The future we're building — and boring

Chris Anderson: Elon, hey, welcome back to TED. It's great to have you here.

Elon Musk: Thanks for having me.

CA: So, in the next half hour or so, we're going to spend some time exploring your vision for what an exciting future might look like, which I guess makes the first question a little ironic: Why are you boring?

EM: Yeah. I ask myself that frequently. We're trying to dig a hole under LA, and this is to create the beginning of what will hopefully be a 3D network of tunnels to alleviate congestion. So right now, one of the most soul-destroying things is traffic. It affects people in every part of the world. It takes away so much of your life. It's horrible. It's particularly horrible in LA.

CA: I think you've brought with you the first visualization that's been shown of this. Can I show this?

EM: Yeah, absolutely. So this is the first time — Just to show what we're talking about. So a couple of key things that are important in having a 3D tunnel network. First of all, you have to be able to integrate the entrance and exit of the tunnel seamlessly into the fabric of the city. So by having an elevator, sort of a car skate, that's on an elevator, you can integrate the entrance and exits to the tunnel network just by using two parking spaces. And then the car gets on a skate. There's no speed limit here, so we're designing this to be able to operate at 200 kilometers an hour.

CA: How much?

EM: 200 kilometers an hour, or about 130 miles per hour. So you should be able to get from, say, Westwood to LAX in six minutes — five, six minutes.

CA: So possibly, initially done, it's like on a sort of toll road-type basis.

EM: Yeah.

CA: Which, I guess, alleviates some traffic from the surface streets as well.

EM: So, I don't know if people noticed it in the video, but there's no real limit to how many levels of tunnel you can have. You can go much further deep than you can go up. The deepest mines are much deeper than the tallest buildings are tall, so you can alleviate any arbitrary level of urban congestion with a 3D tunnel network. This is a very important point. So a key rebuttal to the tunnels is that if you add one layer of tunnels, that will simply alleviate congestion, it will get used up, and then you'll be back where you started, back with congestion. But you can go to any arbitrary number of tunnels, any number of levels.

CA: But people — seen traditionally, it's incredibly expensive to dig, and that would block this idea.

EM: Yeah. Well, they're right. To give you an example, the LA subway extension, which is — I think it's a two-and-a-half mile extension that was just completed for two billion dollars. So it's roughly a billion dollars a mile to do the subway extension in LA. And this is not the highest utility subway in the world. So yeah, it's quite difficult to dig tunnels normally. I think we need to have at least a tenfold improvement in the cost per mile of tunneling.

CA: And how could you achieve that?

EM: Actually, if you just do two things, you can get to approximately an order of magnitude improvement, and I think you can go beyond that. So the first thing to do is to cut the tunnel diameter by a factor of two or more. So a single road lane tunnel according to regulations has to be 26 feet, maybe 28 feet in diameter to allow for crashes and emergency vehicles and sufficient ventilation for combustion engine cars. But if you shrink that diameter to what we're attempting, which is 12 feet, which is plenty to get an electric skate through, you drop the diameter by a factor of two and the cross-sectional area by a factor of four, and the tunneling cost scales with the cross-sectional area. So that's roughly a half-order of magnitude improvement right there. Then tunneling machines currently tunnel for half the time, then they stop, and then the rest of the time is putting in reinforcements for the tunnel wall. So if you design the machine instead to do continuous tunneling and reinforcing, that will give you a factor of two improvement. Combine that and that's a factor of eight. Also these machines are far from being at their power or thermal limits, so you can jack up the power to the machine substantially. I think you can get at least a factor of two, maybe a factor of four or five improvement on top of that. So I think there's a fairly straightforward series of steps to get somewhere in excess of an order of magnitude improvement in the cost per mile, and our target actually is — we've got a pet snail called Gary, this is from Gary the snail from "South Park," I mean, sorry, "SpongeBob SquarePants."

So Gary is capable of — currently he's capable of going 14 times faster than a tunnel-boring machine.

CA: You want to beat Gary.

EM: We want to beat Gary.

He's not a patient little fellow, and that will be victory. Victory is beating the snail.

CA: But a lot of people imagining, dreaming about future cities, they imagine that actually the solution is flying cars, drones, etc. You go aboveground. Why isn't that a better solution? You save all that tunneling cost.

EM: Right. I'm in favor of flying things. Obviously, I do rockets, so I like things that fly. This is not some inherent bias against flying things, but there is a challenge with flying cars in that they'll be quite noisy, the wind force generated will be very high. Let's just say that if something's flying over your head, a whole bunch of flying cars going all over the place, that is not an anxiety-reducing situation.

