Annual General Meeting

Company Participants

- Alan Prescott, Vice President of Legal
- Andrew D. Baglino, Senior Vice President of Powertrain and Energy Engineering
- Elon Musk, Chief Executive Officer, Director
- Hiro Mizuno, Member of the Board
- Kristin Hull, Founder, CEO & CIO
- Robyn M. Denholm, Independent Chairman of the Board
- Rodney D. Westmoreland Jr., Director of Construction Management
- Terry Collingsworth, Executive Director, International Rights Advocates
- Unidentified Speaker

Other Participants

- Analyst
- Jordan Krawitz, Mark Asset Management
- Ross Gerber, Gerber Kawasaki

Presentation

Alan Prescott {BIO 22242369 <GO>}

Good afternoon, everyone. Welcome to Tesla' 2020 Annual Meeting of Stockholders. Really excited that you could be here with us today. My name is Al Prescott, I'm Tesla's Vice President of Legal.

There'll be two parts of today's meeting. First, the formal part of the meeting we'll get out of the way, which will cover the seven items that stockholders have been asked to vote on. After the voting, I'll introduce Tesla's Co-Founder and CEO, Elon Musk, who'll give a presentation about the company update and year-end review. And then following the conclusion of the stockholder meeting, we'll start our separate Battery Day event.

At this time, I'd like to thank the members of the Tesla team and our Board, especially those who are able to make it out here in-person today as well as through our representative from PricewaterhouseCoopers, Tesla's Independent Auditor, who is also here. But before we begin, I'd like to introduce you to Robyn Denholm, the Chairwoman of Tesla, who would like to say a few words remotely.

Robyn M. Denholm {BIO 5964382 <GO>}

Thank you, Al. Hello everyone, and welcome to the 2020 Tesla' Shareholder Meeting. A special welcome to the many Tesla shareholders that have joined us today in-person as well as online from across the country and around the globe. I wanted to start today's proceedings by thanking you, our shareholders for your tremendous support over the last year, and especially to those of you who have been with us through our journey over the past 10 years since the company's IPO in 2010.

While we stayed true to our mission of accelerating the world's transition to sustainable energy.In many ways, our company has evolved beyond recognition over the past decade, and that is a great thing. In fact, the pace of developments and the evolution of Tesla has further accelerated over the past 15 months since I last addressed you in June of 2019. You'll hear more about many of the specific achievements from Elon later in the agenda.

But I would like to take this opportunity to thank all of our Tesla employees across the globe, who have done a tremendous job of executing and staying focused on delivering for our customers and shareholders as world has gone through one of the most challenging periods in our lifetimes. As a Board, we have always taken a long-term view. We have made decisions and supported decisions made by the management team that may not have seemed obvious at the time, but are delivering and will continue to deliver breakthrough results.

But it's also important to remember why we do this. As a company, we are focused on addressing one of the biggest environmental challenges of our generation, how to accelerate the world's transition to sustainable energy? The last year in particular has seen a tremendous increase in momentum in the movement to sustainable energy from both shareholders and the general public. So in addition to developing amazing clean transportation and energy products, we are doing our part by contributing the right facts and information to this important issue. And we released an extended version of our Impact Report in April of 2020.

In this year's version, we have covered in great detail many areas that are important to our shareholders and our customers alike, such as our environmental impact, greenhouse and other noxious gas elimination, our supply chain efforts, especially in cobalt, and our culture and people focus. We hope that by continuing to put this data out there, we will underscore to the world the importance and impact that we are having as a company.

Lastly, continuous feedback and input from our shareholders is essential for us to do our jobs. And I would like to thank you for your support in this regard. Many of you have provided me and the team with ideas and insights that we as a Board take into consideration as we evolve our governance and company practices. It's especially crucial to the Board members as we pride ourselves in adaptability and the diversity of thought and experience that we collectively represent on the Board.

This brings me to my final two things today. As today is his last Shareholder Meeting, on behalf of the Board, I would like to sincerely thank Steve Jurvetson for over a decade of service to Tesla, the Board, and our shareholders. You will be missed.

Finally, I would like to introduce to you our newest member of the Board, Hiro Mizuno, who until recently led the largest pension fund in the world. He brings a wealth of experience to the Board, but let me hand over to Hiro to say a few words. Hiro?

Hiro Mizuno {BIO 5617446 <GO>}

Thank you, Robyn. Ladies and gentlemen, welcome to Tesla Annual Shareholders Meeting. It is my real pleasure to virtually meet you, Tesla's shareholders, people who believe in Tesla's mission, and its growth opportunities. I spent all my career in finance and asset management in Tokyo, New York, London and Silicon Valley.

Until recently, I was a Chief Investment Officer of GPIF, a $1.5 trillion Japanese public pension fund. And one of my priorities as an Investment Chief was to promote responsible investments, which aimed to make financial returns while pursuing ESG agenda such as environment and social issues. I believe in the market where ESG is becoming mainstream, purpose for a mission-driven businesses will gain long-term investor support. This is why I was interested in Tesla, where mission is to accelerate the world's transition to a sustainable energy.

I'm very exited to join the Tesla team on the journey, and hope to assist Tesla deliver what investor expect, while further enhancingit's environmental and social impact. Once again, Tesla shareholders, thanks for your support. I'm looking forward to seeing you in-person next year. Thank you.

Alan Prescott {BIO 22242369 <GO>}

Thanks, Robyn and Hiro. I will now call the meeting to order. Please refer to the meeting agenda that has been provided to you, and posted also to our virtual meeting site. The time is now 1:49 p.m. Pacific time, and I declare that the polls are now open.

We've already received voting proxies from stockholders over the past few weeks, meaning that, almost all of the votes that will be counted were already submitted before the meeting. However, if you wish to vote now or to change your prior vote, you may do so through the virtual meeting site. For those that are here in-person today, ballots and ballot boxes were available to you at check-in.

Tesla's Board of Directors has appointed Computershare Trust Company to serve as Inspector of Elections for the meeting. Computershare has taken and signed an oath as Inspector of Election and has certified that starting on August 13, 2020, the proxy material or a notice of Internet availability of the proxy material were mail or provided to all Tesla's stockholders of record as of July 31, 2020. We have a majority

of the outstanding shares represented at the meeting. So I declare that there is there is now a quorum present and that we may proceed with the meeting.

The items on the agenda are as follows. The election of three Class 1 Directors, Elon Musk, Robyn Denholm, and Hiromichi Mizuno to each serve for a term of three years. Two, to approve Tesla's executive compensation on an advisory basis. And three, to ratify the appointment of PricewaterhouseCoopers LLP as Tesla's independent registered public accounting firm for the fiscal year 2020.

Tesla's Board has recommended that our stockholders vote for each of the Director nominees and for each of those proposals. In addition, we have also received four stockholder proposals as described in the proxy statement. I would like to remind our stockholders that Tesla's Board has prepared a statement in opposition to each of these proposals which appear in the proxy.

The first stockholder proposal is an advisory vote regarding paid advertising. Our Board has recommended that our stockholders' vote against this stockholder proposal. This stockholder proposal comes to us from James Danforth. However, Mr.Danforth has notified us that neither he nor his representative will be presenting the proposal at the meeting today. So we will continue.

The second stockholder proposal is an advisory vote regarding simple majority voting in our governing documents. Our Board has recommended that our stockholders' vote against this stockholder proposal. The proposal comes from James McRitchie who is on the line to present the proposal today.

Mr.McRichie, I would like to invite you now to present. You will have three minutes.

Unidentified Speaker

I'd like to thank the Board for holding such an innovative hybrid meeting during these difficult times. Proposal number 5 basically asks for a majority voting standard to amend by law. I first introduced a proposal on this subject at the 2014 Tesla Meeting. Supermajority provisions are generally used to entrench incumbent Directors and Managers. Academic research finds that reducing such devices is associated with higher returns.

The Board's opposition statement argues they tried to adopt a majority standard last year, but shareholders rejected. However, 99.6% of shares voted for the proposal, only 0.4% voted against it. The problem was that a little more than 35% of shares went unvoted. The vast majority of retail shareholders often don't bother to vote. Since only 65% of shares were voted, we didn't achieve the 66.67% necessary to overturn the current supermajority by law.

It appears, the proposal failed primarily for three reasons, one, the Board put forth less than robust arguments in favor. Two, they added confusion with another proposal to reclassify the Board not into a single class, that's the norm, but into two

classes, elected in alternate years. Third, the Board also failed to make a substantial effort to solicit votes in favor.

Also, please consider this proposal in context with other poor corporate governance provisions at Tesla. First, shareholders can only remove directors for cause. What that basically means is the Director has to be caught in criminal activities for shareholders to remove. Second, because the Board is divided into three classes of shares, shareholders can only hold individual directors accountable every three years. And third, shareholders cannot call a special meeting nor can act by written consent. I hope you will agree, Corporation should not be democratic-free zone. Vote for proposal number five, so that 33% of shares cannot overrule the wishes of 67%. Thank you.

Alan Prescott {BIO 22242369 <GO>}

Thank you. Mr.McRitchie. We'll now move on to our third stockholder proposal, which is an advisory vote regarding reporting on employee arbitrations. Our Board has recommended that our stockholders vote against this stockholder proposal. This proposal comes from Nia Impact Capital, who's representative, Kelly Hull, is online to present the proposal today.

Ms.Hull, I'd like to invite you to go ahead and present. You have three minutes.

Kristin Hull {BIO 17968835 <GO>}

Hello, my name is Dr.Kristen Hull and I'm the Founder and CEO of Nia Impact Capital. As formerly noted, this resolution requests that Tesla's Board of Directors overseen the preparation of a report on the impact of the use of mandatory arbitration on Tesla's employees, and on a work side culture. A report will evaluate the association of Tesla's current use of arbitration with a prevalence of both harassment and discrimination at workplace, and on employees' ability to seek justice, should harassment or discrimination occur.

This proposal speaks to the widespread experience of discrimination in the workplace by Black, Latinx and female employees. Despite this discrimination being unlawful under the Civil Rights Act of 1964, Tesla has faced a number of serious allegations of racism and sexism at its Buffalo and Fremont plant. Companies that allow biased discrimination and harassment in the workplaces are at risk for unnecessary, legal, brand, financial and human capital issues.

Support for this resolution is warranted for the following five reasons. One, research shows that companies benefit from diverse and inclusive workplaces. Two, corporate policies that allow harassment and discrimination risk investors capital. Three, the use of arbitration exposes investors to an unknown level of risk. Four, broad concerns exist with respect to fair treatment in Tesla workplace and Tesla's employees have alleged harassment and discrimination on the basis of both face and gender.

Tesla, a company investors love for its innovation, leadership and wide love is increasingly lagging behind its peers in its disclosures of latest workplace diversity, equity and inclusion. Unlike the forward thinking and innovation in its extraordinary product volumes, Tesla has not shown proactive leadership and building a positive company culture or in addressing concerns about its workplace practices.

And these material issues crossed a line behind its technology and automotive competitors. The use of arbitration limits employees remedy for wrongdoing, precludes employees from suing in court, and often keep underlying facts, misconduct or case outcome secret, therefore preventing employees from learning about and acting on shared concerns.

Simply stated, arbitration allows bad corporate behavior by biased harassment and discrimination to continue hidden from employees and investors. To maintain Tesla's wide mode, it is essential that the Board seriously assess the implications of the use of arbitration, and that Tesla begins to take seriously the need to ensure a fair, equitable, positive and inclusive workplace. Thank you.

Alan Prescott {BIO 22242369 <GO>}

Thank you, Ms.Hull. Our fourth and final proposal is an advisory vote regarding reporting on human rights. Our Board has recommended that stockholders vote against this proposal. This proposal comes to us from the Sisters of Good Shepherd, New York province, whose representative Terrence Collingsworth is on the line to present today.

Mr.Collingsworth, I would like to invite you to speak now. You have three minutes for your proposal.

Terry Collingsworth

Thank you. I'm Terry Collingsworth, Executive Director of the international rights advocate. I'm here representing the Sisters of Good Shepherd, New York province to present Item7 on human rights disclosure, which calls upon Tesla to issue a report to describe Board oversight of human rights and its human rights due diligence process, including systems to provide meaningful remedies when human rights impacts occur. Tesla faces serious human rights issues and failure to establish a culture of respect for human rights. We'll expose Tesla to new liability issues and significant reputational injury, all of which will have a material impact on the company and its shareholders.

The need to set a new course for human rights compliance at Tesla is glaring. Here are five examples of human rights violations occurring now in Tesla's operations. Racism, sexual harassment, and disregard for human safety and dignity harm workers at the Gigafactory-2 in Buffalo, New York every single day, and those workers urge you to remember their experiences in your vote.

Tesla has experienced serious labor relations issues at his production facilities and is actively discouraging union organizing. Workers are being exposed to COVID-19 and then are facing retaliation when they ask for greater protections. There are numerous worker health and safety violations, as well as wage in our issues. And finally, there are serious, even deadly human rights violations occurring in Tesla's global supply chains.

