt, they're the units that do the physical work. They're the units that actually do our industry. Take that away, and it's now what? So-

Nate Hagens (00:56:40):

But we're really not talking about losing it. We're talking about using less of it and it being less available and more costly. That's going to be the reality.

Simon Michaux (00:56:52):

Oh yeah. That'll be the reality. But we are still geared in the idea that the markets will grow every year and everyone shows a profit.

Nate Hagens (00:56:59):

Right.

Simon Michaux (00:57:00):

And industry will continue as it always has.

Nate Hagens (00:57:05):

So thank you. Let's move on to Art. And before I do that, I will just mention that Olivia Lazard, our colleague, couldn't make this inaugural Reality Round Table. She didn't send me her slide because she had to miss this, but I would imagine she would speak on behalf of the Global South, and the impact that a decarbonization attempt will have on rematerializing our economy, and many of these minerals are located in countries that are already enduring climate impacts, and social impacts from colonialization, et cetera. As well as the health of ecosystems that will have to be impacted, from an acceleration of moving the battle from the skies to the Earth, on trying to be more sustainable. So keep those things in mind. And Art, the mic is yours.

Arthur Berman (00:58:15):

Oh, thank you, Nate. My comments are relatively brief. I really have only three to add to so much of what Simon and Pedro have already discussed. But my question to Pedro on the psychological effect of the personal car, was partly because I believe, at least in the United States, that the emphasis on electric vehicles is really a way for the automobile industry to reimagine itself, if you will. Long before there was so much concern about climate change, vehicle miles per year in the United States have been going down and down and down. And now with the concerns about the peak demand and everything, car manufacturers really need to think about marketing themselves.

(00:59:20):

But along those lines, the main point I want to make is if we're really concerned about carbon, then the, not only the best way, but perhaps the only way to deal with it is simply to consume less energy, not to spend billions of dollars. My goodness, everything that Simon and Pedro have talked about, all of these multiple industrial startups that don't even exist, we're going to spend billions, if not trillions, of dollars developing an electric vehicle industry in all of its support, and passenger cars only account for 8% of the world's emissions.

(01:00:09):

Let that sink in for a minute. Back when I used to be a manager in a big corporation, we went to training classes where they encouraged us to say, "Now, you guys need to divide your tasks in terms of descending importance. The really important things are the As, the less important things are the Bs. And then at the bottom are the Cs. And what you guys tend to do is solve the C problems because they're easy and you feel

like you've accomplished something, but you haven't begun to address the A and the Bs."

(01:00:44):

Well, if passenger cars are 8% of world emissions, then EVs are very much a C problem. And so we're spending all of this effort and all of this money to avoid addressing the big part of our emissions problem, which EVs, and electricity for that matter, do not solve. So that's point number one.

(01:01:10):

Following on to what I said in the beginning, I think that what we're really talking about here, the emphasis on electric vehicles, is mainly a way to figure out how finance, the auto industry, the plastic industry, the mining industry, the technology industry, and the shipping industries, can continue to increase their profits, and we as nations can continue to increase our GDP. Now, I'm not implying any kind of conspiracy, and I'm not anti-capitalism or anything like that. I've worked in industry for a long time and this is what we do. We're always trying to maximize or optimize for profit.

(01:01:59):

And thirdly, something which Pedro... Well, both Pedro and Simon mentioned, the idea that greater use of electric vehicles is going to somehow reduce the amount of gasoline produced and consumed is just absurd. It's an argument-

Nate Hagens (01:02:18):

You mean oil or gasoline?

Arthur Berman (01:02:21):

Gasoline. That in other words, if everybody's driving EVs, then we won't need gasoline. And so the point is that, and I think you said it Nate, is that the only way that happens is if we just stop using oil altogether. Because there's no way, there's no physical process, by which we can produce the plastics, the diesel, the bunker fuel, the asphalt, all of the things that all of you people have talked about, without producing gasoline. It is a necessary and unavoidable byproduct of the refining process. And depending on where you are, gasoline can be as much as 45% of every barrel of oil, or it might be less, like 30 or 35%. It doesn't really matter. It's a very large percentage.

