ReSolve ASSET MANAGEMENT

Rodrigo: **00:00:43** All right. Welcome.

Adam: **00:00:45** Yeah, welcome.

Rodrigo: **00:00:46** Alonso Gonzalez Rodriguez who will going forward be known as Al for this podcast. But I guess, Adam, why don't you take it over, do our disclaimer and do a full intro if you can.

Adam: **00:01:01** Yeah. Full disclosure, I asked Rodrigo to introduce Al's name because I'm clearly the underachiever on this call. This entire thing could easily have been done in Spanish, probably a lot more easily than in English, but I appreciate everyone's concession to do it in English.

So, yeah, by way of background, I met Alonso at a conference in Cayman. We sat next to each other at a lunch where Alonso proceeded to spin the most remarkable tale about the potential to unlock an abundance of energy that would power, I think, what he has called an exponential age of knowledge. And Alonso was in the process of writing a book, is much closer to being finished the book. Alonso maybe just let the readers know, or the listeners rather know the name of the book and maybe summarize the major themes. And then I think Alonso is going to walk us through a presentation that zeros in on the idea of energy abundance, where we are now and how we can get to a situation of energy abundance. But maybe, Alonso, what motivated you to want to write this book, and what's the book about?

The Culprit is Knowledge

Alonso: **00:02:26** Yes. Well, hi, everybody. I hope my English is good enough to go through the whole presentation. So, about five or six years ago, Adam, I started noticing a lot of like anxiety in the world, in many, many things. And for some reason, I had the same anxiety, and I wanted to try to make sense of it. So, I went to that rabbit hole, and it took me four, five years into a lot of work and analysis and investigation about why humans globally were feeling this anxiety. And pretty much I came to the conclusion that it was mostly due to uncertainty about the future. Once you have uncertainty about the future, then anxiety happens. And this anxiety, this uncertainty about the future, I started going through, why now? What's causing this uncertainty about the future? And I realized that there's a lot of changes happening. So, changes drive crises and crises drive uncertainty.

So, I went into this rabbit hole, as I was mentioning, and then I found out the true culprit about this. And this was a huge eye-opening for me. And once I figured this out, everything started to make change, sense. And the culprit, knowledge. Knowledge is the real thing that it's moving everything. And we will go through the presentation a little bit more in detail. But once I figured this out, then I could start relating a lot of things. And I found out that they were at least two megatrends that have been with us throughout history since we were almost … 200,000 years ago. And when I was sitting with you talking about energy, because I think at the table was Tony Greer with us. And of course, they always talk about energy, and I think we started talking about energy. And in the book, I have one section where I was -- where energy is energy abundance, which is one of the megatrends that I would go into more detail, not the other megatrends in this presentation, but at least this one. And how this will have a huge effect on humanity going forward.

And then as I went through writing this book, I wanted to share what I have found out. And this is the reason why I want to basically write the book. So, I think the first question for me was are we really -- are humans really entering a new era? And then I started to try to find out, well, what is era? What would it imply to change eras? Okay. And this is my own personal definition, so everybody can have their own opinions. But I came up with the definition that an era for humanity is something where everything changes on all fronts. That's the definition I came up with. And based on that definition, I figured out that there has been only two eras for homosapiens, for humanity. And I am proposing that we are entering a third one.

So, the first era that started out was the cognitive era 200,000 years ago. So, when we became homosapiens, sapiens and that lasted for about 190,000 years. So, we've been humans for around 200,000. For 190,000 years, nothing really changed according to the definition I just described. So, for 190,000 years, basically, humans were living and organizing themselves around the same, the same things. So, we were hunters, nomads, population was not growing a lot. Sharing of information or knowledge was very slow. So, we discovered fire and things of that nature and Stone Age and -- but it was far in between.

The second era where everything changed the way we humans organize ourselves is, of course, when we became sedentary, 10,000 years ago, with the agriculture, with the advent of agriculture. So, knowledge again is the culprit. We figure out how to grow food instead of hunting food. And because we changed from being nomads and we became sedentary, then we had to change everything of how we organize society. So, beforehand, the groups gather around 150 people because we could not manage more than that as nomads. But once we became sedentary 10,000 years ago, well, towns started growing, populations started growing. We had food abundance, something like what we're going to talk today about energy abundance.

But we figure out how to get food abundance in some sense, okay, through knowledge. We didn't need to hunt mammals and animals and things like that. And when we finish all those animals, then we have to move and follow food. Well, when we became sedentary, everything changed, and of course, society needed to organize around political, social, and economic in totally different ways. So, that's the second era. And I believe that for 10,000 years, we've been on that same road, until now. I believe we are entering a new era that may have started in the 1990s, early 2000s. Although I will believe that the date that historians will say it started is going to be 2020. Okay. For instance, if they put a date that will happen. But I believe that we've been going through this. And this is what's causing all this anxiety. So, that's about what I'm trying to find in the book.

Now why like, what are we experiencing for these changes? What makes me think that really everything will change about how we organize ourselves as society? So, for example, in the political sense, will we keep organizing our societies around centralized power, concentrated power? Or will we develop new systems around decentralized autonomous organizations? Do we have the technology to really coordinate without the central power, societies? That's a question that is in humanity now. Will the trend of globalization continue and keep diminishing the power of nation states? For example, some nation states have been diminishing their powers moving forward, through cooperation, global cooperation, okay, through globalization. Will this trend continue? Or will, as many people right now, saying it's going to become a polarized world where there's going to be two groups and things of that nature.

In the social sense, how will our education system change? It's a huge question. Will all the new tools available today make our educational system change radically, and I think we're starting to see that. How will our communications, how will we communicate and relate among ourselves? Are we going to do it through the Metaverse? Are we going to do it through virtual or augmented realities where a computer superimposes a generated image that shows the user -- that shows the user what the word looks like? That's a huge change. How will we transport ourselves to our goods? Is it going to be through autonomous AI type of vehicles? That has huge implications on the whole world? Will we keep killing -- growing and killing animals for our protein intake? If that changes, that's a huge amount of change of how we organize our societies.

What's happening with demographics? The dynamics are changing, and I believe for the first time in human history, where by design, population is decreasing for the first time. China this year is the first year that it records a downwards trend in population growth. So, these are big questions that society is hovering around. And of course, all of these questions, I think the world population feels it, and this is what's causing all this uncertainty. For example, in the economic front, will abundance demonetize everything? Will abundance bring deflation forever? And if so, what would the role of money be? Will robots or AI take all our jobs? I mean, I work in a company, family business where we have a group of manufacturing plant sites and we are feeling all of these things. Okay. We're in the glass industry mostly. So, it's a very energy intensive industry, and we need a lot of workers to produce things. But we are living, as we speak, a lot of change is happening.

So, what will work mean for the future? This is critical. Just work, what is work? How will work change? How will the climate change affect their lives? So, all of these changes, of course, bring crisis, uncertainty and anxiety. And I think one of the big things that will change is in the political arena. Because I believe that most citizens of the world really have no confidence on the ability of our political leaders to guide us through these changes. So, we see a lot of populism, autocrats growing. And we don't understand why, but there's a power vacuum that is being filled. Because citizens around the world really disapprove highly of their governments in a generalized type of form. So, this is like a huge introduction, but I think it was just to set up the context about what we will be talking about. And I think we can go through the presentation if we want or whatever –

How Change Happens

Adam: **00:15:33** Yeah. No. I mean, that was absolutely remarkable set up. I mean, I've got centralized power, role of nation states, social system changes, communications, Metaverse, biosphere impact. Like, there's an enormous amount that you have. Now, we sometimes talk about the interconnectedness of all of these different dimensions of change as forming what some might describe as *the Polycrisis.* Right? And I think the Polycrisis describes the anxiety that people are feeling, with the knowledge that there are these many very important dimensions of our world experience that are experiencing dramatic change. We don't know what the impact of that change is going to be. We don't know whether the direction of that change is in a positive or negative direction in terms of meeting broader societal objectives. And there are some major structural impediments at the society level, the way we have constructed economies and societies right now, that make it difficult to see over the horizon to how we get from here to there. Right?

Alonso: **00:16:57** Yes.

Adam: **00:16:57** And I know you and I chatted a lot about many of these different dimensions. And I think you -- I don't know if you -- would you mind just spending a couple of minutes going through your idea of how change happens? Because I think -- I found that to be a really interesting part of the conversation that we had. I think it sort of gravitated around political change, but I don't think it's limited to political change. So, maybe just spend… Yeah. Go ahead.

Alonso: **00:17:30** Yeah. Yeah. I think maybe the answer would be better answered once I go through the presentation.

Adam: **00:17:37** Oh great. Okay.

Alonso: **00:17:39** I think it's going to be better because it will follow, like, a thought process that will get us into that subject a little bit better**,** so, it will be easier to understand, because… but one thing I would like to comment about your comments, Adam, one thing that I found out, and this is the reason why I mostly want to share with everybody what I found out, is that the way you fight uncertainty, which is the cause of anxiety, is precisely with certainty. It's very simple. And in order to have certainty, what I found out in the book is that there are at least two megatrends that show you what the future will look like in the short term. And then once you have a roadmap about what the future might hold, and I believe I have high convictions about the forces that are going to get us there, then certainty overtakes uncertainty. And then anxiety levels drop.

Adam: **00:19:07** Incredible. I want -- …

Anxiety and the Pace of Change

Rodrigo: **00:19:08** Certainty through knowledge, right, I imagine. And I think that it's about disseminating more of the big megatrends that people aren't seeing so that we can get the anxiety down. Right? I think that I'd be -- I'm really curious to see your presentation. But I think the biggest point of anxiety is not just the change that's coming, but the pace at which change is coming.

Alonso: **00:19:32** Yes. That's a huge thing that I found out. It's not only change, but it's how fast change is happening now. Okay. That's even worse because, okay, you can handle two changes, three changes. But as I just went through the introduction, there's a lot of things happening.

What do I expect about this presentation? So, first, I guess, understand general terms about energy and possibly energy transition. I think they are two words that very few people really understand, more so about what energy is all about, the definition about what energy is and transition. Transition means that we're going to go from one place, from one type of energy to another. And transition usually means that it is -- that something will finish. And that's fossil fuels. The second thing I would like for key takeaways will be to understand the different types of energy mix and how they are used for the USA. So, I'm using the United States because there's a lot of information that you can gather, and we will go through the presentation. Then visualize a chronological roadmap of the transition from fossil fuels to renewable energy in the near future, and the consequences of energy abundance.

And next slide. New era, the exponential age of knowledge, which we've touched based about. So, we're entering a new era of continuous change as never before experienced by humanity. So, having major effects on all of our social and political and economic systems. And this is what we've touched based beforehand, about uncertainty as the common denominator of our age.

And I think this is a why now, which is really the critical question, I think. And why are we seeing this increase in anxiety? And this is the culprit, as I was trying to mention beforehand, is really knowledge behind all of these things. And if we look at the Y axis, we see that knowledge is behind technology. And technology is at the end, scientific knowledge being applied to be used for humanity for something. Technology drives disruptions. And we will talk a little bit more about disruptions and the importance of disruptions. In the X axis is time. And why do I feel -- why did I propose the name exponential era of knowledge? Because I believe knowledge compounds exponentially. So, if we see through the graph, and I don't know if I can try to put pointer options. Let me just try to see. Okay. Can you see the dots?

Adam: **00:23:38** Yes.

Alonso: **00:23:39** Yes. Okay. So, we'll make this here going through the presentation. So, if you see this curve is an exponential type of curve, which means that everything suddenly happens. Linear thinking or linear change follows this line and is when things happen according to past experiences. Now I think the key takeaway is that knowledge is the force behind all of the changes that are happening. And more importantly, that knowledge needs to compound. And it can only grow exponentially as long as it is exchanged and shared. Okay. This is the critical takeaway that I found out.