On this last issue, my organization brought the pending suite against Tesla for using Cobalt, mined in the Democratic Republic of Congo by young children. I personally met young boys who lost limbs or were paralyzed in Cobalt tunnel collapses. Tesla sources Cobalt from these very mines and it's claimed to have quote zero tolerance for child labor in its supplier code of conduct is simply not true. Tesla is not only tolerating child labor in its Cobalt supply chain, it is tolerating the death and maiming of young child miners. This demonstrates why the company must circle-back and begin a process to report on his treatment of human rights issues as requested in this proposal. I think consumers will have zero tolerance for a company that is exposed as being indifferent to killing and maiming child miners.

We are hopeful, the Tesla's innovative spirit can be brought to bear on making human rights a priority at the company. For example, if Elon Musk cared about implementing a zero-tolerance child labor policy, instead of having a useless paper policy, Tesla could employ satellites or drones at every mine it sources from to actually monitor child labor. I encourage all Tesla shareholders to vote for Item7 human rights disclosure. Thank you for your attention.

Alan Prescott {BIO 22242369 <GO>}

Thank you, Mr.Collinsworth. At this time, I'd like to thank our stockholders for all of their active participation in today's meeting and for those who just presented on the line. I'd also like to read some of the comments that have been submitted by you over the course of the meeting.

First comment comes from Michael Overbaugh. I take great pride in the fact that we haven't had to stoop to the level of what advertising represents to get where we are today. I'd hate to get into that kind of temptation now. When we're so close to becoming a household name that's based solely on our merit alone. But if assets do end up having to be set aside for marketing, I'd like to suggest that rather than shoving ads down the customers throats, we establish some sort of hardcore nationwide campaign and event with the goal of getting as many people as possible behind the wheel of a Tesla for an introduction drive. It's well-known how far just doing that alone goes to converting people into fans. Aline, I recently ran across says, you can talk all the specs as much as you want, but when it comes to buying a car, what ultimately puts butts in seats is the feeling of the vehicle gives you. By demonstrating, the Tesla clearly has both the specs and the feeling, what more needs saying.

Our second comment comes from the United Steelworkers on behalf of the Clean Air Now, Coalition of Western New York by Sabrina Lu. Proposal -- and it reads as

follows. Proposals 6 and 7 up for vote this year are the results of widespread concern about mistreatment of Tesla workers at U.S. factories and across the supply chain. It is clear that Tesla is not interested in addressing the harm they have caused to their workers as their board is advising shareholders to vote against the proposal.

We're urging all shareholders to vote in favor of proposals 6 and 7 and on behalf of our workers at the United Steelworkers here in Western New York and for Tesla employees across the country and across the global supply chain. While this doesn't repair the harm that's already been caused to countless employees, no repair. Harm to children and communities forced into slave labor in the DRC. They represent steps towards a more just workplace in Tesla.

This concludes all the comments. Thank you all for your participation in the comments. We'll now have a final opportunity for any of you to submit proxies in order for them to be counted. So I'll pause and wait for a moment for you to do that.

Okay. I declare that the polls are now closed. So based on the proxies that we have previously received, I'd like to announce on a preliminary basis that our stockholders have approved the recommendations of Tesla's Board on all agenda items other than the stockholder proposal for an advisory vote regarding simple majority voting in our governing documents. After the final tabulation is completed, we will formally announce the results of the voting by forming -- filing a Form 8-K with the SEC within four business days of today. This now concludes the official business of Tesla's 2020 Annual Stockholders Meeting, which is now adjourned.

Next, we will have a company update and a year-end review presented by Elon. And then, we will start our Battery Day event. During the course of those following sessions, we may discuss our business outlook and make forward-looking statements. Such statements are predictions based on our current expectations. Actual events or results could materially differ due to a number of risks and uncertainties, including those disclosed in our most recent 10-Q file with the SEC. These forward-looking statements represent our views as of today. They shouldn't be relied on after today and we disclaim any obligation to update them after today as well. We will now continue with the company update and year-end review. And it's my pleasure to introduce Tesla, Co-Founder and CEO, Mr.Elon Musk.

Elon Musk {BIO 1954518 <GO>}

Hi, everyone. Well, I mean, this is definitely a new approach. We have the Tesla drive-in movie theater basically. It's good to see everyone. It's a little hard to read the room with their own being in cars, but it's the only way we could do it. So hopefully it's cool and hopefully, you can hear me. Can you guys hear me? Okay. All right. Great. Well, thanks for coming.

I think it's been an incredible year and I'd like to thank you for your support through tough times, good times, it's been great. Really appreciate everyone who's put their hard earned money into Tesla. And I think it's worked out pretty well as this has been a good year and I think, there's many good years to come. So I'll go through the sort

of -- the shareholder presentation fairly quickly because the sort of real main event here is Battery Day. So, and then really I'm just going through a recap of what's happened over the past year or so.

Starting from yeah in terms of our ability to create a factory, just the huge kudos to Tesla Shanghai team for being able to go from literally a direct pile to volume production in 15 months. It's like -- So and I think something that's really quite noteworthy here is, Tesla is the only foreign manufacturer to have 100% owned factory in China. So this is often not well understood or not appreciated. But to have the only 100% owned foreign factory in China is a really big deal and it's paying huge dividends here. So we really wouldn't have the results that we have had this year without the great efforts of the Tesla China team. So I'm super appreciative of that. And we'll see the Shanghai factory continue to scale quite a bit from where it is right now. I think we really could expect that to be overtime a factory that produces over a million vehicles a year.

Yes, it's cool. So, let's see. So probably we also reached in the past year of volume production of the Model Y and this was the smoothest launch that we've ever had. So I think we're definitely getting better at new vehicle launches and building factories and scaling production. As you've heard me say before it's -- the hardest thing is scaling production especially of a new technology, it's insanely difficult; making a prototype is relatively easy. And if I think of like, what is the real achievement of Tesla in sort of car company terms? It's like it wasn't making sort of exciting prototypes, it was that Tesla was really the first company in about a century in the U.S. -- the first U.S. company in the U.S. to reach volume production and be sustainably profitable like those -- the crazy thing is, this is really not happened in 100 years, that's the actual super hard part. And we now have four vehicles in volume production S3XY. So also the toughest joke, I think maybe ever. It was a very difficult joke to make.

So we also introduced the lowest cost solar in the U.S. it's only $1.49 a Watt. And we really just simplified the whole chain of -- the whole value chain. So reduced sales and advertising. We got rid of a bunch of unnecessary costs and really are just relying upon the fact that it's just the lowest cost most efficient solar in the U.S., providing both retrofit and the solarglass roof, which I think is a really great product. A hard product to make work that will be a major product line in the future.

And we also got four consecutive quarters of GAAP profitability, which is -- was very difficult, yeah. So it's certainly a testament to the hard work of people at Tesla. I mean to do this in extremely difficult times against a wide range of adverse circumstances was insanely hard, but we got it done. So and I think we've -- the future is looking like I think very promising from a sort of an annual profitability standpoint. So in order to achieve -- in order to sort of do well financially, you really need economies of scale, and you need ideally the best technology and I think we have the best technology for a while, but now we are also achieving economies of scale. So and also rapidly improving autonomy, which is a massive value add to each car.

So, I think the value of Tesla is going to be like total just on the vehicle side, total vehicles produced, times the value of autonomy. That's a way to think about the future value of Tesla. We also have consistent free cash flow generation. This is really important for growth and a key element here is tightening up the time from when a car is ordered to when it is built and delivered. So, for a company that's growing rapidly, it's extremely important to tighten the supply chain and to have from when -- from when parts arrive, put it into a car very quickly and deliver the car very quickly to the customer, and if you can do that inside the sort of your kind of a payables timeline. Then, the faster you grow, the more cash you have or conversely, if you're unable to do it within your payables timeline, the faster you grow, the less money you will have which is obviously bad as for capital-intensive situation.

So, just tightening up and having the parts moved very quickly to the factory, put it in a car, get it to a customer, makes a massive difference to cash flow generation. And, I mean, that's why it's extremely important to have a factory in each continent, because you don't -- at least have a factory in the continent. It is impossible to achieve this. So, having a factory in China, that's able to serve China and then soon many other countries in the region will be a key to us tightening that total sort of chain or cash flow and getting essentially the faster we grow, we'll have more cash. This is really important. That's also why it's important to have Giga Berlin complete because then we'll have a factory in China, a factory -- factory in the U.S., and soon, a second factory in the U.S. in Austin and a factory in Europe.

And I mean, even if for the -- for Giga, Texas in Austin, even if we had exactly the same classes in California, it would still be advantageous to do it there because it's roughly two-thirds of the way across the U.S.

So, we can -- in terms of delivering cars to the Central U.S. and to the East Coast is far -- it's just faster, it cost less and it fundamentally improves our economics. So, I think this is also maybe something that's not fully appreciated. Just how important it is to have a factory at least on the continent or reasonably close to where the end customers is, so you can tighten that whole chain.

Industry performance -- while the rest of industry has gone down, Tesla has gone up. I think this speaks to -- thanks.

And so, I'd like to thank all the customers for taking a chance on Tesla and buying our product and really hope you're enjoying it. This is really -- our sales as I was saying really grow by word of mouth. So, this is really I think a very pure -- it's very pure in the sense that it's like it's growing on the basis of existing owners recommending it to other -- to new customers. This is really I think a good way to grow.

So in 2019, we had 50% growth and I think, we'll do really pretty well in 2020, probably somewhere between 30% to 40% growth despite a lot of very difficult circumstances. I mean, there's so many pandemic wildfires, it is like a whole bunch of difficult production issues, but thanks to the hard work of the Tesla team and a lot of

innovative approaches to overcoming issues. We are able to still see some good growth in one of the most difficult -- in fact, I'd say probably the most difficult year of Tesla's existence.

So, and we also published our extended impact report. At Tesla, we try very hard to do the right thing. If I think does not happen it's just because we may be made a mistake or we're not aware of it, but we always try to do the right thing as to the best of our ability and then we publish the extended impact report to show just to sort of a self-examination of okay what are we doing right? What are we doing wrong? What can we do better in the future? We're definitely trying to accomplish the most good. And so, if we occasionally make mistake, we work quickly to fix it and do the right thing.

So, it's worth looking at like the average like stuff -- average life cycle emissions in the U.S. and just how much better a Tesla is than -- or electric car than any other -- of any kind of gasoline car? And what we'll talk about in the Battery Day is also just how much the grids around the world and actually especially in the U.S. are greening. It's actually much faster than I think people realize. The U.S. is moving towards sustainable energy. And so, as we move more and more to sustainable energy, then effectively you end up building the solar factories and the car factories themselves with solar. Over time you do or sustainable energy, over time you even mine with sustainable energy and eventually it will get to an effective emissions of zero. So that's where things will end up.

So, we also have safety at the core of our design. The Tesla cars are the safest cars ever designed. We have the lowest probability of injury of any cars ever tested by the U.S. Government and that's just passive safety when you add active safety into that. It's even better. So, it's really -- if safety is important to you, which obviously it is, the safest car you could drive is a Tesla. So, I think people sometimes -- some people aren't aware of this but it's really -- safety is paramount. It is actually the number one design objective when we built is Tesla safety.

Our factories are also becoming safer. And if you look at the sort of accidents per vehicle -- total vehicle made, its dramatically better than in the past and it's already better than industry average and we're confident we can get it to the best in the auto industry.

Autopilots functionality continues to improve and you can see it in the safety report that we publish every quarter. It's just getting better and better. The U.S. average for collisions is roughly 2.1 per million miles and with autopilot engaged, it's 0.3. I mean, this is a profound difference. It really massive and this will get even better. So, we're confident that over time, we can get the probability of an accident, especially probability of injury to 10 times better than the than the industry average like an order of magnitude better. So, that's just a lot of lives saved and a lot of injuries avoided. So that's a huge priority for us.

And yes on the autopilot front, I think it's kind of hard for people to judge the progress of autopilot like I'm driving -- as a matter of course, I've always done this. I drive the bleeding edge alpha build of autopilot. And so I sort of have insight into what is going on and previously about a couple years ago, we're kind of stuck in a local maximum. So, we're improving but like the improvements kind of started tailing off and not and just not getting where they need to be. We're quite close to getting trapped in a local maximum and so we had to do a fundamental rewrite of the entire autopilot software stack and all of the labeling software as well.

So, we're now labeling in 3D video, so this is hugely different from the previously where we were labeling essentially a bunch of single images from the eight cameras and they would be labeled at different times by different people and some of the labels you literally can't tell what it is you're labeling. So, it basically made it sort of in some cases impossible to label and the labels had a lot of errors.

Now with our new labeling tools, we label it in video. So we actually label entire video segments and the system -- so you get that basically a surround video thing to label and with the surround video and with time -- so it's now taking all cameras simultaneously and looking at how the images change over time and labeling that. And then, the sophistication of the neural nets in the car and the overall logic in the car has improved dramatically.