(01:03:15):

And even in the ideal case, where we somehow no longer need very much gasoline for transportation, what are we going to do with it? Are we going to pour it out into the streets or the fields? We're still going to produce it. So I think that a lot of the thinking about electric cars is not very system oriented, and not very practically oriented, if what we're really trying to do is resolve the human predicament regarding destroying the ecosystem and the atmosphere and the climate. So those are my comments.

(01:03:57):

So the bottom line is this energy transition, first of all, it's a fiction. There really is no energy transition. And all of the solutions, EVs, renewables, nuclear, hydrogen, carbon capture, the graphic that you'll see, is a sign that points in one direction, which is lie, and the other is truth. And the lie points in the direction of the EVs and the renewables and the nuclear et cetera, and the truth points in the direction of less energy. We have to start, we won't, but we should, start thinking about the real solution to our human predicament is how to use less energy, not to figure out new technology to continue using what we're already using now.

Nate Hagens (01:04:45):

So some of my questions to you now, Art, are possibly to all three of you, but on that last point, how many people... We're smart fellows, but there's lots of smart fellows and ladies listening to this and working on these issues, do people really believe in what you just said? The EV's, the renewable future. Or is the truth side of it that we're going to have to use less, and that we've built this monetary musical chairs system of monetary claims on biophysical energy and material reality, and some of those claims won't be able to be serviced in the future?

(01:05:32):

Is the real truth too personally and politically difficult to state? So it's the equivalent of playing poker with a bad hand, and doubling down and going all in, because it's too scary to fold that hand, so you have to see it through. Or is it truly a lack of systems knowledge, on this conversation to today, that is causing governments and CEOs and other people to avoid these difficult conversations? First of all, what do you think, Art? And then I'll ask Pedro and Simon.

Arthur Berman (01:06:13):

Yeah, I think Simon's four myths really cover it pretty nicely. I think it's a psychological problem, that we certainly as a civilization, a modern civilization, much less a species, we are psychologically incapable of accepting that there isn't a solution. We don't know what it is. That there isn't a solution that allows us to continue our present behavior without destroying the planet.

(01:06:53):

There's an awful lot of human energy devoted to trying to debunk and say, "Well, that's not really true. I mean, that's all a lie. Actually the planet's fine and we actually need to use more fossil fuels and more carbon dioxide, it's a plus. It'll be better for plants and all." There's that and there's plenty of support for that idea. But I think deep down, on some visceral level, most people understand that what I do is somehow bad for the planet, and therefore what I'm being sold, what we are being sold, with EVs, is a very personal way of saying, "Hey, I got a solution for you to feel better about yourself." But the idea, as Simon carefully stated, somebody, somehow is going to figure this out, it's just not going to be me. That's the hope. That's the great hope. Which I place zero probability in.

Nate Hagens (01:08:03):

Simon and Pedro, do you have any follow up?

Pedro Prieto (01:08:07):

Yeah, just mentioned the psychological problem. There is a huge psychological problem indeed, because now as you probably know there have been three days plenary in the European Parliament now about a subject which is called Beyond Growth. That was the title that was invented to avoid to say degrowth, because degrowth was too strong, so they were mentioning Beyond Growth.

(01:08:35):

So after the presentation by Ursula von der Leyen, and some other irrelevant people in the European Parliament, some people were saying really, really important things about the problems of the limits to growth. But what is the problem? The problem is that this was organized by 18 parliamentaries in the European Parliament and they have 750. So that means that the idea has not yet got into deep into the politicians sector, or into the political sector. For instance, today I have something about the Belgium Prime Minister, Alexander De Croo that I will transcribe literally. He said

about Beyond Growth, they have started to attack the problem of Beyond Growth or recognizing the limits to growth, and he said, "Sometimes we hear people saying that the solution could be degrowth, the myth that which could combat climate change with a strategy of less, less growth, less investment, less consumption, probably also less job creation. This will never work. The strategy of less is completely contrary to our human nature."

