

# Building a Better Battery Supply Chain with JB Straubel and Aimee Boulanger

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**Ariana Brocious:** This is Climate One. I'm Ariana Brocious.

Batteries are a critical part of our transition away from fossil fuels. From EVs to grid scale storage for wind and solar, demand for batteries is expected to grow 500% by 2030. While there are some exploring new battery technologies, for now, making lithium ion batteries requires a lot of earth-bound materials. Lithium mines around the world are opening or expanding, and in the Congo, children as young as six carry sacks of cobalt-laced rocks on their backs. Whether in the U.S. or abroad, the mining industry has a bad humanitarian and environmental track record.

**Aimee Boulanger:** There is not a country in the world with laws sufficient to prevent significant harm where mining happens.

**Ariana Brocious:** That's Aimee Boulanger, Executive Director at the Initiative for Responsible Mining Assurance, who is working to change that. We'll hear more from her later in the episode. Part of this supply challenge could be addressed by reusing materials from batteries that have already been made. That's what JB Straubel, Founder and CEO of Redwood Materials, hopes to accomplish.

**JB Straubel:** The batteries technically they're 99 or more percent reusable. All the lithium, the nickel, the copper, and cobalt, all those critical metals.

**Ariana Brocious:** Straubel is also former Chief Technology Officer and current board member at Tesla. This episode is underwritten by ClimateWorks. Greg Dalton spoke with JB Straubel in front of a live audience at the Commonwealth Club of California, starting with how Straubel became

dedicated to focusing on climate solutions.

**JB Straubel:** Well, probably a passion for the technology in the engineering first. You know, that's kind of what drew me into climate and sustainability. Had a lot of friends in college that were hardcore environmentalists and even activists. I didn't totally understand where they were coming from initially, but I think I've kind of, you know, migrated to really see that side of things. And initially for me it was just a love for the technology and feeling like it was the right way to engineer systems. Where you didn't have sort of some open-ended waste or some, you know, constrained material that would eventually run out. It was very elegant.

**Greg Dalton:** Right. So there's many different pathways. People come through technology or a connection to the earth, or perhaps economic opportunity. So how have you come to realize, like your environmental friends, the urgency that they are feeling or they're conveying.

**JB Straubel:** Well, I think it's a combination of watching some of the effects you know, basically the commutative effects of what we're doing. Seeing the trajectory and how difficult it is to actually change some of these industrial systems to me that really resonates. And brings a sense of urgency to this whole problem which is we can't just sort of wake up one day and flip a switch and decide, oh, okay, yeah, we really should stop burning fossil fuels let's do that today. It's a very pervasive very challenging problem. And it touches so many parts of our lives that we need to prepare and really engineer toward a solution way, way ahead of time.

**Greg Dalton:** Right. And without that scientific urgency business will go at the rate that's comfortable for business which is not fast enough. Tesla's first production model the Roadster used about 6800 batteries essentially laptop battery strung together.

**JB Straubel:** 6831, actually.

**Greg Dalton:** 6831. My producer wrote that I rounded it up. Looking back now, how crazy does that sound?

**JB Straubel:** I mean in hindsight it was --

**Greg Dalton:** Or genius maybe.

**JB Straubel:** Well, I don't know about genius. Many people said it was nuts at the time. You know these were laptop batteries basically way back then. They were slightly tuned and improved laptop batteries, but stringing together thousands of those at the time when laptops were catching fire in airports and causing other problems. Many people were skeptical and they had some data to be skeptical. But in the end, it turned out to be a really quite robust solution. And as far as I know there's never been a Roadster fire in the entire history of that small fleet of cars anyway.

**Greg Dalton:** Right. and there's kind of an interesting narrative of how people talked about the company, particularly people in the industry. So tell us about how the auto incumbents, the giants kind of shifted their narrative of Tesla from the Roadster days to today.

**JB Straubel:** It was fascinating to watch. You know was kind of the innovator's dilemma played out, I mean in live feed. In the beginning we were completely dismissed almost mocked if there was any opinion whatsoever, was impractical it was unsafe. It would never work. I was amazed at how many people thought we were outright lying about, you know, we'd say okay it's gonna go 200 and some miles 250 miles. And they'd say, ah, that's a lie. I'm like well no, it's not. We've engineered it it's going to do it we'll build it and show it. But that was interesting in the very beginning. It was kind of kind of mockery dismissal, and that evolved over time. But there was always the sense of --

**Greg Dalton:** Then came the Model S and you were like, oh, like a rich boy's plaything.

**JB Straubel:** Yup, I mean that, certainly the Model S was 10 times the volume or more. One MotorTrend car of the year, you know, this impeccable safety record had obvious data really supporting it. But still there were a lot of reasons why that couldn't change the industry. Doesn't have enough range or what about charging or what about, XYZ. It was kind of a lesson really how powerful momentum and even maybe denial could be for whole industries that had so much going in their direction.

**Greg Dalton:** And what I remember is like yeah but you can't scale. It's one thing to make 50,000 cars a year which is not that long about to what Tesla was making. But making 500,000 that's a whole different game. We've been doing this for 100 years. We know how to scale manufacturing. And Tesla had some challenges.

**JB Straubel:** Yeah, they were almost right.

**Greg Dalton:** Right. A couple near-death experiences there

**JB Straubel:** Well, I mean truly scale is enormously difficult. That is another I think underappreciated challenge. If I can zoom out on the history of Tesla, you know, getting the technology right was a relatively small percent of the problem. It took a small team and a small amount of resources and then getting scale correct and doing that profitably enormously difficult. Took a thousand times more resources and people.