I think, we will hopefully release a private beta of autopilot of the full self-driving version of autopilot in I think a month or so. And then people will really understand just the magnitude of the change, its profound. So, yes, anyway, so there's you'll see it's just like a hell of a step change, but because we had to rewrite everything labeling software, but just entire code base.it took us quite a while.

The sort of new sort of I call it like 4D in the sense that it's three dimensions plus time. It's just taken us a while to rewrite everything, and so you'll see what it's like. It's going to be -- it's amazing. Yeah. It's just clearly going to work.

At Tesla, the core competencies, we've got engineering, obviously, but also manufacturing. I think manufacturing is underappreciated in general, and the difficulty of designing the machine that makes the machine is vastly harder than the machine itself. So the designing, like making a Model 3 or Model Y or Cybertruck prototype is really quite trivial compared to designing the factory that makes it, especially if it's new technology, and you want to use new manufacturing methods. It's just at least 10 to 100 times harder to do the factory than the prototype. And that's why you see a lot of companies out there or startups they'll bring out a prototype, but they just can't get it over the hump for who manufacturing, because manufacturing of new technology especially is the hardest thing by far. Basically, the prototype is at best 10% of the difficulty and probably closer to 1%.

And then software. Tesla is both a hardware and a software company, so a huge percentage of our engineers are actually software engineers, and you can think of our car as kind of like a laptop on wheels and so software is incredibly important.

Actually, not just in the car, but also in the factory. So the factory software is extremely important. Just software in general. I mean, these are fundamental. These are the three critical areas that are needed to make for an awesome company. So, yeah.

So we have --now, we'll soon have three new factories incremental on --well, we have one already on three different continents. Shanghai, we're expanding the Shanghai with the second phase. Berlin is making rapid progress, and Texas is making even faster progress. So, yeah. With each factory, what we're trying to do is also improve the manufacturing technology, so in some cases like the Model Y made in Berlin might look the same, but it actually is made in a much more efficient way. Yeah, we'll talk about that later in the battery presentation.

Yeah, we launched Megapack. It's three megawatt hours all-in one energy storage solution, so it's been great overall. Yeah. All right. And I think that's basically it, right? All right, thank you. All right.

Well, thanks, everyone, for coming, and we'll be back in a little bit to go through the battery stuff, and there's a little bit more. In addition to the battery stuff, we've got a few extras as well. So I think you'll really like what we have to say on batteries.

The battery stuff we're going to talk about is truly revolutionary and essential to Tesla's goal. The fundamental good of Tesla, it's like, if you look back in history and say, what good did Tesla do? The good will by how many years did we accelerate sustainable energy? That's the true metric of success. It matters if sustainable energy happens faster or slower, and so that's really how I think about Tesla and how we should assess our progress. By how many years did we accelerate sustainable energy? And what we're going to talk about with batteries and a few other things will really explain how we're going to make a step change improvement in the acceleration of sustainable energy. Thank you.

Alan Prescott {BIO 22242369 <GO>}

Hi, folks. That was great. We are going to take a short break. Before we begin the Battery Day event, so stay tuned. If you're local and here in the audience today, you can feel free to get out of the cars and stretch your legs, but try to stay near the cars because we are going to begin properly in a little bit. See you soon.

Andrew D. Baglino {BIO 21161872 <GO>}

Hello, everyone. Sure, thanks, Elon. Hi, I'm Drew Baglino, SVP of Powertrain and Energy Engineering at Tesla and I'm incredibly excited to talk about what we've been doing at Batteries here at Tesla.

Elon Musk {BIO 1954518 <GO>}

Great. Great. So let's see. You've got the clicker?

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, I got the clicker, yes.

Elon Musk {BIO 1954518 <GO>}

Yes, I'll take it at first, perhaps.

Andrew D. Baglino {BIO 21161872 <GO>}

Sure

Elon Musk {BIO 1954518 <GO>}

So obviously, the issues we are facing are very serious. With the climate change and we're experiencing these issues on a day-to-day basis. It's incredibly important we accelerate the advent of sustainable energy. Time really matters. This presentation is about accelerating the time to sustainable energy.

So, the past five years were the hottest on record. We have what looks like a wall for CO2 PPM. It's obviously, this time is not like the past. It's really important that we take action. Running this climate experiment is insane. So --

Andrew D. Baglino {BIO 21161872 <GO>}

Especially, when it's just a transitory one anyway.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

We're going to run out of these fossil fuels. Let's just move to the future and not run this experiment any longer. Yes.

Elon Musk {BIO 1954518 <GO>}

Talk about ladder.

Andrew D. Baglino {BIO 21161872 <GO>}

You got it.

Elon Musk {BIO 1954518 <GO>}

Okay. So there is a lot of good news though. A lot of people may not be aware that that wind and solar comprise 75% of new electricity capacity in the U.S. this year. So this is really major. So the grid is going sustainable very quickly. Now, it's also worth noting that the length of time that power plants lasts is on the order of 25 years. So even if a hundred percent of energy generation was sustainable, it will still take 25 years to convert the grid. And it's also worth noting that in the past 10 years, power production from coal has dropped in half. So it went from 46% of electricity in 2010 to 23% in 2020. So this is a massive improvement. So good things are happening on a lot of levels. We just need to go faster.

So Tesla's contribution, we've delivered over a million electric vehicles, 26 billion electric miles driven, and many gigawatt hours of stationary batteries, 17 terawatt hours of solar generated. So I think solar is sometimes underweighted at Tesla, but it is a massive part of our future. The three parts of sustainable energy future are sustainable energy generation, storage, and electric vehicles. So we intend to play a significant role in all three.

So to accelerate the transition to sustainable energy, we must produce more EVs that need to be affordable and a lot more energy storage, while building factories faster and with far less investment. So goal number one is a terawatt hour scale battery production. So tera is the new giga. And a terawatt is a thousand times more than a gigawatt. So we used to talk in terms of gigawatts, in the future, we'll be talking in terms of terawatt hours. So this is what's needed in order to transition the world to sustainability.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, and you can see it's a -- we're talking about 100x growth in batteries for electric vehicles to achieve this mission and we are going to get there. Just a matter of how fast and our intention is to accelerate it.

Elon Musk {BIO 1954518 <GO>}

Yes, basically on the order of roughly 10 terawatt-hours a year of battery production to transition the global fleet of vehicles to electric.

Andrew D. Baglino {BIO 21161872 <GO>}

And the average vehicle last 15 years. So, we're talking about a 150 terawatt hours give or take to transition the whole electric -- all vehicles of all types to electric.

Elon Musk {BIO 1954518 <GO>}

Yes, so it's a lot of batteries basically. And yes, so --

Andrew D. Baglino {BIO 21161872 <GO>}

And then on the grid side, we have a similar mountain to climb. 1,600 times growth from today's grid batteries to go 100% renewable on the grid and to take all the existing heating fossil fuel uses in homes and businesses, a 100% electric.

Elon Musk {BIO 1954518 <GO>}

Yes, and this number I think, I might grow even more dependent -- as the world economy matures and as countries with high populations industrialize, we could see this number be even more. But let's say it's like roughly 20 to 25 a terawatt hours per year, sustained for 15 to 25 years to transition the world to renewable. This is a lot.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

Elon Musk {BIO 1954518 <GO>}

So today's batteries can't scale fast enough, they're just too small. For Giga Nevada, 150 gigawatt hours per year is like what we probably expect to make out of there. But this is really pretty small in the grand scheme of things, that's only 0.15 terawatt hours. And it cost too much, so --

Andrew D. Baglino {BIO 21161872 <GO>}

We would need 135 fully built out in Nevada Giga factories to achieve 20 terawatt-hours a year. It's not scalable enough of a solution, we need a dramatic rethink of the cell manufacturing system to scale as fast as we can and should.

Elon Musk {BIO 1954518 <GO>}

Yes and I think we should view this as more than just a question of money. Money is sort of like an ethereal thing, but it's really the amount of effort. You have a certain amount of effort in terms of people and machines and depending on how efficient that effort is, for a given amount of effort you want the most amount of batteries. So it's not just a question of like, well, if we had $2 trillion, you -- tomorrow you could make this, it's not that easy, you actually need to organize the massive number of people, build a lot of machines, build the machines that make the machines and so it's incredibly important to have that effort, yield the most number of batteries.

So and then go to obviously we need to make more affordable cars. I think one of the things that troubles me most is that we don't yet have a truly affordable car and that is something that we will make in the future. But in order to do that, we've got to get the cost of batteries down. We've got to make -- and we've got to be better at manufacturing and we need to do something about this curve, this curve -- the curve of the cost per kilowatt hour of batteries is not improving fast enough. So we have given this a lot of thought over many years to say -- how can we radically improve the cost per kilowatt hour curve. It's been somewhat flattening out actually in recent years. So --

Andrew D. Baglino {BIO 21161872 <GO>}

I mean, early growth was promising but you can we are kind of plateauing. So that's what's motivating us to rethink how cells are produced and designed.

Elon Musk {BIO 1954518 <GO>}

Yes, exactly. So EV market share is growing but EVs are still aren't accessible to all. It's -- and you can see it -- as Drew were saying it's like starting to flatten out a little bit because, the rate of improvement of the affordability of cars is just not fast enough. So that's why, we got Battery Day.

Andrew D. Baglino {BIO 21161872 <GO>}

To make the best cars in the world, we designed vehicles and factories from the ground up. Next and now we do this for batteries as well.

Elon Musk {BIO 1954518 <GO>}

Yes. It's where the slides don't show up quite right -- look like what shows up there (inaudible)

Andrew D. Baglino {BIO 21161872 <GO>}

So let's get started. We have a plan to have the cost per kilowatt hour. And it's not a plan that rests on a single innovation, some research project that will never see the light of day, it's a plan that has taken creative engineering and industrialization across every facet of what makes a cell into a battery pack from raw material to the finish thing. And we're going to go through that plan with you today step by step and build up how we get to these goals and how we accelerate this transition and make our vehicles and our grid batteries more affordable.

Elon Musk {BIO 1954518 <GO>}

We're basically -- thought through every element of the battery -- almost every element, there are a few more elements that we won't get to today, but we will get to in the future.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. So first before we get too far into it, let's talk about what is in a battery cell? We've got the cap and the can, negative and positive terminals of the cell, when you open that cell, you've got a tab connected to those terminals. What we call the jelly roll, which is the wound electrodes on the inside. You can actually see what this looks like as you unwind it, this is over a meter long in a typical 2170 cell, so it's quite a long while winding process and you can see the tab is still there.

And then to explain what's actually going on here, we've identified we've got anode, cathode separator, positive and negative terminal, what should happens as we -- here we go. Discharge the cell, got lithium moving from anode to cathode and then the reverse when we charge the cell, anode moving from -- lithium moving from cathode to anode across the separator.

This is the basic of what makes all Lithium-ion batteries, whether they are -- no matter what the form factor is. And when we look at what's happened today, at least in our products, we've moved from 18650 form factor to the 2170 form factor through a great collaboration with our partners Panasonic, new partners like LG and CATL and probably others in the future.

Elon Musk {BIO 1954518 <GO>}

Actually, a slight note on why is the one called 18650, although not on the slide, this is the 2170 is that, the first two digits refer to the diameter and the second two digits refer to the length. So that helps explain why these -- what's up with these weird numbers, but like nobody could explain to me while why there was an extra zero. So I said, okay, well, we're deleting the zero, that nobody can explain in future form factors. That's why it's technically it's like the 18650 bizarrely but going forward is the 2170, because we just got rid of the extra zero because it's pointless.

Andrew D. Baglino {BIO 21161872 <GO>}

And this was evolutionary step going from 1865 to 2170, bringing 50% more energy into the cell. But when we look to the ideal cell design if we were to do it ourselves, we need to go beyond just what we're looking at us in front of us and study the full spectrum of options. So as you can see, we kind of swept the key figures of merit. How much we can reduce the cost and how much vehicle range increases, as we change the outer diameter of the cell. We found a sweet spot somewhere around 46 meters -- it's in millimeters. But it's not just about a bigger form factor, like anybody could make a bigger form factor.

Elon Musk {BIO 1954518 <GO>}

Any fool, could make a bigger form factor, and we are not any fool.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes exactly. There are problems as you make cells larger, in fact supercharging and thermals in general become really challenging as you make bigger cells and this is the challenge that our team set our sights on to overcome. And we did. We came up with this tabless architecture that maybe you've heard about. That basically removes the thermal problem from the equation, allows us to go to the absolute lowest cost form factor and the simplest manufacturing process. And this is what we mean when we talk about tabless. It's kind of a beautiful thing.

Elon Musk {BIO 1954518 <GO>}

That's what these t-shirts mean, but it's very esoteric as nobody could figure it out, but --

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, we basically took the existing foils, laser pattered them and enabled dozens of connections into the active material through this shingled spiral you can see with simpler manufacturing, fewer parts, 50 millimeter versus 250 millimeter electrical path length, which is how we get all the thermal benefits.