You don't think to yourself, "Well, I feel better about today." You're thinking, "Did they service their hubcap, or is it going to come off and guillotine me?" Things like that.

CA: So you've got this vision of future cities with these rich, 3D networks of tunnels underneath. Is there a tie-in here with Hyperloop? Could you apply these tunnels to use for this Hyperloop idea you released a few years ago.

EM: Yeah, so we've been sort of puttering around with the Hyperloop stuff for a while. We built a Hyperloop test track adjacent to SpaceX, just for a student competition, to encourage innovative ideas in transport. And it actually ends up being the biggest vacuum chamber in the world after the Large Hadron Collider, by volume. So it was quite fun to do that, but it was kind of a hobby thing, and then we think we might — so we've built a little pusher car to push the student pods, but we're

going to try seeing how fast we can make the pusher go if it's not pushing something. So we're cautiously optimistic we'll be able to be faster than the world's fastest bullet train even in a .8-mile stretch.

CA: Whoa. Good brakes.

EM: Yeah, I mean, it's — yeah. It's either going to smash into tiny pieces or go quite fast.

CA: But you can picture, then, a Hyperloop in a tunnel running quite long distances.

EM: Exactly. And looking at tunneling technology, it turns out that in order to make a tunnel, you have to — In order to seal against the water table, you've got to typically design a tunnel wall to be good to about five or six atmospheres. So to go to vacuum is only one atmosphere, or near-vacuum. So actually, it sort of turns out that automatically, if you build a tunnel that is good enough to resist the water table, it is automatically capable of holding vacuum.

CA: Huh.

EM: So, yeah.

CA: And so you could actually picture, what kind of length tunnel is in Elon's future to running Hyperloop?

EM: I think there's no real length limit. You could dig as much as you want. I think if you were to do something like a DC-to-New York Hyperloop, I think you'd probably want to go underground the entire way because it's a high-density area. You're going under a lot of buildings and houses, and if you go deep enough, you cannot detect the tunnel. Sometimes people think, well, it's going to be pretty annoying to have a tunnel dug under my house. Like, if that tunnel is dug more than about three or four tunnel diameters beneath your house, you will not be able to detect it being dug at all. In fact, if you're able to detect the tunnel being dug, whatever device you are using, you can get a lot of money for that device from the Israeli military, who is trying to detect tunnels from Hamas, and from the US Customs and Border patrol that try and detect drug tunnels. So the reality is that earth is incredibly good at absorbing vibrations, and once the tunnel depth is below a certain level, it is undetectable. Maybe if you have a very sensitive seismic instrument, you might be able to detect it.

CA: So you've started a new company to do this called The Boring Company. Very nice. Very funny.

EM: What's funny about that?

CA: How much of your time is this?

EM: It's maybe ... two or three percent.

CA: You've bought a hobby. This is what an Elon Musk hobby looks like.

EM: I mean, it really is, like — This is basically interns and people doing it part time. We bought some second-hand machinery. It's kind of puttering along, but it's making good progress, so —

CA: So an even bigger part of your time is being spent on electrifying cars and transport through Tesla. Is one of the motivations for the tunneling project the realization that actually, in a world

where cars are electric and where they're self-driving, there may end up being more cars on the roads on any given hour than there are now?

EM: Yeah, exactly. A lot of people think that when you make cars autonomous, they'll be able to go faster and that will alleviate congestion. And to some degree that will be true, but once you have shared autonomy where it's much cheaper to go by car and you can go point to point, the affordability of going in a car will be better than that of a bus. Like, it will cost less than a bus ticket. So the amount of driving that will occur will be much greater with shared autonomy, and actually traffic will get far worse.

CA: You started Tesla with the goal of persuading the world that electrification was the future of cars, and a few years ago, people were laughing at you. Now, not so much.

EM: OK.

I don't know. I don't know.

CA: But isn't it true that pretty much every auto manufacturer has announced serious electrification plans for the short- to medium-term future?

EM: Yeah. Yeah. I think almost every automaker has some electric vehicle program. They vary in seriousness. Some are very serious about transitioning entirely to electric, and some are just dabbling in it. And some, amazingly, are still pursuing fuel cells, but I think that won't last much longer.

CA: But isn't there a sense, though, Elon, where you can now just declare victory and say, you know, "We did it." Let the world electrify, and you go on and focus on other stuff?