Why? So, throughout the 200,000 years ago that we've been talking about, knowledge compounded very slowly because it was shared very slowly. So, okay, we discovered fire and Stone Age to make tools, but it happened far in between. Then a society started grouping together. Okay? So, knowledge was shared more and trade was happening. And so things started changing a little bit faster, but still slow because in order to move from one town to another town 5,000 years ago or 2,000 years ago, it required a lot of time. So, sharing started to happen faster, so knowledge started to compound itself, but change was still slow. So, we were still moving in this line. So, even lower than linear. So, things happened very, very slowly.

And just to give something that I found out that I thought it was amazing is that humans, until 500 years ago, we didn't know that we didn't know. And that blew my mind because that means that we didn't know that we were ignorant. And that was mostly because religion and the bible pretty much had answers for everything. But 500 years ago, things started to change with the Renaissance.

And I think one of the big changes was with Nicolas Copernicus in the 16th century, when he discovered that the universe did not revolve around Earth. Because if you look at the sky, you see that everything moves around Earth. So, the sun moves, the moon moves, stars and planets move, galaxies move all around Earth. But that was from our vantage point of view because we didn't know any better. But with Copernicus, because he pretty much told the world that he was not that way. So, we were not the center of the universe. We were just this tiny planet going around the sun and our sun going around our galaxy. So, well, he didn't talk about galaxies, but for sure, just that our Earth was moving around the sun. So, that broke a lot of paradigms because it basically told humans that we were not the center of the universe.

And with that, I think a lot of things started happening, the discovery of America. And then people started writing about books and we figured out that we were really ignorant about things. And the science revolution started 500 years ago. And with that, and of course, the printing and all of these things, knowledge started compounding by itself. And it was being shared because now we had books to share it with at a very slow pace, but it was starting to increase.

Now we are in 2020 or there abouts, where we are here, and it just started to shift to the exponential part. And this is very important because, of course, why now, is because knowledge is being shared as never before. Internet, digitalization, brought a lot of new tools for knowledge to be shared. So, right now, you can find most everything that you want just on the click of a button. But that just happened, you know, 20 years ago. I mean, I'm a chemical engineer, I'm 62 years old and I graduated in the 1980s, in the early 1980s, if you wanted to find out something, you had to go to the library. And it was tough to find information. And some libraries had some information, but some others had another information. And knowledge, even though it was there, it was very tough to access knowledge. Today, through internet, you can find most everything. Communication is instantaneous. So, sharing and knowledge is very easy, and this is why we're here, and this is why we're following this exponential curve. So, knowledge is the culprit, drives technology and technology drives disruptions.

Now we need to understand a little bit more about disruptions, because innovation is not disruption. Okay. And we will go a little bit more in detail about what disruptions mean, because understanding disruption can help us figure out what the future will bring. So, innovation is doing the same things a little bit better. Doing new things, this is disruption. So, disruption is making things that make the old things obsolete. Right? So, you use one thing, now you don't use that thing. And there are a lot of good examples of disruptions like Blockbusters versus Netflix. Kodak, analog photography, with digital photography, and so on and so on. Now, Rodrigo, you were asking that it is accelerating. And this acceleration is because of the exponential part. So, there's more disruptions happening now. And disruptions bring crisis, and crisis brings uncertainty.

Now, this graph sort that I'm showing is very important to try to understand. So, on the Y axis, we have adoption rates. Okay. When things go from one thing to another, making one obsolete, it goes through an adoption rate. The more adoption rate, the more -- the faster the old thing gets out and the new thing gets in. Then you have time here. And just let me go through here. So, as knowledge compounds exponentially, disruption S curves and adoption rates become faster. So, because disruptions is a byproduct of knowledge, so it follows this same exponential curve. Disruptions bring crisis and crisis with it anxiety. And crisis is something that it is very important; another word that needs critical thinking and understanding. Because crisis is really -- bring things from breaking points, from desperation points, from anxiety to turning points.

So, this is the hope part. Of the crisis. So, crisis always brings opportunities for the future, and better things. You need to go through crises in order to go from one thing to another thing. But typically, the new thing is always better. During disruptions, history can be your worst adviser. This is another key takeaway. Most people, and linear thinking, use the path to predict future events. Okay. During disruptions, you cannot do that because you're moving from one thing to another.

Now going through this, and now this is a curve that I designed and drew, so you can ask me questions about it if you have any doubts. But one of the things I figure out is that there's -- I figure out three phases in disruptions. So, phase one is here. It's when -- I call it denial. And the player is the disruptor. So, take going from, in Kodak, from analog to digital. So, the player that defines the outcome, in this case, is the disruptor. Okay. So, the guy that pushes digital photography, or Netflix, or if you want, Tesla with EVs. It's a good example, maybe more appropriate since we will be talking more about energy. So, let's say the disruptor in this case will be Tesla. The incumbents are in a denial phase. So, when Tesla started in 2008, well, nobody paid attention to Tesla. They thought it was crazy. GM had already tried it and electric cars were not possible. So, they just simply says these guys are going to bankrupt. They are in the face of denial. Okay. And it takes X amount of time. Normally in today's time, it's 10 to 15 years, the same.

Then you have the threat phase, which happens to be when adoption rates reaches a tipping point, which is 10%. Okay. When adoption rate hits the 10%, the incumbents are really threatened, and they run scared. And when you feel threatened, you do everything in your power to destroy the other thing. So, in the car industry, for example, the threat phase happened around 2018 with the introduction of Tesla's Model 3 where incumbents saw that it was a better car. It had mass adoption and it reached -- well, the 10% tipping point was really reached this year, but it started really the threatening phase a little bit beforehand when everybody's -- the incumbents started running and trying to fight. And this, the player that defines the outcome here is the incumbent.

Adam: **00:37:34** So, Al?

Alonso: **00:37:35** Yes.

Adam: **00:37:36** So, the 10% threshold, which is the tipping point, and I think it's interesting to point out that there's a whole area of mathematical research that defines why this is the case. Right, this 10% tipping point. And we see it in flocks of birds and we see it in schools of fish and we see it all over the place in nature of this 10% is the square root of 100%, and you just need the square root of the total population to make a change, right? So, I think this is really fantastic. And I'm just wondering, so are you asserting that we sort of reached 10% EV, Electronic Vehicle penetration in, for example, the developed world or in the US around this year?

Alonso: **00:38:27** Yeah, in the -- globally. Okay. 2022, we reached that tipping point. And you are correct, the 10% is a mathematical thing. This has been studied through S curves. It's something that is widely available, let's say. Yeah. But in the EV scenario, which is very, very important as we will go through the presentation, especially in the energy transition, I believe moving transportation, let's say cars and trucks mostly, is one of the first driving forces that will move energy abundance. So, yes, 2022, we reached 10% for the first time in EV adoption on cars, not on trucks. Okay. And it is globally. More so, the adoption rates in China are far higher than 10% as of this year, more in the 30-40%. In Europe, in the 20-25% as an average. Of course, Norway and other countries are in the 80% adoption rate already. Okay. In the US, it's lower than 10% but it's moving very, very fast now. Okay.

Adam: **00:40:00** Yep.

Alonso: **00:40:01** And then the third phase, which is the end game, let's say, when the old thing dies and the new theme comes to life, and that happens when you have around 80% adoption rate and the game is over. And the player that defines the outcome, okay, which is this is very important, it's not the incumbent and it is not the disruptor. It's the end user. So, it doesn't matter how much you want to have as power and all the power that you might have as an incumbent, it's not up to you anymore. Once you hit this tipping point, you the consumer is defining this ...

Now why is this so important to get -- to understand these phase? Because it gives you an idea of when disruptions will make things obsolete. It really gives you an insight about what the future will bring. So, if you know where you are along this curve, you can predict the future with some kind of certainty. Predict the future, not as to the direction, but as to the when things will happen. This is a huge takeaway for me. It was a huge takeaway for me anyways.

Now, this is what I was trying to explain at the beginning about megatrends. And I found out that knowledge is creating at least two megatrends, one of which we will discuss in this presentation. Now, a megatrend is a force that pushes actions and behaviors in one specific direction. This is a huge key takeaway. Because if you know the direction, and you know the direction follows from A to B, and it just goes in that direction; it doesn't go the other way. It doesn't go backwards, it doesn't go this. it really gives you as the second point predictive tools about the future. Right? So, for example, if you have a cup of coffee on your desk and you leave it sitting around, 100% of the times, it will go from hot to cold. It kind of seems like stupid to think about it, but it is a huge -- if you become conscious about this, it can give you a lot of power. Because it always goes from hot to cold, not from cold to hot. If you leave a ball on the hill and you let it go, it will go from top to bottom. The ball will never go from bottom to top. Okay.

So, what I found out is about these two megatrends. So, if these megatrends follow a direction. Now in megatrend, it's not a cycle. However, cycles are typical within a trend. This is important also. So, cycles move like this in a circular pattern. It goes here, things go back, and then they come back again. So, it's a repetitive thing. History repeats itself. Right? So, then you can extrapolate the future from past experiences. But megatrends are not cycles. They move through it. It's like disruptions happened within megatrends. Now, megatrends have been with us, these two megatrends that I found out when I started studying all of these things, have been with us since the beginning for many centuries, millennia. So, if you want to check about these megatrends, you have the benefit of proof of history. Right? So, if things are happening from point A to point B, and we are in the year to 2020, you can go back 200,000 years ago and figure out if those trends are really going in that direction. And if so, that means that probably they will go into the future.

Now I found at least two of these megatrends, I believe. One of these megatrends that we will be talking today is what I call from scarcity to abundance. That has been with us for millennia. So, in this graph, we can see in the Y axis that scarcity moves through abundance. The force behind that, of course, is knowledge. So, like we were talking about when food was very, very scarce because we were hunting animals and chasing them around.

When knowledge brought the technology implementation through agriculture. A disruption happened and it just happens that scarcity became more abundant. It doesn't mean that it was fully abundant, because, of course, at the beginning of the agricultural age, you had to protect your food supplies and you build walls and things like that. And if the other people lost their crops, well, they invaded you and things of that nature. So, it was not really abundance, but it was for sure far better than chasing animals. And that's why population grew because it became from less scarce to more abundant. So, this is a line that follows. And I believe this megatrend follows an exponential type of curve. And we are here.

Now cycles happen within a trend, so you could go maybe up, a little bit down, just like economic cycles. Right? So, you might say, okay, the trend is going down in GDP growth, or up. And within that trend, you will view half cycles, now up and down. So, that's why I say that cycles happen within a trend. But a trend has a direction. It is not a cycle. So, you cannot use past experience to predict future events when you're using megatrends. This is why one of the huge key takeaways is that using the past to predict the future is very dangerous. It could be your worst advisers going through disruptions.

So, a megatrend that has been, because since the beginning is from scarcity to abundance, knowledge is behind all human endeavors. Knowledge leads to continued technological improvement. Technological improvement is behind abundance. Two variables that are driving abundance at an ever faster pace is digitalization and energy production using abundant sources of energy, our sun. And we will be -- we will not go through the digitalization, but it's very easy to see why since having moving from scarcity to abundance through digitalization.

I believe climate change is the most important challenge for humanity in the short term. Energy transition from fossils to renewable is ripe for disruption. Now, fossils are a scarce source. Renewables are abundant and free. So, how could you have energy abundance when the source of energy is scarce to begin with? Right? So, fossils will end, they're scarce. We have to dig them up. We have to extract them, it's an extractive industry. So, you cannot think about going to energy abundance when you have a scarce input. And I like to give this example. Air is the most needed substance for humans. Right? I mean, we can live without food for weeks, without water for days. Well, without air, we will die within minutes.

So, air is the most needed substance for human yet, it is free. Why is it free? Because it's abundant. So, abundance, it tends to make things go down in price. Okay. It's deflationary. By all means, the value change proposition for fuels, fossil, is expensive because of the destructive nature of the production. So, in order, the value chain, how much does it cost us to go from getting the oil to turning into useful things for humans? Well, you have to make a hole, dig the thing, then refine the thing, then store the thing, then transport the thing, put it into gasoline and so on and so on before we can use it. So, it's a very long chain. So, there's a lot of cost involved in that. We need a lot of energy to extract the oil to begin with.