(01:09:49):

Probably this is contrary to the human nature of an economist, which is the one, the most of the people that is governing the European Union and the United States and the rest of the world, they are economists. They are not biophysical economists, they are economists, pure economists. And that's the problem we have. We don't want to realize what we have ahead.

Nate Hagens (01:10:11):

Simon or Pedro, do you have questions or follow up to what Art presented?

Simon Michaux (01:10:17):

Bill Clinton was quoted for saying, "No one ever got elected for telling people what they couldn't do." Now, the people around me in positions of authority are all under considerable pressure not to say negative things, or not to say things that might constitute bad news. Like, "We've got economic trouble coming, or we might be facing a bit more unemployment." Or even little bits of bad news. They're allergic to hearing that. And that has actually filtered the reality.

(01:10:50):

I think we've got a bit of column A, bit of column B. On one hand, the people making decisions don't actually understand the other mechanics of the whole system, because for the last hundred years they haven't needed to. Someone else does all that and it all just sorts itself out. The other part is they know there's a problem. For example, the people I've met up with and talked to in passing are very aware of the financial instability, structural problems in the European Union. They're very aware of that. And they're very aware of the financial problems the United States face and the implications of that.

(01:11:29):

And their approach to all that is, "Stay at your posts. We've got it sorted. Use your credit card. Hey, look, there's a giraffe. Look away. Look away." So what I personally feel is the entire green transition has had the effect of tying up the best and brightest, working on things that aren't actually going to be that useful. Whereas, the public at large believes, because such a lot of effort has been put into talking in circles, that we call that the circular economy. So they believe everything's fine, especially when there are groups out there saying, "Everything's fine." So what's happening is humanity at large has been walked to the edge of the pier, and then the veil's going to lift, but the problem's going to be right in front of us.

(01:12:17):

And our politicians know, I believe, that that is coming. But what they will do is instead of actually saying something unpopular and trying to mitigate the risk, and saying something deeply unpopular, which will destroy their careers, they're going to plead ignorance. Life goes on. And then when it all happens, they'll say, whoever's in charge at the time say, "Oh, the previous administration didn't tell us, they left a hell of a mess with poor policies. And we'll make the hard decisions." And it really has the feel of, it doesn't have to be this way, but we're being led by lemmings.

(01:12:54):

That's an unfortunate statement, but so many people who are so bright, so many good ideas, they're just knocked off because they're not considered politically correct. There are things we could do, but they won't do it.

Arthur Berman (01:13:12):

Yeah. The circular economy, I think it was your colleague, Josh Farley, who talked about the circular firing squad, wasn't it, Nate?

Simon Michaux (01:13:25):

Well, they called it something else actually.

Arthur Berman (01:13:27):

Yeah.

Nate Hagens (01:13:28):

So-

Arthur Berman (01:13:29):

Yeah. That too.

Nate Hagens (01:13:32):

I don't disagree with you, Simon. But I think on our first podcast together we discussed that we currently have a metabolism of global economy, which is around 19 terawatts, continuously. And that something in tandem, with hopefully very little coal, but with our remaining natural gas and depleting oil, in tandem with solar, wind, geothermal, hydro, nuclear, something could be maybe 10 terawatts. Maybe less, maybe more.

Simon Michaux (01:14:13):

If we got organized.

Nate Hagens (01:14:16):

If we got organized.

Simon Michaux (01:14:16):

Well, around that. Yeah, if we did the right thing and we did a disciplined work and reconstruction over several decades.

Nate Hagens (01:14:21):

So, that's unlikely to happen, but just conceptually. But in that situation, let me just ask any of you, is there a role for electric vehicles in a degrowth - and you all know that I don't think we're going to degrow, I think that's a nice conception idea, but post-growth is what we're going to have to do. We won't politically choose to use less, but we will be faced with that end of pier moment, probably in the not too distant future. But in a degrowth scenario where we have a shrinking economy, but we still have factories and stability and a reduced global trade, but still some global trade, what role would EVs have? Or is EVs a mania phase right now in this blow off top of the carbon pulse?