EM: Yeah. I intend to stay with Tesla as far into the future as I can imagine, and there are a lot of exciting things that we have coming. Obviously the Model 3 is coming soon. We'll be unveiling the Tesla Semi truck.

CA: OK, we're going to come to this. So Model 3, it's supposed to be coming in July-ish.

EM: Yeah, it's looking quite good for starting production in July.

CA: Wow. One of the things that people are so excited about is the fact that it's got autopilot. And you put out this video a while back showing what that technology would look like.

EM: Yeah. There's obviously autopilot in Model S right now. What are we seeing here?

EM: Yeah, so this is using only cameras and GPS. So there's no LIDAR or radar being used here. This is just using passive optical, which is essentially what a person uses. The whole road system is meant to be navigated with passive optical, or cameras, and so once you solve cameras or vision, then autonomy is solved. If you don't solve vision, it's not solved. So that's why our focus is so heavily on having a vision neural net that's very effective for road conditions.

CA: Right. Many other people are going the LIDAR route. You want cameras plus radar is most of it.

EM: You can absolutely be superhuman with just cameras. Like, you can probably do it ten times better than humans would, just cameras.

CA: So the new cars being sold right now have eight cameras in them. They can't yet do what that showed. When will they be able to?

EM: I think we're still on track for being able to go cross-country from LA to New York by the end of the year, fully autonomous.

CA: OK, so by the end of the year, you're saying, someone's going to sit in a Tesla without touching the steering wheel, tap in "New York," off it goes.

EM: Yeah.

CA: Won't ever have to touch the wheel — by the end of 2017.

EM: Yeah. Essentially, November or December of this year, we should be able to go all the way from a parking lot in California to a parking lot in New York, no controls touched at any point during the entire journey.

CA: Amazing. But part of that is possible because you've already got a fleet of Teslas driving all these roads. You're accumulating a huge amount of data of that national road system.

EM: Yes, but the thing that will be interesting is that I'm actually fairly confident it will be able to do that route even if you change the route dynamically. So, it's fairly easy — If you say I'm going to be really good at one specific route, that's one thing, but it should be able to go, really be very good, certainly once you enter a highway, to go anywhere on the highway system in a given country. So it's not sort of limited to LA to New York. We could change it and make it Seattle-Florida, that day, in real time. So you were going from LA to New York. Now go from LA to Toronto.
16:49
CA: So leaving aside regulation for a second, in terms of the technology alone, the time when someone will be able to buy one of your cars and literally just take the hands off the wheel and go to sleep and wake up and find that they've arrived, how far away is that, to do that safely?

EM: I think that's about two years. So the real trick of it is not how do you make it work say 99.9 percent of the time, because, like, if a car crashes one in a thousand times, then you're probably still not going to be comfortable falling asleep. You shouldn't be, certainly.

It's never going to be perfect. No system is going to be perfect, but if you say it's perhaps — the car is unlikely to crash in a hundred lifetimes, or a thousand lifetimes, then people are like, OK, wow, if I were to live a thousand lives, I would still most likely never experience a crash, then that's probably OK.

CA: To sleep. I guess the big concern of yours is that people may actually get seduced too early to think that this is safe, and that you'll have some horrible incident happen that puts things back.

EM: Well, I think that the autonomy system is likely to at least mitigate the crash, except in rare circumstances. The thing to appreciate about vehicle safety is this is probabilistic. I mean, there's some chance that any time a human driver gets in a car, that they will have an accident that is their fault. It's never zero. So really the key threshold for autonomy is how much better does autonomy need to be than a person before you can rely on it?

CA: But once you get literally safe hands-off driving, the power to disrupt the whole industry seems massive, because at that point you've spoken of people being able to buy a car, drops you off at work, and then you let it go and provide a sort of Uber-like service to other people, earn you money,

maybe even cover the cost of your lease of that car, so you can kind of get a car for free. Is that really likely?

EM: Yeah. Absolutely this is what will happen. So there will be a shared autonomy fleet where you buy your car and you can choose to use that car exclusively, you could choose to have it be used only by friends and family, only by other drivers who are rated five star, you can choose to share it sometimes but not other times. That's 100 percent what will occur. It's just a question of when.

CA: Wow. So you mentioned the Semi and I think you're planning to announce this in September, but I'm curious whether there's anything you could show us today?

EM: I will show you a teaser shot of the truck.

It's alive.

CA: OK.

EM: That's definitely a case where we want to be cautious about the autonomy features. Yeah.