Now imagine the other route. You have photons or wind, for example. They're free. Right? I mean, they're hitting us all the time. They're not scarce to begin with, and that's the input. And then you put it through a windmill or through a photovoltaic cell and you produce electricity. That's it. You can store it nowadays, or you can use it right away. So, solar and wind have no input cost in their value chain to produce electricity because photons and the winds are abundantly free.

Now, why renewables? Why would that be the route to become energy abundant? And if that is the case, possibly in the future you may have energy free. Imagine the consequences of that. Just a thought. Energy is behind every human endeavor. More so, energy is a common denominator around everything that happens in the universe. So, we should be very conscious about energy and what it means. So, why renewables? Because it is simply the cheapest form of electricity generation, is solar and wind. And if you look at this graph, you can see how the price of electricity in dollars per kilowatt hour or megawatt hour has been coming down. So, in the red line, we have solar photovoltaic. And if you see, this is just a 10-year, okay. Remember the disruption graph that I showed you that the first phase lasts between 10 and 15 years. The second phase, which I forgot to mention, but if you go back to the graph, it's the amount of time in the first phase divided by two. Okay. So, that gives you pretty much a good idea of when things will happen. So, I'm going to go back just because it's important and I forgot to mention this part. Can you see that Adam, Rodrigo?

Adam: **00:53:50** Yeah.

Alonso: **00:53:52** Yeah. All right. So, if this takes X amount of time in the first phase to the second phase, from the second to the third is X divided by two. This is just round numbers. Okay? They are approximate, it could change. And it will probably change as we move in the knowledge curve more in the exponential part, things will happen faster and faster. So, this will probably change, but this is just an approximation.

Adam: **00:54:21** So, if it takes you 20 years to go from effectively zero adoption to that turning point, at 10% adoption, then it takes you 10 years to get to 80% adoption when it's game over. The end user is completely in control of the growth of the new and adoption of the new tech.

Alonso: **00:54:41** Yes. Yes. So, for example, if we take the Tesla case because it will come in the -- which I believe is a very, very important first step to moving to energy abundance. So, Tesla started here or EVs, for that matter. It wasn't Tesla, before it was another company. But let's say it happened around 2005. So, here is 2018. So, that's what, like 13 years, right, 14 years. Okay. So, from 2018 to the endgame, it will be 7 years or thereabouts. Okay, 13, yes, around 7 years. So, this is 2018. That means that the end gain in the EV transition will happen anywhere between 2025 and 2027. Okay. We're in 2023, so 2023, 24, 25, 26, 27. So, within the next five years, I predict, more or less, plus or minus 2 years or plus 2 years possibly, it will be the end game. Incumbents will lose, disruptors will win, and it will happen.

Adam: **00:56:05** So, Al, are you asserting that by sometime around, let's be, I don't know, conservative**,** and say by 2030, that you expect there to be 80% EV adoption. Now is that -- I think what you're saying is that 80% of new cars will be EV cars. Is that -- not, like, 80% of the cars on the road will be EV cars, but rather that 80% of new cars sold will be EV cars. Right.

Alonso: **00:56:38** Yes. Yes. But I will have another comment based on the cars running on the roads because, of course, it takes maybe 15 years before the whole fleet moves or changes, right, because of the lifetime of the vehicle. But I will mention why I believe this, it is even going to be disruptive. Okay? But, yes, in essence, what I am trying to assert is that we will reach 80% adoption rate on new cars before 2030 for sure. That's what I believe for sure, with a lot of -- a high degree of certainty. If you see just many California and many European countries, you will not be able to sell any ICE products or ICE vehicles, let's say, internal combustion engine vehicles by 2030, 2035 at the very latest. So, that's a terminal date let's say that governments are putting. But I believe it's going to happen beforehand. Okay. And we want to go through this in more details as we move on.

Adam: **00:57:57** You might be covering this later Al, but I wonder what the rate limiting step might be on that level of adoption. Right? I think we did touch on this in our chat, extractive -- the elements that are acquired for the batteries, for example. I think you're going to touch on some of that stuff, but I'm definitely interested to investigate.

Alonso: **00:58:22** Yes. Yes. Yes. For sure. There's the adoption rate, probably batteries, energy storage is the one. The one that has the most, but -- and I will go through learning more details in the next slides. But I just want to show why renewals is the case, that it will be the source of energy for the future. And if you see, this is just for electricity. Okay. How we produce electricity. So, if you look at in less than 10 years, look at the slope rate of how these things have diminished in price. And of course, right now is the lowest source of energy of electricity today. I can tell you this because in our group, we are -- since we're highly energy user, and we have all this pressure from our clients, and not only our clients, but just from our shareholders, some stakeholders, to diminish our carbon footprint. So, we enter producing energy, we started to produce electricity also.

And in order to bring down our carbon footprint for our several manufacturing sites, and we've been able to do it with very, very low cost through solar production. And so we have some of our manufacturing sites running at 80% electricity production through solar panels. And our costs are just impressively low. And we're moving very, very fast in that arena. So, this is solar, this is wind, onshore wind. And if you see here, coal, for example, has been driving --lowers little by little, but because these technologies are very old, so the -- let's say, in the evolution cycle of the technology, they're very old. While we see here in solar is that it's still in the early stages. So, we can expect these prices to keep coming down.

Adam: **01:00:51** So, Al, I just want to make sure that I'm understanding this chart fully because it seems to me you have to make a few assumptions. Right? So, if I have a barrel of oil, given current energy production technologies from that oil, I know what -- I know exactly what that output is. With solar and wind, you have to make some assumptions, don't you, about the intensity of the solar rays, what's your latitude, for example, the proportion of sunny versus non-sunny days. The length of day versus night and different latitudes, all that kind of stuff.

Rodriguez: **01:01:41** Ability to store energy.

Alonso: **01:01:43** Exactly. Yeah. Yeah. All of these things are kind of new. Okay. They're just happening as we speak within the last five years or six years, seven years. So, energy storage was something that was never talked about. And because we have never really stored energy in our past. Well, you store it through, let's say, gasoline and things like that. It's kind of storage. Right? As long as you're not using it, it's there. So, once you burn the thing, then you have access to the energy. But just to give you some concepts, electricity is a *just in time* product in the world. That means that there's no space capacity. It's real-time on-demand. And it doesn't follow a straight curve, a straight line throughout the day. Because at nights you don't use electricity and when you get home, you use a lot of electricity. So, it's kind of an S curve. Right? The demand supply within a day follows the sine wave, something like that.

So, imagine that everybody comes home at 7:00 or 06:00 and they turn on their TVs, computers, refrigerators, whatever. The demand goes higher, and you know what electricity, utility companies have to do? They have to turn on more power plants at that exact moment to follow the curve. This is something that we need to understand because as we will go through the presentation, electricity is at the heart of energy abundance. We will not get to energy abundance if we don't turn everything to electricity. Electrons will be our primary source of energy. This transition means that we have to get rid of fossils to produce electric energy or fossils to transport, and we will go through that.

But what happens with this system of *just in time*, let's say, dynamics from the supply and demand of electricity production is that the price of electricity is set by the marginal cost of energy. That means the last portion of the energy that is produced is what the cost of energy is sold to customers, mostly. Most countries in the world use this formula. This is very important to understand. That means that for example, if 90% of the energy were to be produced at this cost with solar, but because you started on 99% to be produced with solar, because in order to sustain the grid for that one last percentage, you use a bigger plant, the cost is a 175. That means that the price for that time, is at a $175. Can you follow this though?

Adam: **01:05:31** Yep.

Alonso: **01:05:31** Adam.

Adam: **01:05:32** Yep.

Alonso: **01:05:32** Okay. Imagine. This is why prices in Europe are so unfair. A lot of the energy in Europe is being produced off electricity with this war of Russia and Ukraine at these prices. But because the marginal part of cost of energy for that last kilowatt that is being produced, has to be used with gas that it's imported with LNG and the gas prices from Russia and whatever, the electricity prices went so much high. Imagine the profits that the companies were making at this…

Energy Storage

Adam: **01:06:13** Yeah. And so I was wondering -- So, I was starting to -- …

Alonso: **01:06:16** It's so unfair.

Adam: **01:06:18** I was starting to feel really stupid some of them. The other thing is really stupid. Like, why -- How is that possible equation works that way?

Alonso: **01:06:23** Do you understand? The thinking is kind of dumb. And the reason why that is, is because we don't have energy storage. We have never had electricity energy storage until now.

Adam: **01:06:39** But even without storage, if you've got 99% of your energy coming from solar, and you've got 1% coming from gas or coal, why isn't the cost of energy when you have turn on the gas or coal, let's say gas, why isn't the cost of energy equal to 1% times the cost of gas or coal plus 99% times cost of solar?

Alonso: **01:07:08** Yeah. Because in the past, let's say, five years ago, they wanted incentives to drive production up with renewables. So, if the price was such high, then you had a huge incentive to produce energy with renewables. That's the thinking behind it. But more so, because that's the way things happen in the supply and demand curve mostly. The last marginal part of the cost is the one that drives the price; the price that you're going to be buying things from. That's the way it just happens because you don't have storage. So, if we were to have storage in the electricity grid, okay, so you could produce with renewables a lot of it, store it, and when you come home and you light all those lights, instead of using and starting bigger plants which are very expensive to produce electricity, you would just simply use the batteries. So, what that would entitle is that the demand on the supply curve would be flat.

Adam: **01:08:34** Yeah. I mean, I'm familiar with the marginal cost of production, setting the prices and the price of any commodity is set to the margin. But in this case, it seems counterintuitive. Anyways, yes, carry on, sounds good.

Alonso: **01:08:50** It's kind of unfair for me, you know, that citizens in Europe are paying such high prices when utility companies are making a bundle of money and just because that marginal cost of the last part of electricity being produced, that's the way the law is written. That's the way prices are written in the code. So, you have to follow that. I think that's going to change a lot with energy storage. Here we see the price of lithium ion batteries. So, this is the storage. We're mostly using lithium ion batteries, let's say, for EVs and computers and iPhones and things like that. In the utility, higher volume, let's say, of energy storage, there's many other type of batteries we use, not only lithium based. But you can see the trend following this downtrend. I don't know if you've heard about Wright's Law. But Wright was an engineer that figured out that for every doubling of production, the capacity increased, the price comes down X amount. And if you take the slope of this curve, it brings you down to, let's say, maybe in this case, and I'm just inventing a number, it goes from $7,500 to about a 180. If you take this slope, it pretty much tells you that maybe 20% for every doubling of production you will decrease the price of the good. Okay? So, it's --

Adam: **01:10:30** Obviously, this is going to -- this will begin to be asymptotic at some point as the cost of production is no longer about all of the capital investment to produce, but is rather set by the cost of the inputs. Right?

Alonso: **01:10:47** Exactly. Because if you see in this graph that I'm showing, like coal, it decreases very slowly through productivity increases.

Adam: **01:10:55** Yes.

Alonso: **01:10:56** But at a very slow rate because the evolution part of that particular system has already been over. You cannot decrease costs below that. But if you look at these new emerging technologies, they still follow the Wright's Law very steeply until one point where it stops.

Adam: **01:11:21** Yeah. I mean, the cost of creating photovoltaic cells probably can approach zero. Right? Because what are the major inputs? It's copper and it's -- but it's mostly silicon, if I'm not mistaken.