Arthur Berman (01:15:20):

I think, Nate, that to be, from a very high level, I think it's fair to say that EVs are a more efficient use of fossil fuels than other forms of transportation. Now, there's a million disclaimers and problems with that statement, but I just say at a very high

level. So once we actually get to having invested in and produced the EV, there is in fact less pollution from it. And not withstanding the comments that both Pedro and Simon have made, the Balearic Islands and the Canaries, they're EVs, but running off of dirty hydrocarbons, potentially EVs are a part of the solution. I don't think there's any question about that.

(01:16:21):

Even if there are questions about that, it doesn't matter, because we're going in that direction, like it or not. But I come back. 8% of global emissions are from passenger vehicles. This is not the most important part of the problem to address. That doesn't mean it should not be addressed. 8% is a lot, but what about the other 92%? And I'll just finish this comment by reiterating what I said before a little bit, in that is Vaclav Smil has very succinctly summed it up. Our modern civilization rests upon four things, all of which require fossil fuels. They are steel, cement, plastic, and ammonia fertilizer. This civilization cannot stand without those four things. And so the answer to your question, Nate, is what part of those four pillars of civilization do electric vehicles solve?

Nate Hagens (01:17:33):

Right. Well, to use Pedro's analogy, you just described building the house from the ground up, instead of from the roof down. Here's a question. Each of you give a brief answer, irrespective of the analysis you just gave on EVs and how sustainable they are, and how many materials, et cetera, can you speculate on what will happen, disregarding this conversation? What is going to happen with EVs and ICEs such, in the coming decade or so? Can you make a speculation? Start with Art?

Arthur Berman (01:18:14):

Well, I've done a lot of analysis of what modelers say, and they include the US Department of Energy, the International Energy Agency, BP, Shell, et cetera, et cetera, et cetera. And in all of their most likely scenarios, EVs will account for something like 12 to 20% of total vehicles by 2050.

(01:18:48):

And you can look at their more hopeful scenarios, their less hopeful scenarios. I think I'm not endorsing those projections because all projections are wrong, but I celebrate the people that are willing to put them out there. But let's just take the EIA and IEAs

12%, okay, let's double it. Let's just say they're way conservative. Okay? So 25% of vehicles will be EVs by 2050. Let's triple it and say 36%. And now we're starting to get close to Europe's objective, according to Simon of 30%, except that's by 2030. All right?

(01:19:34):

So, these guys, you can criticize them all you want, but they're not idiots and I think their projections are notionally realistic. So the answer to your question is, it seems improbable to me, regardless of laws, regulations, guidelines, that EVs are going to make a big difference in, let's just say, our four lifetimes, which as Simon's pointed out, if we can't do it by then, I think we're too late.

Nate Hagens (01:20:15):

Pedro.

Pedro Prieto (01:20:16):

Here in Spain, the official program is, the idea is to have about five million electric vehicles by 2030. This is the five years, seven years term, close to what you have asked for. This is at the time they have met 3% of that target. So it's from the five million vehicles out of the 25 we have now running on the streets, and roads, we are now 3% of the committed target for 2030. It's very difficult to believe that they are going to reach the five million. So we are talking in the same ballpark that Art has mentioned in percentage, shown by 250 from the IEA, or International Energy Agency, or something like that. So I don't think they are going to make such a big difference with the existing today figures. They are not going to make it on time.

Nate Hagens (01:21:19):

Real quickly, in Norway, nine out of every 10 new cars sold are electric vehicles. Why is that so different? And why is that relevant?

Pedro Prieto (01:21:29):

Because they are a very, very rich country, which has a lot of hydro-electricity. Very rich country with a big hydroelectricity generation, which is accounting probably 80%. I don't know the figures by memory, but it is about 80, 90% of those electricity, which is in surplus because they are exporting to Germany. Sometimes they are coming from

hydro. So that's why, because the salary in Norway and in Sweden is three, four times the one of Spain, so it's not the same case. This cannot be extrapolated to Mauritania or to Congo, or whatever.