CA: We can't see that much of it, but it doesn't look like just a little friendly neighborhood truck. It looks kind of badass. What sort of semi is this?
20:10
EM: So this is a heavy duty, long-range semitruck. So it's the highest weight capability and with long range. So essentially it's meant to alleviate the heavy-duty trucking loads. And this is something which people do not today think is possible. They think the truck doesn't have enough power or it doesn't have enough range, and then with the Tesla Semi we want to show that no, an electric truck actually can out-torque any diesel semi. And if you had a tug-of-war competition, the Tesla Semi will tug the diesel semi uphill.

CA: That's pretty cool. And short term, these aren't driverless. These are going to be trucks that truck drivers want to drive.

EM: Yes. So what will be really fun about this is you have a flat torque RPM curve with an electric motor, whereas with a diesel motor or any kind of internal combustion engine car, you've got a torque RPM curve that looks like a hill. So this will be a very spry truck. You can drive this around like a sports car. There's no gears. It's, like, single speed.

CA: There's a great movie to be made here somewhere. I don't know what it is and I don't know that it ends well, but it's a great movie.

EM: It's quite bizarre test-driving. When I was driving the test prototype for the first truck. It's really weird, because you're driving around and you're just so nimble, and you're in this giant truck.

CA: Wait, you've already driven a prototype?

EM: Yeah, I drove it around the parking lot, and I was like, this is crazy.

CA: Wow. This is no vaporware.

EM: It's just like, driving this giant truck and making these mad maneuvers.
CA: This is cool. OK, from a really badass picture to a kind of less badass picture. This is just a cute house from "Desperate Housewives" or something. What on earth is going on here?

EM: Well, this illustrates the picture of the future that I think is how things will evolve. You've got an electric car in the driveway. If you look in between the electric car and the house, there are actually three Powerwalls stacked up against the side of the house, and then that house roof is a solar roof. So that's an actual solar glass roof.

CA: OK.

EM: That's a picture of a real — well, admittedly, it's a real fake house. That's a real fake house.

CA: So these roof tiles, some of them have in them basically solar power, the ability to —

EM: Yeah. Solar glass tiles where you can adjust the texture and the color to a very fine-grained level, and then there's sort of microlouvers in the glass, such that when you're looking at the roof from street level or close to street level, all the tiles look the same whether there is a solar cell behind it or not. So you have an even color from the ground level. If you were to look at it from a helicopter, you would be actually able to look through and see that some of the glass tiles have a solar cell behind them and some do not. You can't tell from street level.

CA: You put them in the ones that are likely to see a lot of sun, and that makes these roofs super affordable, right? They're not that much more expensive than just tiling the roof.

EM: Yeah. We're very confident that the cost of the roof plus the cost of electricity — A solar glass roof will be less than the cost of a normal roof plus the cost of electricity. So in other words, this will be economically a no-brainer, we think it will look great, and it will last — We thought about having the warranty be infinity, but then people thought, well, that might sound like were just talking rubbish, but actually this is toughened glass. Well after the house has collapsed and there's nothing there, the glass tiles will still be there.

CA: I mean, this is cool. So you're rolling this out in a couple week's time, I think, with four different roofing types.

EM: Yeah, we're starting off with two, two initially, and the second two will be introduced early next year.

CA: And what's the scale of ambition here? How many houses do you believe could end up having this type of roofing?

EM: I think eventually almost all houses will have a solar roof. The thing is to consider the time scale here to be probably on the order of 40 or 50 years. So on average, a roof is replaced every 20 to 25 years. But you don't start replacing all roofs immediately. But eventually, if you say were to fast-forward to say 15 years from now, it will be unusual to have a roof that does not have solar.

CA: Is there a mental model thing that people don't get here that because of the shift in the cost, the economics of solar power, most houses actually have enough sunlight on their roof pretty much to power all of their needs. If you could capture the power, it could pretty much power all their needs. You could go off-grid, kind of.

EM: It depends on where you are and what the house size is relative to the roof area, but it's a fair statement to say that most houses in the US have enough roof area to power all the needs of the house.

CA: So the key to the economics of the cars, the Semi, of these houses is the falling price of lithium-ion batteries, which you've made a huge bet on as Tesla. In many ways, that's almost the core competency. And you've decided that to really, like, own that competency, you just have to build the world's largest manufacturing plant to double the world's supply of lithium-ion batteries, with this guy. What is this?