Alonso: **01:11:36** Silicon glass and things of that nature. But then again, as we have seen, like in energy storage, the chemistry's changing as the evolution happens. Okay. So, in the lithium batteries, in this case, oops. Sorry. Let me get out of this thing. Like, in this case, this will keep going down because, like, here in 2018, which is a lot lower now than discussed. Of course, they're way below $100 now. Because, for example, take EV batteries, okay. It started using, let's say, high percentage of -- or they're low percentages, but they had cobalt, which is a very scarce resource. Nickel I think solved that. Now they are figuring out through this Wright's Law because competition and knowledge is compounding, they figure out oh, we can do without cobalt. Oh, okay. How do we do that? And it's new technologies start happening. Because we're seeing the evolutionary part of these new technologies. So, the Wright's Law is still very present in these technologies. So, we can see that these prices are going down.

So, for example, just to give you some ideas. Mexico, had -- the government wanted some electricity production and they put forward this thing for suppliers to come into Mexico and show their projects, projections and actually Mexico closed the deal with solar panels at 2.5 cents per kilowatt hour. Really, really low. Okay? Because as we will see later on, new projects are happening at a very fast pace and faster and faster and bigger and bigger projects are coming online. We will see that through the presentation. So, now let's move into more details. And I hope that this will help you get things clear.

So, what is energy? Everybody has -- everybody guess from -- intuitively what energy is, but nobody really has a conscious or very few people really know what energy is. And energy is very simple, for the universe actually. Energy is the ability to do things, to do things, to do work. Energy comes in various forms. People think that there's just one thing of energy. And, no, energy has different types of energy. So, we can divide them in two main groups. Okay? Potential energy and kinetic energy. Potential energies are stored energy. Okay, like fossils or gravity. And kinetic energies are energies in motion. This is a little bit, maybe a little bit too, as the engineering thinking, but let's try to go through the thing.

Now, work -- energy is the ability to do work. So, work is done when energy changes from one form to another. So, you cannot do things, you cannot do work if you don't move from one type of energy, to another type of energy. Energy cannot also be created or destroyed. In the universe, there's just the same amount of energy in different forms. And in order to do things, it has to go from one thing, one type of energy to another. Fossil fuels are chemical energy. This type of energy called chemical energy, stored in the bonds of matter. Chemical energy is one type of potential energy. Out of these two, fossils fall into this category. In the next two graphs, we can see how the United States uses energy.

So, how do we use energy? What is the work that we use out of energy? So, I divided it in three sectors. Residential and commercial, which is about 29%. Let's call it one-third of how we use energy. Industry is 35%, primarily another third, let's put it that way, just an approximation, and transportation is 36%. Mostly, mostly the way we use energy is to space heating and cooling, water heating, for lights, electricity, home appliances, okay, like washers, refrigerator, computers, TVs, etc. In industry, we use the same things here, but with one additional one. To heat for melting applications in furnaces. So, in the glass industry, for example, we have -- we get sand and sodium carbonate and calcium carbonate, we mix them together, then we put them in a furnace, so we need to heat this furnace somehow. And then through transformation, we convert that sand into glass. So, we require a lot of energy in order to heat and transform one substance into another. Industry uses quite a bit of energy for this purpose. Plus of course electric motors, which would be something similar to home appliances. Space heating the same, and lights so we can see.

Adam: **01:17:58** One thing that I'm curious where it kind of fits in here because it's becoming an increasing share of total global energy use is computation. Right? These huge data centers. And, I mean, the computational capacities that are required to run new AI based applications or you know, social networks, etc., consume an enormous amount of energy. Right? It's like so you're now directly taking energy and you are transforming that into computation. Right?

Alonso: **01:18:43** Yeah. Yeah. Electricity. It's electricity. Just so that we are very -- this is -- thanks for the question. It's not that much, actually, cloud computing and all of that. It doesn't use it that amount. It uses a lot, but very little as we will see in the next graph in relationship to, let's say, transportation. It's very, very low still. But I think that is important that I didn't mention in the presentation, but now that you bring it up, is something that it's good to be cautious about. Is that as civilization progresses, there is more energy usage. Okay. There's a very high correlation between civilization development and energy usage, very critical. As civilization moves forward, we will be using more and more energy. Actually, the universe wants us to use energy and we can go into that subject in another discussion or interview.

But basically, the universe really wants us to use and to do work. And in order to do work, we have to use energy. So, it's actually good to use more energy than not to use energy. When you think energy abundance, you don't think about saving energy. You think about using more and more energy. So, if energy became abundant, we would use a lot more energy for many, many other things. And it will tend to be good for civilization. So, for example, in Roman times, and they're saying a very good book about this … It's a writer that is … . I don't know if you've heard of him. But he is one of the top guys relating to how we use energy and energy and civilization, is one of his books.

And he describes that in the Roman times, we used about 18 gigajoules per capita. Okay. Forget about the units, just think about 18. We used that amount of energy per person during the Roman times. In England, in 1820, where we started really with industrial revolution and the steam engines and things of that nature, we went from 18 to 60 gigajoules per capita. So, like a threefold increase. Of course, civilization was far better. People's lives improved a lot. The quality of life was far better than the Roman times, so we use more energy. Today, okay, in Japan, in Germany, the developed world, we use about 120 to 150 gigajoules per capita. So, doubling again from just from 1800s, from early 1800s to the 2000s. So, in 150 years, we were able to double that again. And of course, we live far better.

Now according -- now in the States just so that you have an idea, it uses twice as much as Japan and Europe, 300 gigajoules per capita. But according to …, he believes that really you don't need more than a 120 gigajoules per capita to have most of your needs covered. Okay.

ReSolve ASSET MANAGEMENT

Adam: **01:22:59** I'm reminded of Bill Gates back in I think it was 1989 where he said no computer will ever more than 640 kilobytes of memory.

Alonso: **01:23:07** Yeah. Yes, yes. But that's why you cannot use the past to predict the future when -- he didn't really understand that disruption. Yeah. Anyways. So, and then you have transportation, okay, and this is a key thing. And we use transportation for moving goods and people, basically. So, that's another use of energy.

Now, okay, this looks kind of scary, but we have to go through it because after this graph, you will have a really good idea of how energy will be disrupted and become abundant. But we have to understand where energy comes from, how we use it, how we waste it. Now this diagram is called an energy flow diagram, which we engineers and we in industry use a lot. And basically, it's diagrams that I will go through it, and don't get scared about the numbers and things. This one is the estimated US energy consumption in 2021. And it's a diagram that tells you where you use energy, where it comes from, how do you use it, and where it goes, and how much is wasted. And in industry, we use it a lot to diminish the waste and to improve the combustion systems and the furnace operations in order to increase productivity and lower our cost of production.

So, let's go through it. Let's give it a try. Don't think about the units now. But it's the United States usage of energy in 2021 is 97 quads, okay. That's a million of bit use per -- But let's forget about the units. Just think about 100. Okay. More or less a 100 watts of things. That's the total amount of energy usage. These diagrams are read from left to right. And they have different sizes of -- so, this is wider than this thing. The amount of this dimension tells you how big it is. So, for example, we can see that on this line, this is the energy inputs. This is all how the energy in the United States, the sources of energy. So, out of the 97 quads, 35 quads are using petroleum. So, you see this is wider. And then you have biomass, you have coal, you have natural gas, geothermal, wind, hydro, nuclear and solar. These are the sources, Yeah.

Rodrigo: **01:26:22** What is biomass? Like, what is…

Alonso: **01:26:25** Biomass is what humans use since we were to 200,000 years old ago. It's mass that comes from Earth, let's say, a tree, wood, burning things like that. Now this is important because we're growing, for example, out of biofuels. I don't know if you've heard of them, but we grow instead of corn for eating, corn and things and then you process it and then you produce. These are called biofuels. It's just a kind of biomass. Okay.

Rodrigo: **01:27:00** Right.

Alonso:	**01:27:01**	This is organic things that you can burn, basically. You need to burn to combust to produce energy. Okay?
Rodrigo:	**01:27:11**	Yep.
Alonso:	**01:27:12**	Okay. And it tells you how much we use, the United States use in this particular year. So, 35 quads out of 97 were oil, biomass five, coal 10, and natural gas 31. Okay. So, these are the big ones. These are called -- these are fossil fuels, let's say in this area. And from here up, well, there's renewables or nuclear. Okay. These guys do not produce carbon footprint. They do not affect climate change. They do not produce gasses that hit the Earth, let's say. Now moving forward to the right in the pink is the usage of energy, which I just tried to describe in the previous slide. So, we use transportation in industry, commercial and residential. I put this, I lumped these two together in the past slide just for practical purposes because they use basically the same type of uses of energy. And then as we move to the right, we can see, and this is very important. This is a huge key take away. Out of all of the energy, out of this 97 quads that we input, we actually only use 31. Okay. So, 30% of all the energy is actually turned into useful things for humans. What it's called here, rejected energy is energy that just is wasted.
Rodrigo:	**01:29:08**	So, can I just stop there because I do want to understand, I've always understood clearly when you have a nuclear power plant that you don't really stop the energy process, generation process. It happens and when you can use it, you use it, when you can't, you just let it go. How is it that petroleum in a just-in-time system can't be turned on when it needs to be turned on and turned off when it needs to be turned off. How is that rejected energy coming from petroleum or biomass or coal?
Alonso:	**01:29:40**	Okay. So, let's go to this one because it's a big one. You see how big -- how thick this line is or how wide?
Rodrigo:	**01:29:49**	Yep.
Alonso:	**01:29:49**	So, we start with 35. And then it -- some of the energy -- some of the oil. Oil, this is -- just oil. There's nothing about coal or natural gas or anything, it's oil, what everybody talks about. Okay. So, 35 input, 24 go to transportation, eight go to the industry. But this is very simple to see because if 24 comes through transportation, we use a little bit more, 26 here because there's some coming on biomass, like biofuels, and there's some natural gas cars that are using. And maybe a little bit of energy you see here, electric vehicles from electricity transportation was at this year was that low, very, very little. So, 26 or 27 quads out of all of these things, which is the largest one, was used for transportation. But you know what was actually used to move the thing? Okay. Cars and -- Only five.

Adam:	**01:31:09**	I think the way to think about this, Rodrigo, is and you probably put this together, but this is just the energy efficiency of the engines that are consuming the energy, they're only -- they're not very efficient. Right? So, we only get about 20% of the total work that is available from that energy. We're only actually capturing that for work and the other 80% is going -- is being burned off as heat.
Rodrigo:	**01:31:36**	So, a practical example of that is sitting in a red light motor idling not actually moving the car forward.
Adam:	**01:31:43**	No. That's one thing, but it's mostly just that when the energy flows to the engine, the engine is only so efficient at extracting the energy from the petroleum.
Rodrigo:	**01:31:55**	So, we're really talking about there is kilojoules being created at the motor level and only, in this case, one-fifth of that is being used for energy. That's how inefficient motors are?
Alonso:	**01:32:07**	No -- Yes, it's very inefficient. But more so because then you say electric vehicles are 80%, 90% efficient and they're still moving. The reason why is because of a process of fossil fuels all of these things are burned. It's a process called combustion. When you combust things, you remember that in the previous slide, I was telling you how energy shifts from one form to another? Well, in the combustion process, when you just burn the gasoline or the diesel in this motor, part of the energy is used in mechanical energy that you transport from chemical energy from fossils to mechanical energy, which is movement energy, how you move the wheels and things like that, which actually is what you actually use. Right? But the other part of the energy from the chemical, the fossils, is lost to thermal heat. Okay. That's another form of energy, heat.
Rodrigo:	**01:33:16**	Unproductive.
Alonso:	**01:33:18**	It just -- you heat the ambient, and it just goes off. Okay.
Rodrigo:	**01:33:22**	Understood.
Alonso:	**01:33:23**	So, in combustion processes, because we burn fossil fuels, we don't burn solar, we don't burn electricity. We don't burn solar to produce electricity. So, this process of combustion is very, very inefficient. And this is what is driving this amount of wastage. So, if we wanted to substitute this 24 quads of oil, or million of barrels per day, you would only need to really substitute with more efficient engines, five. Okay.