Arthur Berman (01:22:09):

And I would point out the basis of that wealth is oil from the North Sea.

Nate Hagens (01:22:14):

Yep. Right. Okay. Simon, A answer this question and then I have two more questions for all of you.

Simon Michaux (01:22:21):

Okay. Also, Scandinavia is very good thinking long term, much more so than any other nation I've come across. So how I see this is actually most production for all the components for EVs, and in fact, technology in general, happens in Southeast Asia, China in particular. Now, we are squaring up to go into a conflict with the two countries that we are dependent on for raw materials, but also manufacturing of all kinds. China in particular is going to be a problem. I can see a situation where the market is about to go inelastic. So China controls a lot of the mining, they also control a lot of the smelting, and to hit these targets for themselves, they're probably going to keep all those materials for themselves, because they themselves have targets that they've got to hit as well, and maybe they're not that interested in helping us. I believe we're going to see an inelastic market, and there'll be some electric vehicles available, not nearly enough for the amount that we want.

(01:23:26):

There'll be some hydrogen fuel cell vehicles, but not nearly enough. I think what we're going to see is the transport fleet is just going to collapse in size, and it's going to be in an environment of market collapse, there's going to be like a fiscal reform happening, our money systems are probably going to undergo some sort of transformation. How, I don't know, but it's all not going to happen smoothly at all. So while internal combustion engines are phasing out, I can see a situation where we'll have less renewable based technology as well. And so society will go through de-growth, or post growth, if you like, the hard way. In a way that's not planned, in a bandaid on a bullet wound kind of way.

Nate Hagens (01:24:13):

Yeah, I concur with that. Two more questions, gentlemen. What about, since we're talking about EVs, EV scaling is one of the reasons that a lot of people, economists, think tanks, are projecting peak demand. That we won't need oil anymore, because we're going to replace things with electric versions of it. I can anticipate what you might think about that, since we've shared hundreds or thousands of emails on the topic, but if each of you could just give a short rebuttal or a commentary on the concept, that oil isn't going to peak and decline because we're running out of it and it's getting harder to extract and more costly, but in fact because humans will not want to use it anymore. Who wants to start? Pedro? Pedro.

Pedro Prieto (01:25:18):

I have heard recently that James Stoltenberg, which is the Secretary General of NATO, has even mentioned the need of the armies to electrify as much as possible, or to become more ecological. Which is sort of a joke, because if you think in the armies now, if you see the war in Ukraine, from both the Russian side and the NATO side in the Ukrainian land, then it's a joke.

(01:25:48):

How many vehicles, how many systems, motorized mobilization of the armies is being made by electric means? I mean nothing. It's just nothing. Everything is fossil fuel power. This is not going to work. The only electric things that working in that war, in that horrible war, are some short range electric drones, which are just to move one kilometer away, because the long range in drones are also fossil fuel power. So it's not going to work. This is a joke, what they are mentioning, and this is armed forces. But then look at the merchant fleet or the fishing fleet, or whatever it is. It's no way that they are going to change this.

Arthur Berman (01:26:35):

Let me talk about oil a little bit. Whenever I read the news every day in the morning, the projections are always for increasing demand for oil. No matter who makes it, it's an assumption. Population's growing, therefore we're going to continue to use more energy.

(01:26:59):

The correlation between GDP and energy consumption, as most people know, is like 99%. And since we have to grow the economy, then therefore we're going to continue to increase energy demand, and a lot of that is oil. But that's not what the data's telling us. So world consumption of refined products, mostly transport fuels, has not recovered to where it was in Simon's benchmark year of 2019. Why not? We can speculate and argue about it, but it simply hasn't. And so there's something else going on here, and I suspect that it has a lot to do with the financial pressure that individuals are under. That people are scaling back where they can, and where I can scale back on my spending is on my personal car use. I can drive less more easily than I can consume less electricity, or that I can order from Amazon less. So that's one part of it. The other thing is-

Nate Hagens (01:28:12):

So on that part, peak demand equals peak affordability, in some ways, on that point.