EM: Yeah, so that's the Gigafactory, progress so far on the Gigafactory. Eventually, you can sort of roughly see that there's sort of a diamond shape overall, and when it's fully done, it'll look like a giant diamond, or that's the idea behind it, and it's aligned on true north. It's a small detail.

CA: And capable of producing, eventually, like a hundred gigawatt hours of batteries a year.

EM: A hundred gigawatt hours. We think probably more, but yeah.

CA: And they're actually being produced right now.

EM: They're in production already. CA: You guys put out this video. I mean, is that speeded up?

EM: That's the slowed down version.

CA: How fast does it actually go?

EM: Well, when it's running at full speed, you can't actually see the cells without a strobe light. It's just blur.

CA: One of your core ideas, Elon, about what makes an exciting future is a future where we no longer feel guilty about energy. Help us picture this. How many Gigafactories, if you like, does it take to get us there?

EM: It's about a hundred, roughly. It's not 10, it's not a thousand. Most likely a hundred.

CA: See, I find this amazing. You can picture what it would take to move the world off this vast fossil fuel thing. It's like you're building one, it costs five billion dollars, or whatever, five to 10 billion dollars. Like, it's kind of cool that you can picture that project. And you're planning to do, at Tesla — announce another two this year.

EM: I think we'll announce locations for somewhere between two and four Gigafactories later this year. Yeah, probably four.

CA: Whoa.

(Applause) No more teasing from you for here? Like — where, continent? You can say no.

EM: We need to address a global market.

CA: OK.

This is cool. I think we should talk for — Actually, double mark it. I'm going to ask you one question about politics, only one. I'm kind of sick of politics, but I do want to ask you this. You're on a body now giving advice to a guy —
EM: Who?

CA: Who has said he doesn't really believe in climate change, and there's a lot of people out there who think you shouldn't be doing that. They'd like you to walk away from that. What would you say to them?

EM: Well, I think that first of all, I'm just on two advisory councils where the format consists of going around the room and asking people's opinion on things, and so there's like a meeting every month or two. That's the sum total of my contribution. But I think to the degree that there are people in the room who are arguing in favor of doing something about climate change, or social issues, I've used the meetings I've had thus far to argue in favor of immigration and in favor of climate change.

And if I hadn't done that, that wasn't on the agenda before. So maybe nothing will happen, but at least the words were said.

CA: OK.

So let's talk SpaceX and Mars. Last time you were here, you spoke about what seemed like a kind of incredibly ambitious dream to develop rockets that were actually reusable. And you've only gone and done it.

EM: Finally. It took a long time.

CA: Talk us through this. What are we looking at here?

EM: So this is one of our rocket boosters coming back from very high and fast in space. So just delivered the upper stage at high velocity. I think this might have been at sort of Mach 7 or so, delivery of the upper stage.

CA: So that was a sped-up —

EM: That was the slowed down version.

CA: I thought that was the sped-up version. But I mean, that's amazing, and several of these failed before you finally figured out how to do it, but now you've done this, what, five or six times?

EM: We're at eight or nine.

CA: And for the first time, you've actually reflown one of the rockets that landed.

EM: Yeah, so we landed the rocket booster and then prepped it for flight again and flew it again, so it's the first reflight of an orbital booster where that reflight is relevant. So it's important to appreciate that reusability is only relevant if it is rapid and complete. So like an aircraft or a car, the reusability is rapid and complete. You do not send your aircraft to Boeing in-between flights.

CA: Right. So this is allowing you to dream of this really ambitious idea of sending many, many, many people to Mars in, what, 10 or 20 years time, I guess.

EM: Yeah.

CA: And you've designed this outrageous rocket to do it. Help us understand the scale of this thing.

EM: Well, visually you can see that's a person. Yeah, and that's the vehicle.

CA: So if that was a skyscraper, that's like, did I read that, a 40-story skyscraper?

EM: Probably a little more, yeah. The thrust level of this is really — This configuration is about four times the thrust of the Saturn V moon rocket.

CA: Four times the thrust of the biggest rocket humanity ever created before.

EM: Yeah. Yeah.

CA: As one does. EM: Yeah.

In units of 747, a 747 is only about a quarter of a million pounds of thrust, so for every 10 million pounds of thrust, there's 40 747s. So this would be the thrust equivalent of 120 747s, with all engines blazing.

CA: And so even with a machine designed to escape Earth's gravity, I think you told me last time this thing could actually take a fully loaded 747, people, cargo, everything, into orbit.