Transitions

Adam:	**01:34:02**	Now just to be clear, Al, that is the total energy produced through combustion of petroleum. Right? It's not like *E equals MC squared* level of potential energy within the oil. Right?

Alonso: **01:34:19**

Right. Energy just shifts from one form to another and in the process produces useful things or work. Right? It just happens that when you use fossils in the combustion process, that you need to go through that to use to do actual work, you lose a lot in thermal energy. So, you don't like to lose thermal energy. You would try to avoid thermal energy as much as you can in order to drive efficiency. Here, for example, coal plants, you see coal, mostly the coal of the fossil fuels, what is it used for humanity? To produce electricity.

Now electricity, this is a critical part of what is going to happen in the future, in the near future. Electricity was discovered in the, well, in the 1900s, but it was actually put in practical use in the 20th century. Right? So, it's not that long ago that we invented this type of -- this is another source of type of energy. Okay. It's a kinetic energy. It's by the electrons, which is called electricity, electric energy. It's one form of energy, like chemical energy, mechanical energy, it falls into the kinetic types of energy, like thermal energy is kinetic energy. Electric energy is kinetic energy. This is a critical aspect of understanding why transition is going to happen.

So, if you look at how we generate electricity today, it's mostly done through the blue line, which is natural gas power plants, combined cycles and bigger plants, they produce electricity. The other one is coal production. And then these things, look at this, the same diagram, how much is wasted? You see, wasted energy. 23 quads out of 36 quads, can you see that? I mean, this is impressive. How inefficient combustion processes are. This is -- we only, out of the 36 quads, imagine 97 quads, 36 are used for electricity generation. We can use only 12 quads out of it. We use mostly in residential, commercial and industry, as I was telling you for motors, for computers, refrigerators, and things of that nature.

But look at how inefficient the process is, thanks to natural gas and coal. And one of the byproducts, Rodrigo, of the combustion process it's CO_2. So, hydrocarbons, it's a molecule composed of carbon and hydrogen mostly. You add air or oxygen from the air, you burn the thing, you produce CO_2, which is what is driving climate change. It's a very powerful gas in …, or what do you call it in English is a greenhouse, greenhouse gas. Right? And it's very powerful and it hits the Earth and then climate change happens. Well, the reason why we have carbon in the atmosphere is because of combustion. Because the products of the reaction from the hydrocarbons with oxygen is water and CO_2. This CO_2 is responsible for water -- for global warming.

And in that reaction, it's called an exothermic reaction. Heat is released and thus thermal energy. This thermal energy is what is causing all these wasted energy, which for the universe is not wasted energy but for our, in our case, it doesn't produce work, it doesn't do useful work for us. Okay. It doesn't do these things. And maybe -- is that more clear?

Rodrigo:	**01:38:46**	Very clear.
Alonso:	**01:38:47**	Yeah. Okay. So, moving along. Let me see here. Where am I going from here? So, oil is mostly used in this great majority, okay, about 66% in transportation. The rest is used in the industry to produce plastics and things of that nature. So, this is actually useful. Oil will always have a -- We'll always use oil, or at least this little bit to produce things for the industry as feedstock, to produce something else. Coal, we really don't need coal, if we can get rid of coal and we can substitute it instead of using coal to generate electricity. And natural gas, we use out of the 31, one-third, we use it to produce electricity, which we can get rid of. We need to get rid of this. No need because it produces a lot of waste. And then natural gas is also used in the industry for heating the furnaces. And we could use, like, in the glass industry instead of using natural gas to heat our furnaces, we could use electric furnaces. So, we will need to produce more electricity from greener sources to be able to substitute part of this natural gas. And then we use natural gas in homes to heat, to cook, and things of that nature, and we have to get rid of this. This will go very fast.
Adam:	**01:40:25**	Al?
Alonso:	**01:40:26**	Yeah.
Adam:	**01:40:26**	For the purpose of furnaces, I mean, the reason why combustion is such an inefficient form of energy translation is because it yields so much heat. Right?
Alonso:	**01:40:46**	Yeah.
Adam:	**01:40:47**	Furnaces, it's the heat you want. Right? You're actually not really asking it to do any mechanical work, you want the heat. So, why wouldn't you continue to use natural gas primarily for, for example, heating furnaces or for industrial functions where you legitimately just care about the heat rather than using electricity to heat furnaces? Are electric furnaces more efficient than natural gas furnaces in terms of the amount of energy consumed per unit of, you know, thermal energy produced?
Alonso:	**01:41:23**	Yes. Yes. For example, just to give you an idea, to melt the theoretical value to melt glass if you were a 100% efficient, it would take 2.5 million BTUs to produce one ton of glass. So, 2.5 million BTUs. Okay. … You cannot go below that. That's the energy that you need to break the bonds and to transform the silica into glass, 2.5 million. The most, of course, driving through knowledge and sharing and all of that, the consumption has been going, let's say, when I started working 40 years ago, the consumption was about 8 million BTUs. Instead of 2.5, we just 8 million BTUs to produce one ton of glass. Now with all the sharing of information and knowledge and fairs and trade shows and whatever, we've been able to drive down to about four and a half, four million BTUs. So, that's quite a big decrease in

40 years, using only natural gas as a heat source. Electric furnaces are in 2.7 million BTUs per ton.

Adam: **01:42:40** Incredible. Okay.

Alonso: **01:42:42** We are using in our industry, electric furnaces, so efficiency is a lot better. Now why are we not using more electric furnaces? Because if most of the electric energy is produce through natural gas and coal, imagine you have already this and you have to go through one process which makes it more expensive. So, electric energy tends to be higher than natural gas. So, there's no economic incentive to use electricity even though the technology exists already today to do that. Of course, now you have regulations and carbon credits and all of these things that are making these more expensive.

Rodrigo: **01:43:22** Don't they want to ban, in the US, natural gas now, recently?

Alonso: **01:43:26** What?

Rodrigo: **01:43:27** Like, there's been a recent push to ban natural gas as well in the United States.

Alonso: **01:43:32** Yes. And the reason why that is, I, okay. And this is totally against a lot of people, but I'm going to say something anyways. I believe producing electricity through natural gas has to be -- the elimination of using natural gas to produce electricity has to be one of the first priorities. I would even say that it is better to kill natural gas than coal. Coal has had a really bad press, which it deserves, okay, because it produces a lot of C02. It's more inefficient to make combustion out of coal than natural gas. But what the oil industry is not telling us, and I know this because we use a lot of natural gas and I'm close to this part of the thing. We don't use coal in our industry, but natural gas we do use it. Natural gas is 80 times, 80 times worse. Greenhouse gas is more potent than C02. 80X.

Adam: **01:44:43** Yeah. So, natural gas is …

Rodrigo: **01:44:44** 80X.

Alonso: **01:44:45** 80X. Okay. Imagine this. And we're using more natural gas, the oil companies are pushing use natural gas, use natural gas, use natural gas because coal got such a bad press, and they said how do we substitute with natural gas? Now you say, okay, but that's natural gas. I mean, CH4, the molecule that has to go to the air, to be 80 times worse than C02. But the problem is that there's a lot of leakage. And the industry doesn't, they don't even know how to measure it correctly. There's leakage all over the place and they're saying that it's like 1%, 1.5%, but new studies have shown that it is far above this number.

Rodrigo:	**01:45:29**	So, to be clear, when you burn the gas, it's -- I don't know. What's the outcome of -- in terms of CO2 gasses or green gasses, greenhouse gasses of when you burn it versus when it escapes?
Alonso:	**01:45:44**	80 times worse. When it escapes.
Rodrigo:	**01:45:46**	When it escapes though. But when you burn it, … is there any --
Alonso:	**01:45:49**	When you burn it, it diminishes. But if you have, like -- I mean, you have two … for the burners, and from the refineries and things of that nature, gas travels everywhere. Well, there's always leakage in the lines, okay, to start with. Second, when you refine oil, I don't know if you've seen this in the refineries, these flares of fires up in the chimneys, this is burning natural gas because they cannot put it in a tube and send it to somewhere else because maybe the refinery is very far away or they just have to burn it. So, in refineries, you burn a lot of gas, but a lot of gas is just thrown into the air. It's not burned. That's criminal. So, I say that humans should try to really reduce bigger plants and efficient coal generation plants of natural gas to produce electricity, before we go to stop coal.
Rodrigo:	**01:47:03**	One last question was just out of curiosity. So, we know that CO2 gasses have an impact. Natural gas is not C02. Right? It is a different compound but has the same greenhouse impact.
Alonso:	**01:47:19**	No. Every time, it doesn't matter if you use -- if you burn oil through gasoline, diesel. Coal when you burn it. Or natural gas when you burn it, the products of that combustion, of that reaction always produces C02.
Rodrigo:	**01:47:37**	Right. Okay.
Alonso:	**01:47:38**	Always. Okay. It doesn't matter if it's natural gas -- …
Rodrigo:	**01:47:41**	The difference is that out of the three, natural gas leaks more than the other two?
Alonso:	**01:47:46**	No. The thing is that natural gas is one type of hydrocarbon. Which is C-- is one carbon and 4 hydrogen CH4, and that, the coal is solid. Right? And oil and gasoline are liquids. Okay. But this thing is a gaseous form. And when it escapes in gas form, this particular one, this and only this is 80 times more powerful than C02, which is the products of combustion from all these reactions. Okay.
Rodrigo:	**01:48:21**	Right.
Alonso:	**01:48:22**	So, the problem is that I believe there's not really good sensors to measure the leakage of CH4. I think there's going to be a lot of improvement, and which we are starting to hear a lot of talks about banning's natural gas because of the leakage of CH4 molecule before it gets burned, let's say.

Adam: **01:48:45** Al, what do you estimate to be the leakage factor if it's not 1%, what do you think it could be?

Alonso: **01:48:51** I have no idea, but some studies have shown to be 3, 4, 5 %. So, imagine if we grow these because they're telling us that natural gasses, that the best transition fossil fuel. Well, the more you use this, the more leakage you have, the more leakage you have, the worse it is for the global warming. So, natural gas, at least, when we're not using it, like, for feedstock because you can use natural gas in industry not to burn it, but for feedstock to produce other things, like fertilizers and things like that that humans need. So, yes, we should use CH4 and natural gas to produce fertilizer but not to produce energy, electricity. Okay. That's a no, no. That's going to move -- And that's going to move, not because I say it, because it's just so obvious that it's going to go.

So, in essence, okay, what needs to happen is that instead of having all of these things, we should have renewables and nuclear. I'm a pro nuclear guy. And we should have all of these forms of energy produce electricity, grow this electricity generation to turn it into useful work for heating homes instead of heating your stove with natural gas, we should use it with electric stove and things of that nature. In industry, we should cut at least 50% of this natural gas to heat and use it through electric energy. And instead of using gasoline and diesel here, we should come from here, put this little line a lot bigger and convert it. This is EVs. Now why are EVs so important? Because this is a huge -- This is the biggest source of inefficiencies in the world, this transportation, it's the biggest use of oil.

So, you see 24 out of 35 quads and imagine there's 100 million barrels of oil produced every day. Okay. The US consumes 20 millions barrels of oil every day, 20% for the world. Out of 100 million, 55 million barrels of oil approximately are used for cars and trucks. And I'm talking about … airplanes, nor boats, nor anything like that. Okay. Just keep this number in mind. And you can see it in this graph. Okay. Pretty much 24 out of 35. This is a little bit higher because you have the airplanes and boats and … and other things that you refine.

So, oil you refine to produce gasoline, for cars, diesel for trucks, … for airplanes and things like that. And we can see it here more in detail. So, this is from the EAI in the US. This is you see, this is the input about 20 million barrels per oil per day per oil is the US, what they consume. In gasoline, 8.8 million barrels of this 20 million barrels that you consume every day in the US, about 9 million are used for gasoline. 96% of that gasoline is used for transportation. Some of it is used for industrial usage and things like that. So, the majority of gasoline production is to transport things. Where do we use gasoline? In internal combustion engine in the cars. This is the industry that is going to get disrupted.