Arthur Berman (01:28:19):

Yeah, exactly. Well said, Nate. The other thing I'll bring up here is, as my friends know, I finally finished War and Peace about 10 years ago, and Tolstoy spends a lot of time taking you behind the scenes, the Prussians and the Russians planning the Battle of Austerlitz, and all of the people that they've hired to help them with strategy. And Tolstoy shows you again and again that all the strategy going into a battle ends the moment that the firing begins, and it's every man for himself. It's about my survival.

(01:28:58):

And so I think all four of us can be somewhat critical of the planning that is being done towards our global predicament. But what there has been is what we're talking about today, and it has to do with carbon goals. And I suspect that an awful lot of that wonderful, idealistic strategizing, when Napoleon's troops come out of the fog, there's a lot Russians that are going to turn around and run the other way. And I don't mean... I'm not talking specifically, I'm talking about the battles he described. So once the firing starts, I think a lot of this planning is just going to, it's going to blow up. It's going to evaporate.

Nate Hagens (01:29:44):

Simon, peak demand.

Simon Michaux (01:29:45):

Well said. Right, so, I've been hearing a lot about phasing out fossil fuel systems through economic efficiency. And everything I've seen so far has not been tethered to reality. It's just not. Like the people involved are not accounting for the mechanical, logistical steps involved with that. Every passing year, we've actually demanded more fossil fuels. And yes, we brought on renewable systems, but what we've brought on has been overrun by economic growth. And so underneath those renewable systems, all fossil fuels have increased.

(01:30:26):

So I don't think we'll willingly do it. What might happen is, not peak demand, but peak affordability is actually a nice way to put it. I think we're going to run out of money, and we're just not going to be prepared to pay for those systems anymore, because we'll have other priorities like food. There's a rising tide of costs across the board for all levels of society. It's not just people, but it's for corporations as well.

(01:30:56):

You did some very nice work to show that the tight oil sector in the United States needs to have continuous drilling, and needs upfront capital to do that. And there was a period of time where they just weren't putting that capital in. And I'm not sure, have they actually sorted that out? Because it seems like-

Nate Hagens (01:31:14):

No.

Simon Michaux (01:31:15):

Yeah, so they're forcing the issue, but they're actually sweating the deposit in an inefficient way for short term gain. This is the old bandaid on a bullet wound. And so, the implications of not putting upfront capital where it's needed most to managing our resources correctly, in exchange for knee-jerk reactions for short term solutions. We run out of money and then that telescopes to everything else, and it all grinds to a halt all at the same time. So it's not peak demand, it's a peak affordability for all levels of society at the same time.

Arthur Berman (01:31:52):

And I would add, Simon, that it's not for lack of oil reserves. We can argue about terminal depletion, but we're not anywhere close to that yet. These are conscious decisions that are being made by oil companies, private, or I'm sorry, public companies, not national companies, in response to what the market is telling them they want. So back to one of Nate's perennial points is we've abdicated everything to the financial structure. Somehow those guys are in charge, and so it's not that oil companies are ignorant to the fact that they need to invest more, it's that they got hammered by shareholders for reinvesting, and so they're not doing it anymore because the investors fled from them.

Simon Michaux (01:32:48):

Same thing's happening in mining.

Nate Hagens (01:32:52):

Yeah. I'll have to have you guys back. We're good friends.

Arthur Berman (01:32:59):

Cool.

Nate Hagens (01:32:59):

We think a lot a alike.

Arthur Berman (01:33:01):

Yeah. Love it.

Nate Hagens (01:33:01):

And there's many, many topics to cover. Let me ask you each a question, please answer it as succinctly as you can. I think it's going to be a difficult question to answer on this particular topic, but I would like to personally make it a habit of me asking this question on every podcast of this format, how could what you all presented be wrong? How could you be wrong about what you just laid out here in the logic? Or is there zero chance that you're wrong?