Elon Musk {BIO 1954518 <GO>}

Yes, this is important to appreciate, like basically the distance that electron has to travel and it's just much less. So you actually have a shorter path length in a large tabless cell than you have in the smaller cell with tabs, so this is a big deal. So even though the cell is bigger, it actually has more power, the power to weight ratio is actually better than the smallest cell with tabs. This is -- again like this is quite hard to do, so it's -- nobody's done it before. So -- and it really took a tremendous amount of effort within Tesla engineering to figure out how do we make a freaking tabless cell and have it actually work and then connect that to the top cap and it's -- there's a whole bunch of things that we're keeping a little secret sauce here that we're not telling everything, but --

Andrew D. Baglino {BIO 21161872 <GO>}

Sometimes, what's elegant and simple is still hard and we -- it took us a lot of trials, but we're happy where we ended up.

Elon Musk {BIO 1954518 <GO>}

Yes, I mean everything's simple in recollection, after you see -- everything -- it's hard until it's discovered and then it's simple. So anyways, there's a lot of really cool things going on that enable tabless and that's really -- due to really great engineering team, Drew and the rest the of team done amazing work in achieving this tabless construction. And it sounds -- I think it may sort of sound a bit silly to some people, but this is like if -- people who really know cells, this is a massive breakthrough.

Andrew D. Baglino {BIO 21161872 <GO>}

For cylindricals to be able to get rid of the tabs, dramatically simplifies winding and coding.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

And has an awesome thermal and performance benefit.

Elon Musk {BIO 1954518 <GO>}

Yes. Just to -- so elaborate on that a bit, it's like when the cell is going through the system, it has to keep stopping where all the tabs are.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

Elon Musk {BIO 1954518 <GO>}

So you can't do a continuous motion production if you have tabs, you have to keep stopping and then there's a rate at which you can start and stop and accelerate again, and it really slows down the rate of production and then sometimes you get the tabs wrong and you also get -- lose a little bit of active area. It's really huge pain-in-the-ass type tabs from a production standpoint.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And so when we put it all together and go to our new 80 millimeter length, 4680 we call this new cell design. We get 5x the energy with 6x the power and enable 16% range increase just form factor alone.

Elon Musk {BIO 1954518 <GO>}

Yes, it's pretty great. And just to clarify that when we see these plus 16% or whatever the percentage range increases, these are the amounts due just to that particular innovation.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

Elon Musk {BIO 1954518 <GO>}

So we'll list a whole bunch of innovations. And then when you add them up, you get a total of improvement in energy density and cost, but these numbers are what refer to just this thing.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And I want to stress. This is not just a concept or a rendering. We are starting to ramp-up manufacturing of these cells at our pilot 10 gigawatt/hour production facility just around the corner.

Elon Musk {BIO 1954518 <GO>}

Yes. It's a video of some of what's going on in the plant. Now, I mean, it's very clear, it will take about a year to reach the 10 gigawatt/hour capacity. So this is important to appreciate, like when you build a factory, there's a certain capacity that you design to and then it takes some period of time to actually achieve that capacity. So I would say it's probably about a year before we get to the 10 gigawatt/hour annualized rate with a pilot plant, and this is just a pilot plant. The actual production plants will be more on the order of maybe 200 gigawatt/hours maybe more overtime.

Andrew D. Baglino {BIO 21161872 <GO>}

And -- thank you. But let's stack up everything we just saw at the cell level. So just the cell form factor change enables a 14% -- dollar per kilowatt hour reduction, just that cell form factor change. And now that you've been teased on this factory, we're going to go on and walk step by step through that factory and discuss a series of innovations there.

When thinking about the ideal cell factory, we have inspirations behind us in the paper and bottling industry, where from humble beginnings, over a century of innovation has enabled mass scale continuous motion, unbelievably low manufacturing cost. And when we think about the lithium-ion industry which is really only in its third decade of high-volume production, it has so far to go to achieve similar scale and simplicity, and that was the inspiration that we set out to the team as we thought about how to marry cell design and manufacturing in the best possible factory.

And let's talk a little bit about what's in a cell factory. First, there's an electrode process where the active materials are coded into films on to foils. Then those foil -- coated foils are wound in the winding process. We just talked about where if you do have tabs, you have to start and stop a lot. Then the jelly roll is assembled into the can, sealed, filled with electrolyte, and then sent to formation where the cell is charged for the first time and where the sort of the electrochemistry is set and the quality of the cell is verified.

And we set out, at every step of this process, to try to take that inspiration we just showed and think about how we make those processes fundamentally better and more scalable. And one of the most important processes is where it all begins, the wet process of the of the electrode coating. And just to give you all sense of scale, I'm going to walk through what's in that wet process. You've got mixing where the powders are mixed with either a water or a solvent, solvents for the cathode. That mix then goes into a large coat and dry oven, where the slurry is coated onto the foil. Huge ovens, tens of meters long, dried, and that solvent then has to be recovered. You can see the solvent recovery system. And then finally, the coded foil is compressed to the final density.

And when you're looking at this, you're like wow, that's a lot of equipment for one step, especially when you consider that little speck next to the coating oven is a

person. This is serious iron involved in making batteries. Wouldn't it be great if we could skip that solvent step, which is one of those dig a ditch and then fill the kind of things where you put the solvent in and then take it out and recycle it, and just go straight to dry mix to coat. And that's what the dry process really is about.

And in the most basic form, you can see it here on a bench top, literally powder into film as simple as that.

Elon Musk {BIO 1954518 <GO>}

I mean it's hard actually. Just to be clear. So if this was easy, everyone would do it. So the -- it's not like dry coating electrode is actually easy, it's actually very hard to do what appears to be a simple thing, and it's worth noting. I -- we did acquire Maxwell as like a little over a year ago I guess. And certainly a good company and everything, but the dry coating that it had was like -- is like sort of I'd call it proof-of-concept. Since the acquisition, we've actually ramped the machine that does dry coating 4x. So when we revision full post acquisition of the machine and there's still a lot of work to do. So I would not say this is like completely in the bag. There is still a lot of work to do. And as you scale -- go from like benchtop to lab to pilot to volume production, there are actually major issues that you encounter at every level. It's Not like you make something work on your bench and bingo, now you can make a bazillion of it.

Andrew D. Baglino {BIO 21161872 <GO>}

Absolutely.

Elon Musk {BIO 1954518 <GO>}

It's insanely difficult to scale up.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. But --

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

But if you do scale it up, what you saw before becomes this.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

So you can see the motivation. A 10x reduction in footprint, a 10x reduction in energy and a massive reduction in investment, but as Elon was saying, simple is hard.

Elon Musk {BIO 1954518 <GO>}

Yes. I mean to be clear, I would like not to say that right now, it's just totally working. It's close to working, but it's not -- even now, at the pilot plant level, it is close to working. Well, okay, I think it's fair to say probably it does work, but with not a good -- with not a high-yield.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, so -- we're still ironing out the kinks, but we've made tens of thousands cells, thousands of kilometers or electrode. I mean we are on the fourth generation of the equipment, so we've learned a lot along the along the way.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

I mean it is super demanding, because every atom has its place if you want to deliver the energy density and the cycle life in the supercharging.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

But we're confident that we will get there, but it will be a lot of work along the way.

Elon Musk {BIO 1954518 <GO>}

There's a clear path to success, but a ton of work between here and there. Yes. So -- but this is a really profound improvement again for people that know battery manufacturing. This is a -- it's a gigantic. We'll probably be on machine revision six or seven by the time we do large scale production. The rate at which the machines are being improved is extremely rapid, like literally every three or four months is a new row.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And beyond the electrode, we continue to innovate on every other process steps. So let's talk a little about assembly which is next. The key to a high-performing assembly line is accomplishing processes while in motion -- continuous motion and

thinking of the line as a highway max velocity down the highway, no start and stop, no city driving.

Elon Musk {BIO 1954518 <GO>}

Definitely. No stop lights and traffic lights, everything. You want the highway.

Andrew D. Baglino {BIO 21161872 <GO>}

The highway.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

And together with our internal design team that makes this equipment and designs this equipment, we coupled thinking about how to make the best cell, we're thinking about how to make the best equipment so that we could accomplish the fastest parts per minute rates on all of these tools. And through all of that development, we were able to get to the point where we can implement assembly lines, one line 20 gigawatt hours, 7x increase in output per line. And when you're thinking about scalability and pure effort having one line be 7x the capability is just effort multiplying.

Elon Musk {BIO 1954518 <GO>}

Yes. You can sort of think about like the sort of the fundamental physics of a factory or something like -- I think it's actually quite a lot like the rocket equation where you've got basically -- there are equations you've got your exhaust velocity and then the log of a start in masses. So it's basically saying -- how fast are things going and what percentage of your -- the factory volume is doing useful work and conveyance does not count as useful work. So --

Andrew D. Baglino {BIO 21161872 <GO>}

Only the value added steps.

Elon Musk {BIO 1954518 <GO>}

Yes. If you could break the factory down into cubic meter sections and say -- or smaller, it could be like one litter sections and say, is a majority of this volume doing useful work? You would be astounded at how bad most factories are. They are like maybe 2% or 3% including a factory in Fremont. So I think it is possible to get to at least 10x that volumetric efficiency. So well like 30%-ish maybe more and be 10x better, which means the factory can be 10x smaller. And then the other thing is how fast are things going through the factory, it's like speed and density.

The faster you go -- a factory that's moving, let's say twice the speed of another factory is equivalent to two factories basically. And the company that will be successful is because company that with one factory can accomplish what other companies take two or three or four factories to do. So this is what we're trying to do here is, say, okay, how do we with one factory achieve what maybe 5 or even 10 factories would normally be required to achieve.

Andrew D. Baglino {BIO 21161872 <GO>}

And the vertical integration with the machine design teams at Grohmann and HIBAR and others allows us to really accomplish that, because we don't have these edge conditions between one piece of equipment and another, we can design the entire machine to be one machine and remove all these unnecessary steps.

Elon Musk {BIO 1954518 <GO>}

Yes. I mean basically Tesla is aiming to be the best at manufacturing of any company on Earth. This is the thing that's actually most important in the long run. I think just from a company standpoint and from basically achieving sustainability as fast as possible, but I think also for long-term competitiveness, eventually every car company will have long-range electric cars, eventually every company will have autonomy, I think -- but not every company will be a great at manufacturing. Tesla will be absolutely head and shoulders above anyone else in manufacturing, that is our goal.

Andrew D. Baglino {BIO 21161872 <GO>}

Manufacturing is hard and hard problems are fun.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

Okay, now let's talk about formation. In a typical cell factory, formation represents 25% of the investment and what is formation. It's charging and discharging cells and verifying the quality of the cell. Turns out we've charged and discharged billions and billions of cells in our vehicles, so we know a thing or two about that. The typical formation setup is you charge and discharge each cell individually in our car, we charge thousands of cells at once. And we took our principal and our power electronics leveraging powerwall vehicle battery management systems and others to dramatically improve the formation equipment cost effectiveness and density. 86% reduction in formation investment, 75% reduction in footprint.

You want to take this one?

Elon Musk {BIO 1954518 <GO>}

Sure. So essentially what this translates to based on what we know today is about a 75% reduction in the investment per kilowatt hour or gigawatt/hour. It's just a basically 4x better than the current state-of-the-art to the best of our knowledge. And I think there's probably room to improve even beyond that.

Andrew D. Baglino {BIO 21161872 <GO>}

Definitely.

Elon Musk {BIO 1954518 <GO>}

Definitely, yes. So we're able to, from a volume standpoint, actually get what in a smaller form factor than Giga Nevada, we were able to get many times the cell output. So you can see like basically we can get a terawatt hour in less space than it took to make a gigawatt hour, 150 gigawatt hours. So this is pretty profound, it's like -- I would actually not have thought this was possible several years ago that we could actually get to terawatt hours scale in less space than what we currently envisioned for doing a 150 gigawatt hours.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, simpler accelerates terawatt hours scale and that's what we need to do to accelerate our mission. And as Elon said, we're going to try to even improve on this as we push towards our goals which are --

Elon Musk {BIO 1954518 <GO>}

Yes. So this is just for -- this just talking about Tesla internal cell production. As I tweeted out earlier, we will continue to use our cell suppliers, the Panasonic and LG and CATL. And so this is a 100 gigawatt hours supplemental to what we buy from suppliers. And yes, essentially this is like reduce our weighted average cost of a cell, because -- but it does allows us to make a lot more cars and a lot more stationary storage. And then long-term, we're expecting to make on the order of 3,000 gigawatt hours or 3 terawatt hours per year. I think we can -- I think we've got a good chance of achieving this actually before 2030, but I'm highly confident that we could do it by 2030.

Andrew D. Baglino {BIO 21161872 <GO>}

When you look at the size of that factory on the previous page, it really shows how enabling all these advancements are and achieving a 3 terawatt hour goal by 2030. And not only is all of that manufacturing innovation, fantastic for enabling scale, it's also an additional 18% reduction in dollar per kilowatt hour at the battery pack level.