Distillate fuel oil or diesel, 77% goes for transportation. So, that's about 3 million. So, out of the 20 million, 11 million barrels of oil are used for transportation in the car and the truck to move goods.

Key takeaways from the flow diagram. Okay. So, the use of fossil fuels is highly inefficient. Only around 33% of the total amount of input energy is actually used to do work for human activities. The rest is wasted mostly in the form of heat as a result of the process of combustion from fossil fuels. In the US, fossils, that means carbon natural gas and oil, represent about 80% of the input energy mix. These guides here represent 80% of the 97 quads. 36% is used in oil, whose main 55% function is for the car and truck transportation. This is a number that we have to keep up in mind to understand what the future will bring us. The USA consumes about 20% of all of the oil in the world or about 20 million barrels per day.

Now, this is critical to understand. The transition from fossils to renewables needs three steps. This is the process, the way we have to think about it. One, it has to be electrification. Meaning that instead of using this, we have to mostly use electricity as the primary source of energy to do work. That's called electrification. Point number two, how we produce electricity has to be from renewable sources. That means something that doesn't kill us in the process like global warming and CO2. So, we take combustion process away, we take away the C02, and we need to use renewables. Why renewables? Because we now have the ability as humans to produce electricity as the cheapest source of energy from renewables. So, it's a no-brainer. And the third thing that we need is what we just talked about, a lot, energy storage.

Now the good news is that all of these, the previous steps, these three steps, have a working technical solution. It's nothing that, like, a fusion. Okay. Yes. Okay. There was a big discovery now that we can produce more energy than what we put in through fusion. Okay. But that's going to take 15 years more. There is not a technical solution to that problem yet. But for all of these things, there are technical solutions as we speak. So, the problem is not technical in nature, it's not about knowledge or technology. We're in the disruptive part of the cycle. The only real challenge for humanity is scalability or the velocity of implementation. Prices for all of these three steps will keep coming down following Wright's Law and the evolutionary stage that these technologies are right now.

And this is just a graph showing that oil has only about 20% efficiency. Imagine, 80% is wasted as heat. Natural gas and oil to produce electricity, it's around 50%. And natural gas uses in residential and commercial, it's a little bit better with 65%. So, electricity generation by time, just some data. Solar plus wind only represent around 12% of electricity generation in the US, versus around 22% in Europe. That's quite a bit of a difference. All renewable sources, hydro, geothermal, solar plus wind plus nuclear, which is not, let's say, renewable, represent around 40%

of the electricity generation in the US versus two-thirds in Europe. There again, it's a huge difference. Natural gas and carbon represent around 57% of the electricity generation in the US. The combustion process used by these fuels, fossil fuels, is highly inefficient between 40% and 66% of wasted heat. So, in the car industry, it's 80% wastage. To produce electricity from fuels, it's around 50%, 40 to 66%.

This is just a diagram showing, and I'm going to go very fast through all of these. But how electricity is produced in the world, so you have the US, okay, again, 20% from renewable sources; geothermal, wind, solar, hydroelectric, 20%. In Europe, in Germany, which is close to Europe, 45%. Nuclear in the US is 20%, in Europe it's 11%. So, if you add these two together that's about 40% that doesn't cause CO_2. In Europe, it's 66%. Japan is very low. Japan is 20 and four. So, they use a lot of natural gas to produce energy, the same as in the States. Coal, the same as in the States. But look, for example, China. China, which is a big country to follow and India because of the population size, the renewable is 28%, India's 18%. Nuclear is very low, still in China at 5% and 3% in India. Look at coal -- this is coal. 60% of electricity generation in china is through coal, and 74 in India. Okay.

So, the roadmap, five actions for the transition to renewables. Number one, and the most important one, the one that will start the whole thing moving, electric vehicle substitutions away from internal commercial engines in the sectors of cars, trucks and public transportation. So, out of that 100 quads that we talked about of the input, something that we need to kind of memorize. So, there's a 100 quads approximately in the US, five quads are coming from renewables in the States. Which is half of what they use in Europe. So, Europe, they use 10 quads, equivalent. In the US it's only five. So, it will give us just how much of new electricity we need to generate from renewables to substitute all of the oil for car usage and truck usage.

So, if we were to reduce oil, we would reduce 20 quads of oil, okay, out of the 100, which is equivalent to four quads of additional electricity generation by renewables. So, right now, the US is producing five quads. So, they will need to double to get rid of 20 quads of oil. It's kind of doable. No? I mean, in Europe, it's already twice as more in renewables. It's pretty much doable. Eliminate the use of carbon as a source of electricity generation. So, that would take away 9.5 quads, which if we go to the curve is these ones, you see 9.5. So, get rid of these, we get 9.5 less. And then this generation, electric generation because of the inefficient factor we would need to produce 3.5 quads of additional electricity, we were to get rid of all carbon.

Adam: **02:01:30** Coal.

Alonso: **02:01:31** If we eliminated natural gas to produce an electricity, which it's around 11.5 quads, again, these ones, you see 11.6. We were to eliminate that, we will need another five quads of additional electricity generation, a 50% substitution of natural gas in commercial and residential applications. Instead of using natural gas in homes, we could use heat pumps, solar panels, batteries, we would require three quads of additional electricity, and we get rid of four quads of natural gas. And then in industry, we were to substitute natural gas and oil usage in industry, mostly in the form of heating and combustions, if we were to have electricity prices coming down, then industry would move very fast to substitute natural gas, instead of electricity, instead of natural gas. So, we could have a reduction of 9.5 quads of oil and natural gas, that's five quads of additional electricity generation. So, this is the conclusions in general terms.

The result of the implementation of these type actions that I just described, which are happening as we speak, is a reduction of the total fossil fuel mix by around 55 quads of the total of 77 quads, okay, a reduction of 70%. That means that if we pay -- if with these five steps, natural gas, coal, and petroleum use the 35, 10 plus 31, if you add that up, it's 77 quads. It's 77 quads. If we were to do these five actions, we could get rid of 55 quads or a reduction of 70%. It's very significant. Solar and wind in the US represents only five quads. That's the production in 2021, which is higher and it's getting quite higher in the next three, four, five years. So, we will need 20 quads of additional electricity instead of producing five. So, 4X more in order to do this five-action plan. Okay. It's doable - 4X.

I think that these five actions will be implemented, okay, around 65% by 2035 and 85% by 2045. By the year 2050, most developed countries will be, in theory, carbon free. Okay. Carbon neutral. So, yeah, I think it's doable and I think it's going to happen very fast at the beginning. So, the graph will look something like this, very fast at the beginning, and it will slowly decrease with time. So, we will see big changes before 2035.

Disruptions

Adam: **02:04:41** I think we also need to remember too, right, that energy consumption grows at about the same rate as GDP, right? So, if we sort of expect global GDP to grow at 2 to 2.5% per year in terms of real output, then we'll need 20% more total energy by 2030 than we're seeing now. But just scale those numbers -- …

Alonso: **02:05:11** Yes and no. Yes and no, Adam. I agree with that. Absolutely. There's a correlation, as I mentioned before, between development and civilization and GDP growth with energy usage. That's a correlation that it's intact. But with disruptions where things might change a little bit, and we will talk a little bit in the next few slides how, for example, if transportation gets disrupted of how we use transportation, things could change radically. Our transportation is a big chunk of the problem. So, for example, when you buy a car, most everybody that owns a car, it's kind of a dumb thing if you stop and think about it. You get an asset that the rate of utilization is only 5% of its time.

If you were to say that in any meeting in the industry that you were going to buy an asset to use it 5% of the time, they will throw you out of the door. It doesn't make any economic sense. Do you agree?

Adam: **02:06:27** Absolutely.

Alonso: **02:05:29** It's kind of stupid. You have to use space to park the car. You have to take insurance, do maintenance, you know. And you only use it for 4-5% of the time. What will happen, and I believe it will happen within the next four years, three years is going to start is autonomous driving or transport as a service, let's say. Why would you want to own a car? The only reason why you own a car is because it's the only practical solution to move around from point A to point A, especially the States. I mean, if you use public transportation, okay, you can move within a circle of points. But you have to go from point A to the public transportation, then from public transportation, you have to walk to get to point B. So, you need a car to go from A to B.

But if you had autonomous driver, imagine there's no driver, and for that, you need an electric car. You cannot do it in combustion, in ICE cars. You need smart car, like a smartphone. It's not a phone, but it's a smartphone. You need a smart car, not a car in order to do this. But this is happening as we speak and if that is the case, I would say that the miles traveled, if you were to use this system, transport as a service, what that would imply is that you would use the car 8X times or 10 times more, instead of 5%, 40%, 50% of its time actually using the asset. Right? And if that is the case, the miles traveled in the whole population will be mostly used through high usage of autonomous driving cars.

What is the implications of this, is that I believe and we're already seeing it that the total amount of car production is diminishing in the world. So, right now, it's about 100 million cars that we produce in the world globally. This number is starting to come down. So, I believe like what, when we're reaching peak oil, I believe that we already reached peak car production. Car is going to go down for one simple reason because it makes economic sense. If a middle class family were to just disregard the car, and use autonomous driving, it would save around $5,500 a year. Just let that number sink in. If all Americans were to do that, it would bring one trillion, a little bit more than $1 trillion in excess money in purchasing power. Yes, the numbers are staggering if you stop and think about it.

Now why would anybody want to do this? Number one, for convenience, for cost savings. And the only reason would be because the cost per mile travelled is lower than if you own the car. Right? So, right now, it's about 70 cents, per mile driven if you own a car, that's the cost. With autonomous driving, with no driver, electric cars, electric energy, that cost could go down to 35. Some say even lower than 20. So, even public transportation could not compete. Why would you not do it? So, yes, I agree that as GDP growth, but this is a disruptive type of technology that the past -- you cannot use the past to predict the future. So, I believe that if this were to happen and I believe it will happen within the next five years, it's going to start, of course, like a typical disruption curve, 10% and then it's going to go fast.

You know, in San Francisco, there are cars already that you can take from GM and Google and Tesla and all of these companies are pushing this technology fast. So, if that were to be the case, then Adam, you could make a case that even if India and China were to go this route with their high population growth, if they were to go this route, it would not have that huge impact on energy usage. I don't know if it was more or less clear, my explanation.

Adam: **02:11:25** Yeah. No, that's good. That's a good insight.

Alonso: **02:11:29** Yeah. Okay. Now just to give you some examples that I live around because we're in the glass industry. So, solar PV installations will increase significantly in the next seven years. Glass manufacturers are a good leading indicator as glass is a major component of solar panels, okay. Just in 2010, there were around 40 gigawatts of solar panels. So, the glass industry had to produce this amount of glass. In 2020, it grew to 710 gigawatts. This is exponential as we move forward. So, that's a big increase. Right? And by 2030, the glass industry is right now investing in furnaces to supply this increase in solar panel usage to 3,000 gigawatts. From 710 to 3,000 gigawatts. In the USA, the use of solar panels for electricity production's around 3%, very low. But expected to grow very fast around 30% to 40% by 2030. The things are moving.

Now Sun Cable, which is an electric utility company in Australia, is constructing a 20 gigawatt, imagine 20 gigawatt, you will see the numbers, 20 gigawatt solar farm in northern Australia. The largest solar farm in the world right now is in China with 2.8 gigawatts. I mean, 2.8, imagine who is crazy enough that I mean, this Chinese solar farm is huge. Now, these guys are going to go 7X the more just in one shot. And the 2.8 gigawatt of installed capacity is enough to power 1 million homes in China. And this is where -- This graph is a really interesting one. Okay. And I'm just about to close the presentation.