EM: Exactly. This can take a fully loaded 747 with maximum fuel, maximum passengers, maximum cargo on the 747 — this can take it as cargo.

CA: So based on this, you presented recently this Interplanetary Transport System which is visualized this way. This is a scene you picture in, what, 30 years time? 20 years time? People walking into this rocket.

EM: I'm hopeful it's sort of an eight- to 10-year time frame. Aspirationally, that's our target. Our internal targets are more aggressive, but I think —

CA: OK.

EM: While vehicle seems quite large and is large by comparison with other rockets, I think the future spacecraft will make this look like a rowboat. The future spaceships will be truly enormous.

CA: Why, Elon? Why do we need to build a city on Mars with a million people on it in your lifetime, which I think is kind of what you've said you'd love to do?

EM: I think it's important to have a future that is inspiring and appealing. I just think there have to be reasons that you get up in the morning and you want to live. Like, why do you want to live? What's the point? What inspires you? What do you love about the future? And if we're not out there, if the future does not include being out there among the stars and being a multiplanet species, I find that it's incredibly depressing if that's not the future that we're going to have.

CA: People want to position this as an either or, that there are so many desperate things happening on the planet now from climate to poverty to, you know, you pick your issue. And this feels like a distraction. You shouldn't be thinking about this. You should be solving what's here and now. And to be fair, you've done a fair old bit to actually do that with your work on sustainable energy. But why not just do that?

EM: I think there's — I look at the future from the standpoint of probabilities. It's like a branching stream of probabilities, and there are actions that we can take that affect those probabilities or that accelerate one thing or slow down another thing. I may introduce something new to the probability stream. Sustainable energy will happen no matter what. If there was no Tesla, if Tesla never existed,

it would have to happen out of necessity. It's tautological. If you don't have sustainable energy, it means you have unsustainable energy. Eventually you will run out, and the laws of economics will drive civilization towards sustainable energy, inevitably. The fundamental value of a company like Tesla is the degree to which it accelerates the advent of sustainable energy, faster than it would otherwise occur.

So when I think, like, what is the fundamental good of a company like Tesla, I would say, hopefully, if it accelerated that by a decade, potentially more than a decade, that would be quite a good thing to occur. That's what I consider to be the fundamental aspirational good of Tesla.

Then there's becoming a multiplanet species and space-faring civilization. This is not inevitable. It's very important to appreciate this is not inevitable. The sustainable energy future I think is largely inevitable, but being a space-faring civilization is definitely not inevitable. If you look at the progress in space, in 1969 you were able to send somebody to the moon. 1969. Then we had the Space Shuttle. The Space Shuttle could only take people to low Earth orbit. Then the Space Shuttle retired, and the United States could take no one to orbit. So that's the trend. The trend is like down to nothing. People are mistaken when they think that technology just automatically improves. It does not automatically improve. It only improves if a lot of people work very hard to make it better, and actually it will, I think, by itself degrade, actually. You look at great civilizations like Ancient Egypt, and they were able to make the pyramids, and they forgot how to do that. And then the Romans, they built these incredible aqueducts. They forgot how to do it.

CA: Elon, it almost seems, listening to you and looking at the different things you've done, that you've got this unique double motivation on everything that I find so interesting. One is this desire to work for humanity's long-term good. The other is the desire to do something exciting. And often it feels like you feel like you need the one to drive the other. With Tesla, you want to have sustainable energy, so you made these super sexy, exciting cars to do it. Solar energy, we need to get there, so we need to make these beautiful roofs. We haven't even spoken about your newest thing, which we don't have time to do, but you want to save humanity from bad AI, and so you're going to create this really cool brain-machine interface to give us all infinite memory and telepathy and so forth. And on Mars, it feels like what you're saying is, yeah, we need to save humanity and have a backup plan, but also we need to inspire humanity, and this is a way to inspire.

EM: I think the value of beauty and inspiration is very much underrated, no question. But I want to be clear. I'm not trying to be anyone's savior. That is not the — I'm just trying to think about the future and not be sad.

CA: Beautiful statement. I think everyone here would agree that it is not — None of this is going to happen inevitably. The fact that in your mind, you dream this stuff, you dream stuff that no one else would dare dream, or no one else would be capable of dreaming at the level of complexity that you do. The fact that you do that, Elon Musk, is a really remarkable thing. Thank you for helping us all to dream a bit bigger.

EM: But you'll tell me if it ever starts getting genuinely insane, right?

CA: Thank you, Elon Musk. That was really, really fantastic. That was really fantastic.