Elon Musk {BIO 1954518 <GO>}

But wait, there's more.

Andrew D. Baglino {BIO 21161872 <GO>}

But wait, there's more.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

So we have a manufacturing system. We've got a cell design. What are the active materials we're going to put in that cell design. Let's talk about the anode first. Let's talk about silicon. Why is silicon awesome? It's awesome because it's the most abundant element in the Earth's crust after oxygen, which means it's everywhere, it's sand.

Elon Musk {BIO 1954518 <GO>}

Yes, sand is silicon dioxide.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And it happens to store 9x more lithium than graphite, which is the typical anode material in lithium-ion batteries today. So why isn't everybody using it? The main reason is because the challenge with silicon is that it expands 4x when fully charged with lithium, and basically all of that expansion stress on the particle, the particle start cracking, they start electrically isolating, you lose capacity, the energy retention of the battery starts to fade and it also gums up with a passivation layer that has to keep reforming as the particles expand.

Elon Musk {BIO 1954518 <GO>}

Yes, basically with silicon, the cookie crumbles and gets gooey, that's basically what happens.

Andrew D. Baglino {BIO 21161872 <GO>}

Good analogy.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

And current approaches to solve this which exist. I mean we have silicon in the cars that you're all in right now, are involved highly engineered expensive materials in the

scheme of things. Now, they're still great and they enable some of the benefits of silicon, they just don't enable all of it, and they're not scalable enough. And you can see some of the things that maybe you've heard of SiO, silicon with carbon or silicon nanowires, that's kind of the space right now. What we're proposing is a step change in capability and a step change in cost, and what that really is, is you just go to the raw metallurgical silicon itself. Don't engineer the base metal, just start with that and design for it to expand , and how you think of the particle in the electrode des ign and how you code it?

Elon Musk {BIO 1954518 <GO>}

Yes. I'm not sure if you saw this is -- basically a dollar because ours -- basically if you use simple silicon, it's dramatically less than even the silicon that is currently used in the batteries that are made today and you can use a lot more of it.

Andrew D. Baglino {BIO 21161872 <GO>}

The anode would cost -- yes, with this silicon in the anode cost $1.20 a kilowatt hour. And how does it work? Start with raw metallurgical silicon, stabilize the surface with an elastic ion conducting polymer coating that is applied through a very scalable approach. No like chemical vapor deposition, no highly engineered, high CapEx solutions and then integrated in the electrode through a robust network formed out of a highly elastic binder. And in the end, by leveraging this, the silicon to its potential, we can increase the range of our vehicles by an additional 20% just this improvement.

Elon Musk {BIO 1954518 <GO>}

Yes, it gets cheaper and longer range.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And when we take that anode cost reduction, we're looking at another 5% dollar per kilowatt-hour reduction at the battery pack level and there's more. Let's talk about cathodes. What is a battery cathode? Cathodes are like bookshelves where the metal, the nickel, the cobalt, the manganese or aluminum is like the shelf and the lithium is the book. And really what sets apart these different metals is how many books of lithium they can fit on the shelves and how sturdy the shelves are. Cobalt is a --

Elon Musk {BIO 1954518 <GO>}

Yes, sorry. I would just say like, it's such a exactly figure out what the right analogy is to explain cathode and anode, but a bookshelf is probably a pretty good one in the sense that you need a stable structure to contain the ions. So you want to structure that does not crumble or get gooey or basically that holds its shape in both the cathode and the anode. As you're moving these ions back and forth, it needs to retain its structure. So if it doesn't retain a structure, then you lose cycle life and your battery capacity drops very quickly.

Andrew D. Baglino {BIO 21161872 <GO>}

Absolutely, yes, I totally agree. And I think people are always talking about like, oh, what's the cathode going to be, is it NC or whatever, the thing to consider is just fundamentally what the nickel -- the metals are capable of and that's what we have on the chart here, $1 per kilowatt-hour cathode of just the metal, using just LME, London Metal Exchange prices versus the energy density of just the cathode. And you can see, nickel is the cheapest and the highest energy density and that's why increasing nickel is a goal of ours and really everybody's in the energy -- in the battery industry. But one of the reasons why cobalt is even used at all is because, it is a very stable bookshelf, and the challenge was going to pure nickel is stabilizing that bookshelf with only nickel, and that's what we've been working on with our high nickel cathode development, which has zero cobalt in it, leveraging novel coatings, and -- novel coatings and opens [ph]. We can get a 15% reduction in cathode $1 per kilowatt hour.

Elon Musk {BIO 1954518 <GO>}

Yes, they do.

Andrew D. Baglino {BIO 21161872 <GO>}

But it's not just about nickel. You want to?

Elon Musk {BIO 1954518 <GO>}

Yes, sure. So in order to scale, we really need to make sure that we're not constrained by total nickel availability. I actually spoke with the CEOs of the biggest mining companies in the world and said, please make more nickel, it is very important. And so I think they are going to make more nickel, but there's also I think we need to have a kind of a three-tiered approach to batteries. So starting with iron, that's kind of like a medium range and then nickel manganese as sort of a medium plus intermediate and then a high nickel for long-range applications, like cyber truck and the semi. Yes, something like a semi truck, it's extremely important to have high energy density in order to get long-range. So -- and just to give sort of iron a bit more time like the -- below the -- if you look at the watt hours per kilogram at the cathode level of iron, it looks like nickel's twice as good. But when you fully considered at the pack level, everything else taken into account, nickel is about maybe 50% or 60% better than then iron. So iron is not is little better than it would seem, where you -- when you look at it at the pack level fully considered.

It's not as good as nickel, nickel is like 50% to 60% better, but it's still -- it's actually pretty good. And so, good for stationary storage and for medium-range applications where energy density is not paramount, and then like I said for intermediate, it's kind of a nickel manganese and it's relatively straightforward to do a cathode that's two-thirds nickel, one-third manganese which would then allow us to make 50% more cell volume with the same amount of nickel.

Andrew D. Baglino {BIO 21161872 <GO>}

And with very little energy trade-off.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

Just enough to have you still want to use a 100% nickel for something like a semi truck, but really not much of a sacrifice at all --

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

And beyond the metals, because a lot of people spent time talking about the metals, actually the cathode process itself is a big target, 35% of the cathode dollar per kilowatt-hour is just in -- transferring it into its final form. And so we see that as a big target and we decided to take that on. Here's a view of the traditional cathode process. Effectively if you start if you start at the left and you have the metal from the mine, the first thing that happens is the metal from the mind is changed into an intermediate thing called a metal sulfate, because that's just happened to be what chemists wanted a long time ago. And then when you're making the cathode, you have to take this intermediate thing called metal sulfate add chemicals, add a whole bunch of water, a whole bunch of stuff happens in the middle, and at the end, you get that little bit of cathode and a whole bunch of wastewater and byproducts.

Elon Musk {BIO 1954518 <GO>}

Yes, it's -- insanely complicated. If you look at the total -- like, if you're just like, it's a small will journey of I am a nickel, and so what happens to me and it's like -- it is crazy. Like you're going around the world three times, there's like the moral equivalent of like digging the ditch, fill in the ditch, and dig in the ditch. It's total madness basically. And these things just grew up as just that they're just kind of like legacy things that -- it's like how it was done before and then they connected the dots, but really didn't think of the whole thing from like a first principle standpoint saying how do we get from the nickel ore in the ground to the finished nickel product for a battery. And so we've looked at the entire value chain and said, how can we make this as simple as possible.

Andrew D. Baglino {BIO 21161872 <GO>}

And that's what we're proposing here with our process. As you can see, a whole less -- a whole lot less is going on here. We get rid of the intermediate, metal water, final

product cathode, recirculate the water, no waste water at all. And when you summer it -- summarize all of that, it's the 66% reduction in CapEx investment, a 76% reduction in process cost and zero waste water; much more scalable solution. And then when you think about the fact the now we're actually just directly consuming the raw metal nickel powder, it dramatically simplifies the metal refining part of the whole process. So we can eliminate billions in battery grade nickel intermediate production, it's not needed at all.

And we can also use that same process in the previous page to directly consume the metal powder coming out of recycled electric vehicle and good storage batteries. So this process enables but simpler mining and simple recycling. And now that we have this process, obviously we're going to go and start building our own cathode facility in North America and leveraging all of the North American resources that exist for nickel and lithium and just doing that, just localizing our cathode supply chain and production, we can reduce miles traveled by all the materials that end up in the cathode by 80%, which is huge for cost.

Elon Musk {BIO 1954518 <GO>}

Yes, to be clear cathode production would be part of our -- the Tesla cell production plant. So just be -- basically raw materials coming from the mine and from raw materials in mine, out comes a battery.

Andrew D. Baglino {BIO 21161872 <GO>}

And on that note, the way the lithium ends up in the cell is through the cathode. So then we should obviously on site lithium conversion as well, which is what we will do using a new process that we're going to pioneer, that's a sulfate free process again, skip the intermediate, 33% reduction in lithium cost, a 100% electric facility co-located with the cathode plant.

Elon Musk {BIO 1954518 <GO>}

Yes. So it's important to note that there is a massive amount of lithium on Earth. So lithium is not like oil, there's a massive amount of it pretty much everywhere. So in fact there's enough lithium in the United States to convert the entire United States fleet to electric. It's like the all the cars in the United States, all -- like 300 million or something like that, every vehicle in the United States can be converted to electric using only lithium that is available in United States.

Andrew D. Baglino {BIO 21161872 <GO>}

Discovered today.

Elon Musk {BIO 1954518 <GO>}

Yes, what we already know is good.

Andrew D. Baglino {BIO 21161872 <GO>}

People really haven't even been looking.

Elon Musk {BIO 1954518 <GO>}

Yes, people have been trying, because this is like widely available. So -- but it is important to say like okay, what is the smartest way to take the ore and extract a lithium and do so in an environmentally friendly way? And we actually discovered a -- again looking at a sort of first principles of physics standpoint, instead of just the way it's always been done, is -- we've found that, we can actually use table salt, sodium chloride to basically extract the lithium from the ore. And this is -- nobody has done this before to the best of my knowledge; nobody's done this and it's a -- sort of all the elements of reusable, it's a very sustainable way of obtaining lithium. And we actually got rights to a lithium clay deposit in Nevada.

Andrew D. Baglino {BIO 21161872 <GO>}

Over 10,000 acres.

Elon Musk {BIO 1954518 <GO>}

Over 10,000 acres. And then the nature of the mining is actually I think also very environmentally sensitive, and that we sort of take a chunk of dirt out of the ground or remove the lithium and then put the chunk of dirt back where it was. So it will look pretty much the same as before, and it will not look like terrible, and yes, it'll be nice.

Andrew D. Baglino {BIO 21161872 <GO>}

So simply mix clay with salt, put it in water; salt comes out with the lithium, done.

Elon Musk {BIO 1954518 <GO>}

Yes, it's pretty crazy.

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, so we're really excited about this and there really is enough lithium in Nevada alone to electrify the entire U.S. fleet.

Elon Musk {BIO 1954518 <GO>}

Yes, I guess that's true. Actually just what's in Nevada, that's basically so much damn lithium on earth, it's crazy. It is one of the most common elements on the planet.

Andrew D. Baglino {BIO 21161872 <GO>}

And eventually, as we said at the beginning, when we get to this steady state 20 terawatt hours per year of production, we will transfer the entire non-renewable fleet of both power plants, home heating and battery -- and an industry heating and vehicles to electric. And at that point, we have an awesome resource in those batteries to recycle to make new batteries. So we don't need to do any more mining at that point and you can see why. The difference in the value of the material coming back from the vehicle versus the ground, you'd always go to the vehicle.

And we recycle 100% of our vehicle batteries today, and actually we are starting our pilot full scale recycling production at Gigafactory Reno next quarter to continue to develop this process as our recycling returns.

Elon Musk {BIO 1954518 <GO>}

Yes, I mean to date, it's been done by third-parties, but we think we can recycle the batteries more effectively, especially since we -- our batteries, we are making the same battery as the thing we're recycling. So whereas like third party recyclers have to consider batteries of all kinds?

Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And just to think about what this actually means, the recycling resource is always 10 or greater years delayed, because batteries last a really long time. But eventually it is the way that all resources will be made available, and that's why we're investing in this recycling facility in Nevada.

Elon Musk {BIO 1954518 <GO>}

Yes. Long-term, new batteries will come from old batteries, once the fleet reaches steady state, right?

Andrew D. Baglino {BIO 21161872 <GO>}

Okay. So we just talked about scaling cathode and recycling. All of the benefits that you just saw are added to this benefit of 12% reduction in dollars per kilowatt hour at the battery pack level, almost at our half the cost goal, but there's one more section. Take it away, Elon.