Fossil fuel volume forecast, and this is my graph. This is all my doing. So, here we have the volume and I'm graphing what will happen with oil through time, in a time frame of say '23, 2030, what will happen with natural gas, what will happen with coal. So, peak oil, I think will be this year or last year or thereabouts, plus or minus one year. So, I think peak oil is already set. It's going to be driven by demand destruction, not by supply constraint. Most analysts today think that oil should be a lot higher because of all the ESG, not investing enough in oil and production and all of that thing. At the end of the day, that's not happening. I think where things will be moving is from demand destruction. So, why am I saying that? Because oil is used mostly for transportation. And as we will see, EV adoption rate is already hitting the destruction curve. So, this thing is going to happen either we like it or not, it's going to go that route. Oil is used for gasoline and diesel, 55% of the volume, and this is already started. So, oil has but one way down.

Natural gas is going to go up, so does coal, mostly because of what you were mentioning, Adam, because GDP growth will happen and we will need electricity. So, we will be using these two because we will need more electricity for EV adoption. And even though renewables are going to be implemented very fast, I still believe that countries like India, Mexico, Japan, China will be using natural gas as a transition gas to produce electricity.

Rodrigo: **02:16:03** For electricity generation.

Alonso: **02:16:04** Just for electricity generation.

Rodrigo: **02:16:05** That will power the EV cars in the transition period.

Alonso: **02:16:11** And then it's going to hit in 2030, coal is going to get -- it already has bad press, it will get a lot worse and it will diminish very, very fast. And I don't know when exactly here, but this will end somewhere in the 2050s, 60s somewhere around there. Okay. Oil will keep going down at a slower pace and natural gas will definitely start dropping here. This is 30 million barrels of oil, destruction between 2023 and 2030. This is huge.

Peak oil. Around 55% of oil is used for transportation. That's about 55 million barrels of oil per day. Global car production per year is around 100 million units and around 1 million for trucks. Global battery electric vehicles, battery electric vehicle sales for 2023 will be around 20% for all cars. It was 10% last year. China will be around 40% of battery electric vehicles. China is the largest car market in the world and has the most battery electric vehicles manufacturers in the world. There are about 100 producers for electric cars in China. There's a lot of them. The new Toyotas will be coming out of China within the next few years. They're already here. For every incremental, okay, look at this number, for every incremental 1 million battery electric vehicles in sales, so out of the 100 for every 1 million, there's around 150,000 to 200 barrels of oil per day are replaced or destroyed.

Once autonomous driving or transport as a service becomes readily available as we were mentioning, and battery electric vehicle's actual usage is increased from around five to 40%. Therefore one, for every million of battery electric vehicles used for autonomous ride-hailing services, destroys about 1.2 million barrels of oil per day. Autonomous ride-hailing service is expected to become readily available sometime in the next three to five years. The technology is already there are very advanced. Battery electric vehicle production for 2023 is estimated to be around 18 million units versus 8 million units in 2022. Okay. So, that's 10 million more EVs this year. So, around 1.5 million barrels of oil per day are being displaced this year.

The trend will continue to accelerate in the next three to four years. So, as adoption rate increases, and as prices for battery electric vehicles keeps declining before the 40,000 US dollar per vehicle. That's the threshold. Now I don't know if you've heard about Tesla dropped their prices to around 20%, 15%, 12%. The Inflation Reduction Act that President Biden put in place is really huge. I think it has really big ramifications in the world, more so than what people might think and we're seeing one of them. Because some of the cars from Tesla were left out of this $7,500 subsidy from the government to the new users of electric vehicles as they push this transition. What Tesla did was lower the prices.

And right now the way they lowered the prices, it's going to put a lot of incumbent players in real serious difficulty. Because imagine if you're Toyota or General Motors and you're very highly indebted companies, Toyota not so much, but GM and Ford are. And most of their investment money and the debt that they owe was to produce factories, to produce ICE vehicles, or internal combustion engines. Imagine just sitting on that board and telling you that all the money that you spent is just about to be scrapped and you have to throw it out. But you still have to pay the debt. Not only that, now you have to really put a lot of new investment and new debt, to build new factories, to try to compete in the EV market. Because people think EVs are the same, it's just a car with wheels and you just change the engine, but that's not the case. It's not the same. A Nokia phone and an Apple smartphone, it's totally different. So, they're going to be in for a lot of trouble.

Internal combustion cars will keep losing ground every year at an accelerated rate. The end came between the battle between ICE cars and battery electric vehicles will be somewhere around 2026 or 2027. In 2022, total car sold decreased about 8%. Okay. This is what I was telling you, Adam, that car sales production of units of cars is diminishing. Now this could be because of COVID and things like that, but the tendency seems to be going that way. Instead, battery electric vehicles increased around 45% last year. And ICE cars decreased by around 10%. The tendency is very clear. This is a trend. Once adoption rate passes 10% tipping point in the disruption curve, the end game is near.

Any car incumbent that does not move very fast within the next three to five years, in battery electric vehicle conversion is probably not going to make. The total car market will decrease in units sold per year as transport as a service to autonomous ride-hailing services become more readily available. Some estimates put the reduction around 35% less global car productions around 65 million units produced per year. So, instead of producing 100 million, because people will just not just buy cars no more, they're going to use transport as a service. There are some predictions that the number will be around 65 million units produced per year. Miles travelled will be done mostly through transport as a service. Car ownership is reduced as transport as a service becomes available.

The median USA household can save up to US $5,500 per year in savings. It will give a huge purchasing power boost to American families. Oil has very low stock-to-flow ratio. So, stock to flow is a ratio that tells you how much stock there is of any good commodity, gold, silver, oil or whatever you want to touch base? How much there is in stock in relationship to how much is produced? So, in the case of oil, the ratio is very, very low. This means that for any small variation, around 1% in either the supply or demand has big price action. A move in one to 1.5 million barrels per day demand destruction can have significant price swings. Oil prices should be on the downward path, giving low cost oil produces an advantage in the near future. So, the prices, I believe, will come down in oil.

Of course, in cycles, will up and down, up and down, up and down. But the dependency should be going down. And I'm not trying to give any investment advice nor anything during this presentation. Okay. I'm just giving some thoughts. There are around 4 million, look at this number. It's impressive. There are around 4 million semi-trucks in the US responsible for moving around 80% of whole freight. I never thought about this until I studied it. So, 80% of all goods in the US are moved by trucks. Each semi-truck travels around 100,000 miles per year or so, so that the substitution of 1 million semi-trucks, there are only 4 million semi-trucks in the US moving goods. So, if you were to move just 1 million semi-trucks, 25% of the fleet for battery electric semi-truck, that would mean another 1 million barrels of oil destruction per day.

Now Tesla just delivered last December, the first batch of semi-trucks to PepsiCo, and the results are impressive so far. It out beats an ICE truck by a long shot. The cost of maintenance, the cost of charging energy, it's far better. A semi-truck can go 1 million miles with minimum maintenance because there's a lot less moving parts. So, if this is the trend at Tesla, actually, just gave notice that they're building a huge factory in Nevada to produce the semi-trucks.

Rodrigo: 02:26:30 Yeah. That was an interesting…

Alonso: 02:26:33 Just so that you get an idea on this graph I think is very telling. US light vehicle sales between 2022 versus 2021. Look at the numbers. All the incumbents, the disruptor. So, if this trend continues, and you're sitting on the board of Toyota or GM or Ford. I mean, you will be freaking out.

Rodrigo: 02:27:14 Yeah. I think -- You know it's interesting about the Nevada plant is that it's supposedly designed to be self-sustaining through renewable energy. So, now there's always been the argument that producing an EV car is just as disruptive to the economy -- to the environment as -- or worse than any other car because of supply chain. But now we're starting to see the feedback loop. Right? If he can produce a gigafactory that's a 100% renewable that produces 100% renewable energy cars, you start being, as always, it's always been kind of the example for everybody else to follow. Right? And I think they're aiming to produce 50,000 semis in 2024. And that's just one company. Right? If everybody else leads, all of a sudden you're replacing -- it'll follow that exponential curve over time. But you're replacing, let's say it's only Tesla, you're replacing 50,000 units every year. That's probably likely to go up from one company. But if everybody else and the board decides to get in the game, it could get really interesting really quickly. That's fascinating.

Alonso: **02:28:22** Exactly. And they're only 4 million units running on the road.

Rodrigo: **02:28:26** To replace. Yeah.

Alonso: **02:28:27** But I'm telling you, imagine what will happen to the used car market. In California, if by 2030, I think it's the law, you cannot buy an ICE car, what are you going to do with your ICE car?

Rodrigo: **02:28:46** Collectible.

Alonso: **02:28:47** Do you see? And now with the lowering of prices from Tesla from the Model Y and Model 3, they're really competing one-on-one with ICE cars far better. And the only restriction is battery production. But battery production just so that you can have an idea, I have a graph here, which I'm -- I don't -- I'm so sorry, couldn't put it on the presentation, but just I'll give you the numbers. In 2022, the amount of gigawatt-per-hour production of batteries is around one terawatt. So, 1,000 gigawatt hours. And that produced all this EV transition. By 2027, so that's five years away, instead of one terawatt capacity of battery production, it's going to go to nine. That's 9X. That's already factories being built.

Now people say, oh, this is very destructive because of all destructive of lithium and nickel and graphite and whatever.

Rodrigo: **02:30:06** There's a lot of people pulling their hair right now listening to this thinking he doesn't understand the lack of capacity. We can't produce that much – that many batteries and the environmental effects of lithium and all that fun stuff.

Alonso: **02:30:20** But it is happening and I can tell you the names of the company. CATL BYD, Tesla which is the slowest one of all, I mean, they're going to ramp up production, but not as fast as the Chinese or the Japanese or the Koreans. You see, I always believe that you cannot go against human ingenuity. Once you know you have the solution, and it's only a scalability problem, humans will figure out how. And I'm just going to give you one example.

The US produced the amount of oil that they extracted, I mean, it was like 5 million barrels of oil, what, 12 years ago or something like that. They peaked around 10 million, and then it started going down, and then it went down around 5 or 6 million barrels per day production. They invented this thing called fracking, and they implemented the technology, it was very disruptive. And now the US is producing -- it's the largest producer of oil in the world. I mean, more than Saudi Arabia and Russia. 12 point some million barrels per day are producing, and they did it within eight years. This is impressive, you know, I think. I mean, just to think about that, I think it's just a wow moment, no.

Adam: **02:31:56** One of the other things that you chatted about, Al because I pressed you and I was listening to Robert Friedland who has been for the last 40 years involved in a majority of the world's largest copper mining developments and is a big proponent of sustainable copper mining, etc. But he's made a strong case that you'll need to quadruple or even in some estimates, 10X, the total number of extracted copper in order to electrify. So, move from internal combustion to electrify the economy. And I remember I posed this challenge to you, and you had some really good answers. So, I want to give you an opportunity to address that.

Alonso: **02:32:48** Yes. This is a huge problem. Like, in every disruption, there's always problems. But solutions follow problems. And this is human creativity, ingenuity. This is what we have minds for. This is why we are humans at the end of the day. And you figure out better ways to do things. So, I believe strongly that if you think, and linearly and you extrapolate, well, if we were to convert all of these EVs and all of the grid and all of these things, we would need so much amount of copper from past experience. Right? But during disruptions it's dangerous to use history as an adviser. Because for example, yes, there is a lot more copper. Okay. Copper is needed for sure in electric vehicles. But if car production goes down because of transport as a service, well, you need less materials. Right?

Adam: **02:34:03** Well, you need more copper, a lot more copper in an electrical vehicle than you do in an ICE vehicle. Right?

Alonso: **02:34:11** Yes. Yes. Without any doubt. But for example, if you change the wiring, on the way you wire the car, for example, Tesla's trying to do -- changing the wiring, so instead of using I don't know, two kilometers per car or some number like that, I don't remember the thing. They could drop it like a 100X if they change the way they wire the thing, So, that's one way to reduce the thing. But instead of producing 100 million electric vehicles, you produce 65 because it's transport as a service, well, you have 35 million less. So, for example, another thing, another way.