Simon Michaux (01:33:39):

I'll take that one first.

Nate Hagens (01:33:40):

Simon, go ahead.

Simon Michaux (01:33:42):

Okay, so what has to happen, there's two sides to the equation. There is what energy source do we use, to deliver electricity and heat? And then there's the technology systems we are to use that stuff, like our cars, our EVs, our whatever, and our industrialization is across that spectrum. What has to happen is one of those sectors, every single sector has a logistical bottleneck, every single one of them. What if something radical happened to cause one of them to evolve? And it evolved in a way according to a set of rules like we've never seen before.

(01:34:20):

And so this is someone will think up something, but what if someone develops a technology that doesn't take years to build, and can be telescoped out to everyone on the planet, and can be developed quickly? I think it's unlikely, but if the apple cart is upset, it'll come from that direction.

Nate Hagens (01:34:43):

Pedro.

Pedro Prieto (01:34:45):

Well, I've been wrong many times. In September, 2001 when I saw the bombing of the Twin Towers, I thought with a friend that I was working in that moment in intercommunication sector, and I thought this implies a change of paradigm, and it was a change in paradigm. Then in 2002 and 2003, I joined ASPO and then we were thinking that probably the peak oil could happen somehow, even the peak oil of the conventional oil would be around 2010.

(01:35:22):

We didn't miss so much, but we were very much criticized and we were wrong. Probably it was not 2010, it was 2012. But I can be wrong in many ways. But I think I am right in one thing. The giant of this societal structure, organized and led mostly by capitalism, is a monster. And as every monster, it lasts a long time to fall down. My only wrong approach, it could be in the time of seeing the giant falling down. Probably it will last a little bit more to fall down than I expect, but in no doubt, I think sooner than later

the system will collapse. So let's hope that if it collapse, we can prepare ourselves better for the future in knowing that this is going to happen.

Arthur Berman (01:36:23):

I will repeat what both have said. I am wrong lots of times, and so I can see, for instance, on the gasoline issue that I brought up, okay, we have technology that can reform any kind of hydrogen and carbon in such a way that we can take gasoline and turn it into diesel, or turn it into just about anything we want. It's technically possible.

(01:36:59):

The scaling of that is the reason that I say what I do, and not to mention the cost. So I could be wrong about that, but I think that what is unlikely to be wrong is the state of the ecosystem and the planet. We have data to tell us that the population of animals has declined by 69% since 1970. Okay? That's not speculative. Well, there's probably some uncertainty in that number, but it's a huge number. We cannot dispute, or I cannot dispute, the fact that we're undergoing problems with our oceans, and pollution, at rates that are somewhere between appalling and terrifying.

(01:38:05):

So, the momentum of all of that is so strong, that wherever I am wrong in the specifics of what I've discussed today, even if somebody can turn that around, as Simon said, overnight, it takes a long, long time to slow the momentum of biophysical destruction. And again, my point is not to be a doomer, or anything, it's just to say that's not wrong. And so if EVs are part of the solution to the future, and they're a bigger part of the solution, then I'm assuming I'm willing to be wrong about that.

(01:38:46):

But I'm going to ask somebody to show me, tangibly, how that can affect where we're going as a planet. And I don't mean to be a tree hugger here, I mean that in order for us to prosper as humans, we have to have a functional ecosystem.

Nate Hagens (01:39:04):

This has been great. Seriously, thank you guys for your time today. Thank you for your selfless work on these issues, and I'm sure we'll probably exchange emails later in the day. And enjoy the rest of the day, thanks for being part of Reality Round Table Number One.

Arthur Berman (01:39:24):

Thanks for making it happen, Nate.

Pedro Prieto (01:39:25):

Thank you very much.

Simon Michaux (01:39:26):

I've learned a lot from you guys. I really appreciate-

Arthur Berman (01:39:29):

Likewise.

Simon Michaux (01:39:29):

... your presence.

Arthur Berman (01:39:30):

Thanks, you too, Simon.

Nate Hagens (01:39:33):

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