Elon Musk {BIO 1954518 <GO>}

So I mean there's an architecture that we've been wanting to your Tesla for a long time and we're finally -- we finally figured it out. And I think it's the way that all electric cars in the future will ultimately be made. It's the right way to do things. So it starts with having a single piece casting or single piece casting for the front body and the rear body. And in order to do this, we commissioned the largest casting machine that has ever been made, and it's currently working just over the road at our Fremont plant. We have the -- it's pretty sweet, making the entire -- currently making the entire rear section of the car, as a single piece high pressure die cast aluminum.

And in order to do this, we actually had to develop our own alloy, because we wanted a high-strength for casting alloy that not did not require coatings or heat treatment. This is a big deal for castings.

Especially with a large casting, if you heat treated afterwards, it tends to deform. It kind of like does this like potato chip thing? So it's very hard to keep a large casting to have its shape. So in order to achieve this, there was no alloy that existed that could do this. So we developed our own alloy, a special alloy of aluminum that has high strength without heat treat and is very castable. So that's a -- it's a great achievement of our materials team.

In fact in general, we've got a lot of advanced materials coming for Tesla that new alloys and materials that have never existed before. So you are basically making the front and rear of the car as a single piece and then -- that then -- interfaces to or call it the structural battery where the battery for the first time will have dual use -- or the battery will -- both have the use as an energy device and as structure. This is absolutely the way things are done.

In the early days of aircraft, they would carry the fuel tanks as cargo. So the fuel tanks actually had -- were quite difficult to carry. They are like basically worse than cargo. You had to kind of bolt them down. It was very difficult. And then somebody said, hey, what if we just make the wing tanks? What if we just make the fuel tank in wing shape? So all airplanes, the fuel tank -- your wing is just a fuel tank in wing shape. This is absolutely the way to do it. And then the fuel tank serves as dual structure and it's not -- it's no longer cargo, it's fundamental to the structure of the aircraft. This was a major breakthrough. We're doing the same for cars.

So this is really quite profound. The -- effectively the non-cell portion of the battery has negative mass. So we save so much mass in the rest of the vehicle. We save more mass in the rest the vehicle than the non-cell portion of the battery. So it's like, well, how do you really minimize the mass of the battery? Make it negative, make the battery -- non-cell portion of battery pack negative? So it also allows us to pack the cells more densely, because we do not have intermediate structure in the battery pack. So instead of having these like supports and stabilizers and stringers and structural elements in the battery, we now have a lot more space in the battery because the pack itself is structural.

The -- and what we'd do essentially, like what we -- like instead of having just a filler that is a flame retardant, which is currently what is in the 3 and Y battery packs, we have a filler that is structural adhesive as well as flame retardant. So it effectively glues the cells to the top and bottom sheet. And this allows you to do shear transfer between the upper and lower sheet. Just like if you have like a Formula 1 craft or like a racing boat and you have a carbon fiber face sheets and say aluminum honeycomb between them, this gives you incredible stiffness. And that's really the way that any super fast thing works is you create a -- basically a honeycomb sandwich with two pace sheets.

This is actually even better than what aircraft do, because aircraft do not do this. They can't do this because fuel is liquid. So in our case, the batteries are solid. So we can actually use the steel shell case of the battery to transfer shear from the upper and lower face sheet, which makes for an incredibly stiff structure even stiffer than a regular car.

In fact if this was in a -- like a convertible that had no upper structure, it would be stiffer, then that convertible would be stiffer than a regular car. So this is -- it just really -- it's really major. So improves the mass efficiency of the battery and then those castings are also quite important, because you want to transfer load into the structural battery pack in a very smooth continuous way, so you don't put arbitrary point loads into the battery.

So you have kind of that -- you want to sort of feather the load out from the front and rear into the structural battery. It also allows us to use -- to move the cells closer to the center of the car, because we don't have the -- in the top one, we got that sort of all the supports and stuff. So the volumetric efficiency of the structural pack is much better than a non-structural pack and we actually bring these cells closer to the center, and because they're closer to the center it reduces the probability of a side impact potentially contacting the cells, because they have it has to go □ in any kind of side impact, it has to go further in order to reach the cells.

It also proves what's called the polar moment of inertia, which is that -- you can take like when there's a like ice skater arms out or arms in, arms in, you rotate faster. So if you can bring things closer things closer to the center, you reduce the polar moment of inertia, and that means you can -- the car maneuvers better, it just feels better. You -- don't know why, but it just feels more agile. So it's really cool. This is a really major, I'd say, sort 10% mass production in the body of the car, 14% range increase, 370 fewer parts. So I mean, I really think that long-term, and any cars that do not take this architecture, will not be competitive.

Andrew D. Baglino {BIO 21161872 <GO>}

And it's not just at the product level a better product, but in the factory, it's a massive simplification. You saw the part removal, it's casting machine, it's the structural battery pack. So we are looking at over 50% reduction in investment per gigawatt hour, 35% reduction in floor space and we'll continue to improve that as we make the vehicle factory of the future.

Elon Musk {BIO 1954518 <GO>}

Yes, so a major improvements on all fronts from the cell all the way to the vehicle.

Andrew D. Baglino {BIO 21161872 <GO>}

And in addition to the improvements we just said on enabling additional range and improving the structural performance of the vehicle, it is worth another 7% dollar per

kilowatt-hour reduction at the battery pack level bringing our total reductions now to 56% dollars per kilowatt hour.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

All right. So stacking it up, we're not just talking about cost or range, we've got to look at all the facets. So range increase, we're unlocking up to 54% increase in range for our vehicles and energy density for our energy products; 56% reduction in dollars per kilowatt hour at the battery pack level and 69% reduction in investment per gigawatt hour, which is the true enabler when we talk back about how do we achieve this scale here.

Elon Musk {BIO 1954518 <GO>}

Yes. And yes -- so I think it's pretty nice that investment per kilowatt -- per gigawatt hour reduction is 69%, I mean who would have thought?

Andrew D. Baglino {BIO 21161872 <GO>}

Yes, just happened to happen out that way.

Elon Musk {BIO 1954518 <GO>}

I mean 0.420% of course. Yes. So what this enables us to do is achieve a new trajectory in the reduction of cell cost. To be clear, it will take us probably a year to 18 months to start realizing these advantages and probably -- to fully realize the advantages, probably it's about three years or thereabouts. So it's not like if we go to these instantly we would, but it's really -- I think what this bodes? It just really bodes well for the future and means that the long-term scaling of Tesla and the sustainable energy products that we make will be massively increased. So what tends to happen as companies get bigger, as things tend to slow down? Well, actually they're going to speed up.

Andrew D. Baglino {BIO 21161872 <GO>}

And they have to speed up if we're going to accelerate the transition to sustainable energy.

Elon Musk {BIO 1954518 <GO>}

Yes. I mean long-term, we want to try to replace about at least 1% of the total vehicle fleet on Earth, which is about 2 billion vehicles. So long-term, we want to try to make about 20 million vehicles a year.

Andrew D. Baglino {BIO 21161872 <GO>}

But I think it's important to point out that when we talked about 3 terawatt hours by 2030, the problem is a 20 terawatt hour problem. So everybody needs to be accelerating their efforts to accomplish these objectives. It doesn't matter where you are in the value chain, there is the ton to do. You need a rethink from first principles how you do it, so that you can sale to meet all of our objectives.

Elon Musk {BIO 1954518 <GO>}

Yes.

Andrew D. Baglino {BIO 21161872 <GO>}

Anyone?

Elon Musk {BIO 1954518 <GO>}

Sure.

Andrew D. Baglino {BIO 21161872 <GO>}

What does this mean?

Elon Musk {BIO 1954518 <GO>}

What does it mean -- what does this mean for our future products? So we're confident that long-term, we can design and manufacture a compelling $25,000 electric vehicle. So this has always been our dream from the beginning of the company. I even like wrote a blog piece about it. Because our first car was an expensive sports car and it was like slightly less expensive sedan, and then finally sort of a -- I don't know mass market premium, but -- like the Model 3 or Model Y, but it really -- it is always our goal to try to make an affordable electric car. And I think probably like sort of about three years from now, we're confident we can make a very compelling $25,000 electric vehicle that's also fully autonomous.

Andrew D. Baglino {BIO 21161872 <GO>}

And when you think about the $25,000 price point, you have to consider how much less expensive it is to own an electric vehicle. So actually it becomes even more affordable at that $25,000 price point.

Elon Musk {BIO 1954518 <GO>}

Yes. So we have -- and extreme performance and rangem and we should probably talk about the model S Plaid. Yes, what about that?

[Audio Video Presentation]

Yes. So yes, we took the latest Plaid out to Laguna Seca on Sunday, you got 1.30 minute, and we think probably there is another three seconds or more to take off that time. So we're confident the model S Plaid will achieve the best track time of any production vehicle ever of any kind, two-door or otherwise. And you can order it now, and it's available basically in the next year. So -- and now, we'll move to Q&A.

Questions And Answers

A - Alan Prescott {BIO 22242369 <GO>}

(Question And Answer)

A - Andrew D. Baglino {BIO 21161872 <GO>}

Absolutely.

A - Elon Musk {BIO 1954518 <GO>}

So we'll invite a few people on stage.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Come on up team.

A - Elon Musk {BIO 1954518 <GO>}

It is just a small portion of the team, but it will be great to show you some more of the team. And when we do Q&A, we can like give various people different questions to answer.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Sounds great. Actually, I don't know how we're getting the questions.

A - Elon Musk {BIO 1954518 <GO>}

Actually. And I don't know either. Okay. Well, because it's like you can maybe get out of the car for two seconds and yell it at us. I don't know -- how do we get in the questions?

A - Andrew D. Baglino {BIO 21161872 <GO>}

Oh, there are mics. Okay. Wait for the mic.

A - Elon Musk {BIO 1954518 <GO>}

There are mics. Okay. Great, great. All right. Okay. We'll definitely need to give people mics because otherwise, there's no way. We're going to pass the mics up.

Q - Analyst
What are you going to name the $25,000 car?

A - Elon Musk {BIO 1954518 <GO>}
Oh, we don't have a name for the $25,000 car yet.

A - Andrew D. Baglino {BIO 21161872 <GO>}
It's a great question though.

Q - Analyst
Elon, you talked about (Question Inaudible)

A - Elon Musk {BIO 1954518 <GO>}
Yes. We will be manufacturing cells in Berlin. Yes?

Q - Analyst
(Question Inaudible)

A - Andrew D. Baglino {BIO 21161872 <GO>}
Thermal management system?

Q - Analyst
For homes.

A - Andrew D. Baglino {BIO 21161872 <GO>}
For homes?

A - Elon Musk {BIO 1954518 <GO>}
Oh, you mean like the home HVAC? Yes. I mean that's a pet project that I'd love to get going on. I don't know, maybe we'll start working on that next year. Because I just think there's, man, you can really make a way better home HVAC system that's really quiet and super-efficient and, yes, super energy efficient and also has like a way better filter for particles. And, yes, just -- and it works very reliably. And we've already developed that for the car, like so the heat pump in the Model Y is really pretty spectacular. I mean, it's tiny, it's efficient, it has to last for 15 years, it's got to work in all kinds of conditions from the coldest winter to the hottest summer.

So we've actually already done a massive amount of the work necessary for really kick out some home HVAC. And they could also like stack them. So if you want to, say, depending upon the size of your house or whatever, how much you need, you can just basically stack them and just have a very compelling, superefficient home HVAC. And it could also communicate with a car and it'll know when you're coming

home. So it's like, oh, I don't need to keep the house cold all day. I'll just -- cool it down, because I know you're coming home. So the pack can communicate with the car and just like really dial it into when you actually need cooling and heating. It would be great.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Fun product.

A - Elon Musk {BIO 1954518 <GO>}

Yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Who's next?

Q - Analyst

Hello? Hey, guys. Eli here from Tesla Owners Club, My Tesla Adventure. Just a quick question. So I'm a huge fan of car camping in my Tesla with my dream case, like my all-time favorite activity. Is it going to be possible to get climate control to the back of the Cybertruck, because that will be the ultimate camping machine if we can get all-night climate control?

A - Elon Musk {BIO 1954518 <GO>}

We'll try to do that. Yes. I agree. That would be really cool. Yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

All right, who's next?

Q - Analyst

Hello. Long-time fan, Elon, great guy. Just a question, how does the ICE industry look like for -- in the future?

A - Elon Musk {BIO 1954518 <GO>}

Well, I don't think there will be an ICE industry long term. Yes. I mean, well, I guess there might be like a few things that are like -- it's like curious thing. I mean, there's still like some steam engines made somewhere, but like they're just basically sort of quirky collectors' items. And I mean that will be the future of the internal combustion engine car.

Q - Analyst

Hi, Elon. To your left here in the white Model Y. Ryan McCaffrey from the Ride the Lightning Tesla podcast. Curious about Cybertruck. It was interesting to see where you had it in on the battery technology front, I'm sort of curious what you see for it in the production front. Is it volume? Trucks are so popular in America. Do you see its

volume equaling the 3 or the Y in the future? And also, is the -- did you -- were you able to get -- Tesla is able to legally be sold in Texas as part of the Giga Texas deal?