If you were to put, say, oh, well, we need to change all the grid to sustain all this amount of new electricity generation. Well, I say distributed power, it's a good solution. Right? If you are your own utility factory, let's say, your household, which

I am in my case, for example, and I see all the benefits. So, I produce solar, with wind, even with hydro, and I have batteries in my house. I produce everything. I charge everything. And I actually sell energy to the grid. And if I have my car, my electric battery car, which has 75 kilowatts, more or less of batteries versus a home that has about 15 kilowatt hours, imagine all the energy storage capacity you have in cars. So, if you're not using it and you connect it to the grid, and the price, it just happens that it's going up because it's late at night and people are demanding more energy, well, you could sell your energy to the grid. It doesn't have to come from the grid to -- from utilities to you. It's called distributed power. So, that would require less. Right?

Now, of course, copper is going to be needed. Yes or yes. I mean, this is a no-brainer. For example, there are other materials like lithium, nickel, manganese, graphite that will be needed very, very high, especially for battery productions. But the good news is that batteries have circular economy. So, that means that once the battery is depleted or it stops usage or you change your car for whatever reason, these batteries can be recycled higher than 95%.

Adam: **02:37:11** Really?

Alonso: **02:37:12** So, all the materials you need are already there. So, if you become a circular economy, well, why would you need extractive? I believe that in the future, this from -- moving from scarcity to abundance, one of the things that will drive this abundance is digitalization, which we did not have time to talk in this presentation. But what that basically means is that you will derail or diminish extractive things from Earth. I mean, taking things away from Earth and just pushing it through the digital world. So, for example, and I think we mentioned this during our meal, Adam, newspapers. Just digitalization of news, the value chain was totally destroyed, from newspapers to digital news. So, I think just to print the New York Times for Sunday, you have to cut like 80,000 trees or something like that.

Imagine cutting trees, sending it to a paper factory to make pulp. And then from there, you have to make the paper, which is sent to the printer. The printer has these huge machines that you need steel and things of that nature. And then you have to strike inks so you can put it on a piece of paper. And then once you print all that thing, you have to use a car, a driver, to send this newspaper all around the city. And then if you want to buy the paper, you have to go and move in your car, buy the paper. To do what? What is the whole purpose of this thing? It's to get news. You want to read the news. Okay. Well, that process of digitalization that I'm going to be talking about now, just destroyed extractive nature of scarcity because trees are scarce, iron is scarce, inks are scarce, all of these because they become -- they come from the Earth, they come from extractive nature.

Now, the news you already have, you put it into the computer, you press a button, you wake up, you open your computer and you not only need -- you're not only limited to read in New York Times. I personally read about 15 newspaper, just the headlines from around the world every day. It takes me 15 minutes to go through the thing. I did not -- we did not destroy any trees. We didn't need to extract iron to build machines to do the printing process and all of that thing. This is the value chain between one technology to another one. This is disruption in the happening. And the great news about this is that it cost me nothing, zero. It's abundant. Right? Before I had to pay for the newspaper. And then what do I do with the paper? It's a huge problem. No? So, you see how circular the economy is changing, and we go back to the beginning of my presentation. We are moving in a new era where things are happening a lot faster, and you cannot use the past to extrapolate the future because you will lose. Okay. I don't know if this answers the question, Adam.

Adam: **02:41:21** Yeah. No, no, those are great answers. I wanted to get into the distributed or decentralized power production. And we can, if we get into a decentralized power framework, then you can take a lot of those copper wires that are used for distribution right now and redeploy them as well. So, that's interesting. Okay. Well, we're at 2 hours and 45 minutes. We've asked a bunch of questions …

Alonso: **02:41:50** Oh, no, I'm sorry.

Adam: **02:41:52** No. No. No. It's absolutely fantastic. I've been riveted the whole time. And I have to say that our initial lunch really got my wheel spinning. And that this has continued to reinforce, because I -- I tend to use the history to try and extrapolate to the future. And I think it's really useful sometimes to break that frame and say, well, what if you can't use history or extrapolate history to forecast the future? How would you position, how can you make decisions today that can hedge against some of those exponential growth type scenarios that are dislocations that may not be fully priced into the way that you consume nowadays, may not be fully priced in terms of markets or investments, etc.

So, I think it's extremely valuable to explore these kinds of concepts and really dig deep, internalize them and contemplate the consequences against your current frame in order to have that cognitive flexibility that we all need to be able to adapt and not experience that anxiety about this rapid rate of change. You know, I do wonder -- there's some practical engineering things we could explore, how quickly are batteries storing enough energy to be able to move cars for distances that matter, that sitting at charging stations is right now kind of impractical. Are we going to move to a hot-swap battery kind of model? Or there's all this kind of stuff that we could explore. There's a number of different directions I think we could explore, but we covered a huge amount of ground. I think we've probably, hopefully, been successful in at least jarring people into exploring further some of these areas and maybe change a few minds along the way. So, I think it's been -- …

Rodrigo: **02:44:09** Can I just -- Before we wrap up, though, and I know we're running out of time here, Alonso But I'm looking at your slide deck because this is to me where I have always thought we were going as well.

Alonso: **02:44:21** Yes.

Energy Abundance and Humanity

Rodrigo: **02:44:22** I tend to tilt optimistic, Adam tends to tilt a little bit more pessimistic. To me, this summary is where I think is -- it's just an interesting conclusion. So, we talked about energy abundance. What does that mean to humanity over time?

Alonso: **02:44:37** Yeah. This is the last slide, and I think it's the consequences of going through this energy abundancy. I think it's the beginning of the end of big oil. Most macroeconomics concentrate on the supply dynamics to predict price action of oil when the demand side will be the determining factor. I think lower energy costs will produce deflation across all sectors. Okay. This is huge. Because energy is the common denominator on every human endeavor. So, if you lower energy cost, I mean, the glass that we produce has to go to down, because we will go to our suppliers and tell them, okay, your energy is free, so you lower the thing. Transportation cost will go down, so transportation costs go down.

Imagine what this implies just for the economics in the world. I believe it increases the purchasing power of -- for all people. Like if autonomous ride-hailing comes to fruit and transport as a service really becomes the norm, imagine all that free purchase, free extra money that people will have in purchasing power. I believe income inequality becomes less relevant. This is something that I've always thought about and this is just another crazy idea for you guys to wonder about. But I believe that let's say, lower middle class person today in the US has a better quality of life than Rockefeller, the richest man, did 100 and some years ago.

Rodrigo: **02:46:27** No doubt.

Alonso: **02:46:28** Just stop and think about that. Okay.

Rodrigo: **02:46:31** I remind my children every day.

Alonso: **02:46:33** Oh, you do? It's incredible. I mean, people today have access to a lot of goods and services than the richest people, just 50, 100 years ago, did not have. So, if that is the case, then income inequality becomes less relevant. GDP and GDP per capita as metrics are complemented by other metrics like quality of life, happiness, freedom of time, etc. And the Inflation Reduction Act will bring one of the biggest incentives to the American economy in decades. It will accelerate the transition to sustainable sources of energy. So, the implications of this are so big that I don't even think that we're capable to imagine all the consequences of this. So, I will end the doc here. I think this is the end of the presentation. This is one chapter of the book, imagine.

Rodrigo: **02:47:38** Well, we'll have you back once a week for the next 52 weeks to -- so that we can round up the full depth of this conversation.

Alonso: **02:47:46** Yeah. Because the other megatrend has very pronounced effects, I think, on humanity. But in the end, I would end up being very positive. I think all these crisis are from breaking points to turning points and turning points always bring better. And I really believe that we are on that track. And as we enter this era, things are going to get very interesting. I think we're living in the most interesting time in humanity. And we're very lucky to be experiencing them. And more so, if you can get a grasp or try to understand where these things are coming from, I think you put everything in context, and then once you see the news and you see the trend, you try to follow if your trend and your predictions about the future are coming to fruit. No.

Rodrigo: **02:48:52** It's just interesting this brings me back to the conversation with Steven Keane, Adam, about the -- what you think about production efficiency, it's all about capital input, labor input, when in reality its energy input, in his view, like his modeling. And how important that is if we are able to produce basically abundant free energy. We didn't get into fusion, which I think is going to be a massive disruptor, possibly bringing it down to zero when it does come online. And some people are saying in 15 years. What that means to -- well, those old models are gone, are no longer necessary because we're also going to automate everything. Capital is just a matter of creating things with robots and then you have free energy. It really does free all the time for humanity. We'll all talk about the social implications of that at a later time. Whether it's utopian or dystopian, but it is a brave new world that we're entering into. We probably can't even imagine what the world's going to look like in 50 years.

Alonso: **02:49:54** No. No. No.

Rodrigo: **02:49:57** Very, very interesting.

Alonso: **02:49:57** Well, I'm sorry for the time.

Adam: **02:50:01** No, thank you for being so generous with your time. I want to make sure -- Can people find you? Are you on social media at all? Or do you have a website that people can go to learn more about you and what you're doing? Or maybe that's in the works when you publish a book. Obviously, you'll, hopefully, you'll have some sort of web presence for the book.

Alonso:	**02:50:25**	I have my email, and if someone really wants to get more deeper into the thing now, we can go through the email. You have my email and you can put it so everybody. I'm on Twitter and things like that, but I don't really use it. So, I'm more of a private person.
Rodrigo:	**02:50:40**	You should. A lot of those facts, a lot of those slides should live out there in the Twitter world so you can get some engagement as your ramp up your book. And just to really change the conversation from a pessimistic one that we see often to an optimistic one. I think you should -- you would do the world of favor if you started tweeting at least two to three times a day.
Alonso:	**02:51:07**	Yes. Yes.
Adam:	**02:51:08**	Well, I want him to get the book finished. So, maybe wait till the book -- …
Rodrigo:	**02:51:11**	One at a time.
Alonso:	**02:51:12**	Yes, yes. But maybe we can have another chat and talk about another section of the book, another chapter, and there's a lot to dismantle and talk about these things.
Adam:	**02:51:26**	Alonso, we would have you back to talk about every chapter if you're willing.
Alonso:	**02:51:31**	Thank you, Adam.
Adam:	**02:51:32**	Absolutely.
Alonso:	**02:51:33**	Thank you. Yeah.
Rodrigo:	**02:51:35**	Alonso, when do you expect the book to be finished and possibly published?
Alonso:	**02:51:40**	You know, I have a problem because I'm not a writer. You know, I'm just trying to learn how to write and express yourself in the written world. It's just been a challenge and it's been a pretty good experience for me. So, I hope to have it maybe within the next six months. I have all the information already there, all the investigation has been done. So, it's just putting all these stacks of notes and papers and things into a coherent form. But the subjects are already there and it's really, really interesting. So much so that I started trying to share my views, and I thought the book was a good way of doing it. Maybe through these types of presentations, dividing the book because it's like not complex, but it has a lot of subjects. And now I figure out that I need to write two more books because I keep learning in the process. Those are -- …
Rodrigo:	**02:52:46**	Don't worry, you will. You will rewrite your book two or three times. We've been there. We have been there.

Alonso: **02:52:53** Yeah. Yeah. Yeah. So, it's interesting. So, hopefully, within the next six to seven months, I should have it done.

Rodrigo: **02:53:00** Excellent.

Adam: **02:53:01** Amazing. Well, we'll have you back when you do. If nothing else to talk about digitization and I'm sure there'll be other themes that we're going to want to cover. Alonso, thank you so much for sharing.

Alonso: **02:53:14** Thank you.

Rodrigo: **02:53:14** Thank you, Alonso.

Adam: **02:53:15** And I know you put a lot of preparation into this and it really paid off. It was incredibly interesting and inspiring. And good luck with the book, and we look forward to having you on the next time.

Alonso: **02:53:26** Sure, Adam. Great. Thanks for having me and giving me the chance to share my thoughts.