A - Elon Musk {BIO 1954518 <GO>}

Well, it's hard to say what the volume exactly would be for the Cybertruck. The orders are gigantic. So we have like, I don't know, well over 0.5 million orders, I think, maybe 600,000 -- it's a lot basically, we stopped counting. So I think there's probably room for, I don't know, at least like a unit volume of like 250,000 to 300,000 a year, maybe more. So now we are designing the Cybertruck to meet the American spec, because if you try to design a car to meet the global -- the superset of all global requirements, it basically -- you can't make the Cybertruck. It's impossible.

So it really is designed for the American market, but this is the biggest market. Our North American market is the biggest market for pickup trucks by far or large pickup trucks. And then I think for -- we'll probably make an international version of Cybertruck that will be kind of smaller, kind of like a tight wolverine package. It's a little bit cooler, but it will be smaller because you just can't make a drive truck like that for most markets. So yes, but it's going to be great.

And I don't know. I think probably we'll be able to sell directly in Texas. We do pretty well right now, but it is a bit -- we're not being able to actually conclude a transaction in Texas, but it's got to be like a click on a server-based in California. So -- but really, we can do leasing in Texas, we're not selling, but hopefully, that will get cleared up in the future.

Q - Ross Gerber {BIO 6277666 <GO>}

Elon, great job with everything that you're doing. It's Ross Gerber from Gerber Kawasaki. Your team is amazing. What I'm most curious about, these innovations are incredible, but on my drive up here fully on Autopilot for 400 miles, the entire state is brown. And this is ultimately about climate. Has there been some analysis done if all these things are achieved, what will its direct impact be on climate?

A - Elon Musk {BIO 1954518 <GO>}

Well, I mean, I think we'll have a very significant impact, because it will stop the CO2 PPM from growing as it is every year. And I mean, I should say like, I try to view the whole climate thing for -- as a science question as much as possible, science you always question your hypothesis. Is it true? Is it not true? Or assign a probability to a given hypothesis. And I should say that my original interest in electric vehicles predates the climate issue. I just wonder as in high schools like I thought, man, if we don't figure out electric cars, the whole economy is going to collapse when you run out of oil. So it's like we better figure out electric cars and sustainable energy or civilization is going to crumble.

And then it's only kind of later that the significance of the climate risk became apparent, and we're also able using tracking and other types of technology to access a lot more fossil fuels than previously thought, which is helpful for lowering the cost

of gasoline, but it's pretty bad for the total tonnage of CO2 that you can put in the atmosphere, it's now greatly beyond what people previously thought. So but this is -- as we were just going through this presentation, it's like an absolutely monumental task to accelerate the advent of sustainable energy. I mean, the entire global economy is still more than 99% dependent on -- or call it, roughly 99% dependent on fossil fuels. So although electric cars kind of get a lot of press right now, they're still -- and there's still very few -- as a percentage of the total global fleet, it's practically nothing. I would say, yes, less than 1% of the global fleet is electric right now, yes, because 2 billion cars and trucks and whatnot in use.

So there's a massive amount of work ahead, just in saying, like hard to comprehend, how much work is ahead to get the new vehicle production to be sustainable, to massively increase the amount of stationary storage, which is critical, because renewable energy is intermittent, wind and solar is intermittent, sometimes wind doesn't blow and obviously sun doesn't shine at night. So you've got to have batteries, a massive, massive number of batteries, so --

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes, it's hard to measure in direct impact, but it's an experiment that we shouldn't be performing. And the sooner we can sort of end the experiment, the sooner we can kind of move on in a fully sustainable way that is actually lower cost. I mean, I think the thing that people haven't fully internalized is once we do get to the $25,000 car, the ownership cost of that car is incredibly lower than the prior car. And then on the solar side and wind, with the cost of solar and wind coming down and with batteries coming down with them, the actual cost of energy on the grid is going down. So we're sort of moving towards a sustainable lower cost future. So there's not like a sacrifice.

A - Elon Musk {BIO 1954518 <GO>}

Yes, that's true. It is a false dichotomy to say that it's like -- it's either prosperity or sustainability. This is often used by oil and gas to say like, oh, well, do you want people to lose their jobs? Do you want to have lower people -- standard of living? Do you want to make all these economic sacrifices really in order to have sustainability? And the reality, as Drew was saying, is that a sustainable energy is going to be lower cost, not higher cost, than fossil fuels.

Q - Analyst

Hey, Elon, a quick question for you, right here in front. First, thanks for having everyone. And I was telling a friend, the one company to go work for that's going to have the biggest structural impact over the next 10 years at scale, it's probably Tesla. So kudos to everyone at Tesla for what they've done to this point and going forward.

The two questions for you. As you've looked at the auto and the storage markets, I know you've talked about it kind of 50-50 long term. But it seems like a lot of the battery cost curve achievements that you are -- that you presented today really make some of these storage opportunities much more feasible over the next five years. And so I guess the first part of the question is, does your calculus upon learning and

improving these things change on that 50-50 mix? Or is there a role where storage becomes bigger?

And then the second part of the question, with all these huge grand visions, who's going to be with Tesla from a corporate perspective accomplishing these things? Obviously, Tesla can't do it alone. But when you look at some of the traditional auto industry or power, et cetera, I don't see a lot of other Teslas.

A - Elon Musk {BIO 1954518 <GO>}

Well, actually -- so there's a lot of companies in China that I think are doing great work with electric vehicles and also with stationary storage. Although we don't see that much in the U.S. yet, but I think probably we will in the future.

I don't know. I mean, obviously, we're doing everything we can to encourage other companies to move to sustainable transport and also make stationary storage batteries. We opened up -- made our patents freely available. We really try to tell these companies, hey, you really need to do this or you won't exist in the future. But they don't believe it. So I mean we've talked until we're blue in the face. What are we supposed to do? But we really are hopeful that other companies will also are doing and that will make a sustainable future comes sooner.

A - Andrew D. Baglino {BIO 21161872 <GO>}

From a fundamental market size perspective, like we did the first, like ground up work to show the size of the market in terawatt hours and they are roughly 50/50, 10 terawatt hours for transportation, 10 terawatt hours for the grid. And part of that is because the grid batteries -- because when you're making a power plant, you're making a large investment, our 25-year assets are greater. If they were -- if the grid batteries were 10-year kind of things, the grid -- that market would be bigger. But because it's a longer duration asset, they're roughly the same size.

Q - Analyst

Thinking long term, is there any other segment that this new battery be able to disrupt or electrify beyond just the initial Model 2 or cheaper sedan like a Bow, Boring Company, Loop, Plane?

A - Andrew D. Baglino {BIO 21161872 <GO>}

Where are you going?

Q - Analyst

What's up, right here?

A - Elon Musk {BIO 1954518 <GO>}

Okay. Great. It's like (Multiple Speaker) it's like, we just get the sound of the speaker, I can't tell where the heck it's coming from.

Q - Analyst

Yes. Any hints or is the Model 2 such a big deal because it decreases the cost of transportation, that, that is really the disruption? Or should we get height that this new cost curve opens up different vehicle categories like a high passenger density bus? Boring, Loop, Bow, Plane?

A - Elon Musk {BIO 1954518 <GO>}

Well, I mean, there's -- there are batteries in limited production right now that do exceed 400 watts hours per kilogram, which I think is about the number you need for a decent range, medium-range aircraft. And I think our batteries will, over time, start to approach the 400 watt hours per kilogram range as well. So yes, I mean, I think over time, we'll see all modes of transport with the ironic exception of rockets transition to sustainability, or to electric, basically.

On the rocket front, what we're planning to do is about 80% of Starship is liquid oxygen, and we're actually already running a power line to be able to use wind power to create the liquid oxygen. So we're making some decent progress on sustainability on the rocket front, but there's just no way to have an electric rocket. And it's important for the future of life and consciousness that we become a multi planet species. So we've better keep doing that.

Q - Analyst

Hi, Elon.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Hello.

Q - Analyst

Josh Phillips here, retail investor. I have a question in regards to the lithium and nickel industries and the likely price spikes and shortages of high-grade materials. The EV industry is likely to see if they don't act fast to address future supply. Tesla have clearly made the right moves that are necessary. But there's a real worry that the potential supply issues and price spikes will create a drag on the rest of the EV industry, and therefore, a drag on global EV adoption. What advice would you give to the EV and mining industries to quickly solve these looming hurdles? Because for a sustainable energy future, the spice must flow. Thank you.

A - Elon Musk {BIO 1954518 <GO>}

Yes, indeed. The spice must flow. The new spice. I don't know. I think the -- I'm not sure. I guess we can try to like basically overdo it in cell production and perhaps supply sales to others. But we do see the fundamental constraint as total cell production. That's why we are putting so much effort into making cells and kind of reinventing -- trying to reinvent every aspect of cell production from mining the ore to a complete battery pack, because it's the fundamental constraint. We're not

getting into the cell business because we -- just for the hell of it, it's -- because it's the fundamental constraint. It's a thing that is the limiting factor for rapid growth.

But we could certainly try to overdo it on cell production and perhaps sell cells to others. Although we are going at absolute top speed, so it's like -- it's not like we're holding it back. But I think like just making really efficient cars and that are -- must have lower drag coefficient, low rolling resistance, efficient powertrains. I mean that's kind of what we've done in order to make iron phosphate still have a good range. So iron phosphates is lower energy density solution, but there's -- while there are some limitations on the total amount of nickel produced every year, there's really no limit on the iron. There's so much iron. It's ridiculous. So you can really scale up iron phosphate at a raw materials basis, plus more than you can nickel. But yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

And just to point out, when we were walking through this presentation, we intentionally separated all the different aspects. The benefits of structural battery apply to iron-based cathode in the same way they apply to a nickel-based cathode. So you get longer-range iron-based vehicles. And also the silicon benefit can apply to the iron-based vehicles as well. So there's -- we can do a lot to extend the range of an iron-based vehicle, which is why it's a key part of the road map going forward. And then I invite Turner up here to talk about what the mining industry can do.

A - Unidentified Speaker

Yes. Diversification on the cathode side is obviously massive and EVs are all about efficiency. And so for the EV industry, for the vehicle industry, we need to see powertrain efficiency really increase at all other companies matching Tesla powertrain efficiency, so that everyone can have that diversified cathode approach where LFP is used in medium-range and even really make a 300-mile vehicle with LFP. And really the goal that we are trying to present here was a model for vertical integration -- strategic vertical integration that a lot of different people can do. What we need to see is vertical integration that shortens the process path from mine to cathode. And what we're doing here is novel and we're trying to push the industry in that direction. So we're presenting a model here that anyone can follow.

A - Elon Musk {BIO 1954518 <GO>}

Yes. In fact, if there's anything that you guys want to comment on, feel free to step forward and say something.

A - Unidentified Speaker

I think the key is to be smart about your chemistry choices, your materials choices. Yes. If you're smart about your materials choices, the spice will continue to flow. You don't need to use the same kind everywhere. And if you -- it's about strategically planning it out. And for miners, I think we are incentivizing them quite a bit to ramp up their production.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes. And actually, we had good calls, like they're all motivated. I think they've been sort of sitting back being like, are you going to grow like crazy? And we're like, yes, we're going to grow like crazy. And then I think this indicates we're going to grow like crazy. And that's what the miners want to hear. And then they'll go make the investments.

Q - Analyst

Hello, Elon. This is Ben Limpic. I'm a musician. I was wondering, does Tesla have any future plans to make partnerships with music companies, like it has done with Tencent Games or things like that, for you guys to actually kind of expand your services for artists and other types of creative people to get involved in producing content that can be part of the Tesla ecosystem or so other people that do creative things can get involved with you guys?

A - Elon Musk {BIO 1954518 <GO>}

Well, we don't -- we haven't really thought about that much. But I suppose it's probably something we should think about. We will be providing a title on Teslas. So we're providing music to more music sources that people can choose from and just generally trying to improve the entertainment experience in the cars.

And I think actually, as we go to a more autonomous future, the importance of entertainment and productivity will become greater and greater. I mean, to the degree that -- if you're just basically sitting in your car, the car is fully autonomous and driving somewhere, it's kind of like being in a -- the car is essentially your chauffeur. And then the things that become important are, okay, well, let's have good entertainment, and if you want to do some productivity stuff, then that actually starts to become much more important, because you're no longer spending your attention driving the car. So it will be extremely important in the future.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Should we do some of the say dot com questions?

A - Unidentified Speaker

Yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Okay. Should you do the second one?

A - Elon Musk {BIO 1954518 <GO>}

Yes. The first one, I think we really answered. Like if we have -- if we're able to make enough sales, which we'll try to do or we will supply other companies, it's definitely not an intentional effort to keep the sales to ourselves. If we can make enough for other companies, we will supply them. And we're trying to do the right thing for advancing the sustainable energy, whatever that is.

So vehicle to grid. We get asked that a lot. I think one thing that's important to note is the vehicle to grid, it doesn't -- unless you have a power cut off -- like you need to cut off your main supply to the grid. Otherwise, if you lose the power in your house, you'll basically just backflow energy to the grid. So just having a reversal in the power flow does not actually keep the lights on. You need a whole separate system to cut off power to the grid. And I think there's also the case that people really want the freedom to be able to drive and to charge at their house. And it's obviously really problematic if you get to morning and your car, instead of being charged, it discharged into the house.

And then you're sort of, okay, now I can either drive or use the battery to power my house. I think it's actually going to be better for people's freedom of action to have a powerwall and a car separate. And then it's -- everything works. And you have that -- you basically combine that with solar, either solar retrofit or a solar glass roof and a local battery storage. So you basically become your own utility. And then the car is -- can be charged also with solar. I think that's like the stuff that works. That said, like we can certainly do vehicle to grid, and I think we could -- like we can basically enable that with software in Europe or something, right?

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes. We are -- future generations of power electronics, we will be able to do this more or less everywhere from a like energy market participation perspective, but yes, from a backing up the house, and it just so happens that the way the North American connectors are on all the cars in North America, it doesn't matter whether it's the Tesla Connector or the connector that the other vehicles have. It doesn't actually support powering your home, it's unfortunate. So you'd need an additional hardware to do that. But yes, in the future, all versions of our vehicles will be able to at least do bidirectional power flow for the purposes of energy market participation.

But even for that, it's important to remember that your car isn't plugged in 24/7. So it's kind of an unpredictable resource for the grid. It will have a value, but it's not the same as a stationary battery pack.

A - Elon Musk {BIO 1954518 <GO>}

Yes. Honestly, a vehicle to grid sounds good, but I think it actually has a much lower utility than people think. I think very few people would actually use vehicle to grid. And we actually had -- with the original Roadster, we had vehicle-to-grid capabilities. Nobody used it.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

Q - Analyst

(Question Inaudible)

A - Andrew D. Baglino {BIO 21161872 <GO>}

How do we find the engineers to do everything we're saying?

A - Elon Musk {BIO 1954518 <GO>}

How do we find the engineers to do all these things?

Q - Analyst

Yes.

A - Elon Musk {BIO 1954518 <GO>}

Well, I guess we recruit a lot of engineers from all parts of the world. I think Tesla has a good reputation for doing exciting engineering and that tends to attract the -- a lot of the top engineers in the world, because they know that their efforts at Tesla will really serve the greater good and we're super hardcore about engineering.

Tesla is like, first and foremost, an engineering company. It's like hardcore engineering is what we do. Like the sheer amount of hardcore engineering done at Tesla is insane. And if you look at, say, there's various surveys done of engineering schools, where do you want to go? Like what's your top choices? And actually, the top two choices in the last few years have been Tesla and SpaceX. So sometimes it's Tesla first and sometimes it's SpaceX first, but those are the 2 top ones.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes. I mean, if you are motivated to solve some of these problems, which are the hardest problems in the world to solve, that really fundamentally enable the future we all need, please reach out. Help us work on these problems.

A - Elon Musk {BIO 1954518 <GO>}

Absolutely. And like you said, the battle is far from over. Less than 1% of the global automotive fleet has been converted to electric and even maybe 0.1 -- less than 0.1% of stationary storage has been done. So stationary storage has barely begun, converting the global vehicle fleet to electric has barely begun. So there's still a massive amount of engineering work to be done at Tesla and other companies to accelerate this transition to sustainability.

Q - Jordan Krawitz {BIO 21312007 <GO>}

Hey, can you guys hear me?

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

Q - Jordan Krawitz {BIO 21312007 <GO>}

This is Jordan from Mark Asset Management. So you've talked about the importance of the factory and you've mentioned the ground-up design process and a lot of the new things that you're going to be doing or started to do in Shanghai, Berlin and

Austin. Can you just maybe help us understand and quantify like how financially meaningful all of those improvements will be? And then given what you're trying to accomplish as a company, is it fair to assume that the vast majority of improvement will be given back to the customer in the form of lower prices?

A - Elon Musk {BIO 1954518 <GO>}

Yes. I mean, it's -- I think certainly, we will try to get back as much as possible to the customers. It's not like -- it's like Tesla's profitability is crazy high. Our average profitability for the last four quarters is like maybe 1%. So just to be clear, it's not like we're minting money. Our valuation makes it seem like we are, but we're not. So we do want to try to make the price as competitive as we can without like losing money. And if you lose money, then you keep doing -- if you keep losing money, you'll just die. So we have to -- this thing called profit is just like we need to bring in more money than we spend. Otherwise, we're dead. So --

A - Andrew D. Baglino {BIO 21161872 <GO>}

But affordability is key to how we scale, right?

A - Elon Musk {BIO 1954518 <GO>}

Yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Like the demand goes non-linear as you reduce the price of the car.

A - Elon Musk {BIO 1954518 <GO>}

Yes. I mean, it's important to sort of separate the difference between affordability and value for money or desirability of the product. So for a lot of people, they want to buy a Tesla, they simply don't have enough money. We could make the car infinitely desirable. But if somebody does not have enough money, they can't buy it. Sometimes, people kind of forget this, it's like -- it's not -- it's like somebody -- you'll have enough money to buy the car, and just making a car super desirable, but expensive does not mean they can afford it. So it's absolutely important that -- critical that we make cars that people can actually afford. Yes. So I wish (Multiple Speakers) some of these things, just scroll down or something.

A - Andrew D. Baglino {BIO 21161872 <GO>}

When you expect Tesla vehicles to be ICE vehicles on initial purchase price?

I think the way to answer that question is, in the classes of vehicles we sell today, we're already doing that.

A - Elon Musk {BIO 1954518 <GO>}

Yes. We're already pretty, yes, pretty close. Yes. And then a factoring in total cost of ownership and the fact that electric vehicles require much less servicing and are way cheaper to run, when you look at like total cost of ownership -- and you can always

lease the car. So if you just like lease the car or get a loan for a car, you've got your sort of monthly payments and then your cost for either gasoline or electricity and your cost of servicing. And -- but the fully considered cost of an electric car is much less than a gasoline car of the same nominal purchase price.

I mean, that said and like maybe on the order of three years, when we can do a lower cost, like a $25,000 car, I think that will be basically on par, maybe slightly better than a comparable gasoline car. So I think maybe it's on the order of three years-ish.

A - Andrew D. Baglino {BIO 21161872 <GO>}

However, the technology advancements and increased vertical integration of battery manufacturing influence your ability to improve the environmental and social impact of the supply chain. And I think -- yes.

A - Elon Musk {BIO 1954518 <GO>}

We've sort of -- I've said that already.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes.

A - Elon Musk {BIO 1954518 <GO>}

Do you have some ability to scroll through this? Just a scroll away.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Have we covered recycling?

A - Elon Musk {BIO 1954518 <GO>}

Yes. Let's just scroll until we've got stuff that we haven't covered.

A - Andrew D. Baglino {BIO 21161872 <GO>}

We've definitely covered that top one.

A - Elon Musk {BIO 1954518 <GO>}

Yes. A lot of these things, we've already answered, I think.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Covered that. That one -- I think we --

A - Elon Musk {BIO 1954518 <GO>}

We literally just answered that.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Oh, I saw a cathode durability question, let's go to that one. Go down, go down, go down. Good technical question. Keep going. How are you going to address the cathode durability and cost and environmental impact to trifecta? Is this something you're going to leave the -- upstream and supply chain to sell?

No. I think we tried to answer that directly. I mean, we really are looking at not just what happens in the cathode facility, but like currently outside the cathode facility, that should really be inside and removing processes that shouldn't have been there in the first place and the use of reagents that add -- are just costly and not necessary in removing a bunch of wastewater from the process.

A - Elon Musk {BIO 1954518 <GO>}

Guys, is there anything you want to add to, like go through everyone and like maybe say what you're doing and say a few words? I don't know.

A - Unidentified Speaker

Sure. I just want to reiterate the fact that this is a massive problem.

A - Elon Musk {BIO 1954518 <GO>}

Massive problem.

A - Unidentified Speaker

And it seems like Tesla is on its way and ahead. But we need everybody's help, because it's everybody's planet and we are not going to get to 20 terawatt hours by ourselves. So please think about this carefully as this affects everybody. So let's get on it.

A - Elon Musk {BIO 1954518 <GO>}

Yes. And obviously, if you care about solving sustainability and doing hardcore engineering, definitely come work at Tesla.

A - Unidentified Speaker

Yes. We went through a couple of the manufacturing improvements. And it kind of looks easy when you put together a nice slide deck. But the challenges are like this -- it's super challenging. When you take materials out of the process, when you integrate processes together, you have to do a lot of things at once. And that's like this immense engineering challenge. And so I'd like to appreciate that, like you need -- like to get through this, we need like the best engineers we've got. And we've got this awesome team. I just want to shout out also to all of our team watching, like you guys are awesome, like you absolutely kicked down [ph] putting this together. And yes.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes. Thank you. Thank you, Tesla team, totally agree.

A - Unidentified Speaker

Yes. That's it, like, yes. Rodney?

A - Rodney D. Westmoreland Jr. {BIO 6596407 <GO>}

Rodney Westmoreland, managing the construction here at Tesla. What I would like to say is, one, shout out to the team. The team has been working effortlessly, a very, very tough project here for 24 hours a day, it seems like, round the clock to have this complete.

The thing that sets us apart from a lot of other construction -- yes, we have a construction company here. The thing that sets us apart is that we're integrated in the manufacturing process. So every detail that comes from Drew's mouth is directly implicated into the system that we're building. That way, what would typically take three or four months to create a specification, our design team is working right with the manufacturing team to allow us to speed that process up tremendously. So --

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yes. It's definitely a important part of the vertically integrated approach. It's to be able to design the factory around the equipment, in fact, together with the equipment so that you can build the factory at lower cost and more quickly.

A - Unidentified Speaker

Yes. I'm Scott. I focus on cell design. I think it's hard to put into words how inspiring this is. I've been at this a long time with Tesla. And I really hope others do join us.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Yeah. Since when Scott?

A - Unidentified Speaker

Since 2005, with many of you, but thank you. A year before, Drew, but who's keeping track? But I'm really stoked to what the team has been able to accomplish over the last short period of time, about a year. It's been really an incredible transformation. I mean, hopefully, what we've shown you inspires you to join us or join somebody else in the effort. And I couldn't think of a greater, more intelligent, more hard-working team to be working on with this problem.

Hi, Peter, I lead the manufacturing improvement team. And I guess the point that I would like to make is manufacturing improvements is like the accelerator. So like you think about the execution that Rodney talked about in terms of how fast we've been able to put together this factory, which is amazing and something that's been really incredible to be a part of, that's not enough. What we need to do is improve the manufacturing technology. That's the real accelerator, and that's what we're really focused on. Elon talks about it all the time that really, going and improving that system is what will enable us to get to the scale and the cost that we need.

And then the other point that I would make is on the recruiting side. Like it doesn't matter if you know about batteries, if you come from any industry, you can do something fantastic in the work that we're doing. We talk to people from industries that you wouldn't imagine. Like I talked to a guy from -- who makes golf balls. And he has stuff which is really impactful for what we're doing. So if you're in any industry and you want to be impactful here, like come join us, it'd be great.

I'm Tony. I've been working in lithium and cathode materials for almost 23 years now and this is the most growth I've seen in a company. I've been here a little over a year and half. We're hiring amazing people that are allowing us to leverage technology that most of the industry is struggling to achieve.

So to answer the question, how are we going to do this? We are really advancing the materials manufacturing for cathodes and for lithium beyond what has been accomplished in the previous 20 years.

A - Andrew D. Baglino {BIO 21161872 <GO>}

It's exciting.

A - Unidentified Speaker

Yes. My name is Turner, I work closely with the team, have worked a lot with everyone here. And on the cathode and upstream materials side, it's really important that everyone understand that this growth is coming. This growth is real. We are going to make all of these batteries, and everyone needs to grow with us, the entire supply chain needs to grow with us. And if you have an idea that simplifies anything in the supply chain, come talk to us, come work with us, and let's do it.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Any existing specification is wrong, any existing manufacturing method is wrong.

A - Unidentified Speaker

That's always true.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Process equipment, it's wrong. It's just a question of how wrong, quote Elon Musk.

A - Elon Musk {BIO 1954518 <GO>}

Yes. Exactly. If we're wrong, it's just question of how wrong, so we try to be less wrong.

A - Unidentified Speaker

So tell us how we're wrong and how we could do it better so that we can accelerate and improve as fast as possible.

A - Elon Musk {BIO 1954518 <GO>}

All right. Well, I guess, thank you, everyone, for coming. I hope you like the presentation. Very exciting future ahead. We're going to work our damnedest to transition the world to sustainable energy as quickly as possible and your support and help is key to that success. So thanks again. Super appreciate it and look forward to the next event. Thank you.

A - Andrew D. Baglino {BIO 21161872 <GO>}

Thank you.