**Greg Dalton:** And did you think that the GMs and Toyotas of the world would respond faster would change faster to what you were doing?

**JB Straubel:** Oh, absolutely. We were almost maybe idealistic internally and we kind of, oh, okay, we've really shown them now. And this car, you know, will move the whole industry and look at this and then it would be kind of frustrating when we see the reality that no one would change. And everything would kind of, you know, continue on the same way more or less and it's only been quite recently. I think due to customer pressure and economic pressure that a lot of the OEMs have truly and generally started shifting and changing.

**Greg Dalton:** So what change do they get scared I mean you're clearly taking away market share from BMW, Mercedes, these premium luxury brands. And now you're moving into the Model Y is what, almost the most best-selling car in a lot of places that's like there's a new Toyota Camry, the utilitarian affordable vehicle for the masses.

**JB Straubel:** It's an incredible vehicle. As you said, best-selling in many different countries and regions. So I think the data on what customers are choosing the fact that that's lasting year on year and growing and not some fad, it's lasting through high prices of oil and low prices of oil. That's I think what's finally shifting is really customer voice and the customers demanding this of other brands that they may be are loyal to.

**Greg Dalton:** Bloomberg has written about the tipping point. Now we're seeing, you know, what 20% or so of new car sales in California approaching and companies saying they're gonna stop selling gasoline cars pretty soon 2035. There's no way that happens without well Tesla. And as a CTO for 15 years you were instrumental in everything from the Roadster, 6830 batteries to other things. I think this is achieved, the speed and scale that is often talked about by investor John Doerr and others to address the climate emergency, we need things at speed and scale. And few companies and honestly few individuals have achieved speed and scale like you and Tesla. So what lessons do

you learn from that?

**JB Straubel:** Well, it was definitely difficult. You know that was more difficult to do both those things than we would've assumed in the beginning. But to make an impact on sustainability on global climate you need scale. Ideas and startup ideas are relatively more common, but we need things that can scale and do it enormously quickly to actually make a dent on the whole problem.

**Greg Dalton:** Yet the brand has also been damaged by politics, the offensive comments of Elon Musk recently. Why did you step down from your position in 2019 and then you recently came back on the board?

**JB Straubel:** Well, I mean I love Tesla. I always have. It had some sort of place in my heart and really will for the rest of my life. I love the team there. I love the mission, the products. It's awesome. Doesn't mean it's an easy place to work, you know, it's challenging. It kind of needs to be to be successful I think. Part of why I decided to leave back in 2019 and it was incredibly difficult personal decision. Probably the most difficult decision businesswise in my life was really reflecting on what I enjoy and what I'm good at. I love being entrepreneur and I love creating and building and being an engineer. Actually, being hands-on and really tinkering and building things. Certainly, that was still possible to some degree at Tesla, but more and more the company needed execution at scale. It needed vehicle deliveries, it needed sales, it needed manufacturing ramp. And there were people that are more passionate about that and frankly much better at it than me. And, you know, that's kind of a difficult thing to admit sometimes when you're in the midst of it, and especially if you kind of like grown in an organization that have a position where maybe you're managing these people or alongside them. Yet kind of have to realize that, you know, wow, these people are they're really passionate about doing the thing that I have to kind of force myself to do because I know it's important. So for me all part of that calculus. I also from a topic point of view, really, I love learning. And I wanted to kind of go into an adjacent supportive, I thought, field where I could do something that would potentially kind of float all the ships and help electrification help sustainability more broadly using kind of what I've seen and what I learned in our struggles and some of our challenges at Tesla.

**Greg Dalton:** Redwood is positioning itself as a battery component manufacturer though it's grabbed a lot of headlines on recycling. And so I want to start there. According to one Stanford professor 95% of lithium ion batteries currently end up in landfill. Why is that and how are you planning to change it?

**JB Straubel:** Yeah, it's pretty amazing. And I think largely that happens because there's no obvious place of where people should take them. If you think about it and you had a lithium-ion battery today where would you take it? Most people don't know. So a lot of people are storing them up. They maybe don't want to throw it in the garbage can. For those people that feel guilty though they'll put it in a box in their garage or in a drawer somewhere.

**Greg Dalton:** I have a box at home that goes back to the Trio, yeah. Because I don't know what to do with them because of the batteries.

**JB Straubel:** So that's an opportunity. All those batteries their materials are still in there. They're still usable as long as they get reprocessed and remanufactured.

**Greg Dalton:** Okay. And a battery is more complicated than a beer bottle or pay for or aluminum so there are more components far more materials. But as new battery chemistries are developed how big a challenge is it for you to separate all these different materials because batteries are changing so quickly.

**JB Straubel:** Well, that's part of I think kind of the technology fun of it all is making sure our ways to recycle and separate all these things can adapt. But we also get this weird looking in history of personal electronics because what is largely being recycled is hopefully what's worn out. So we're getting Trios and blackberries and flip phones, and things like that occasionally. So we have to kind of be relevant and applicable to technologies that were quite old. We still see things like nickel cadmium batteries coming in and even lead acid batteries from huge old devices. The reality of it is a lot more messy than taking a brand-new clean feedstock and then doing something precise to it. And I was used to working in building factories and building automation where we had the parts presented in pristine trays and everything was perfect and even that still a robot would have enormously hard time picking up the part that was in the perfect place brand-new and putting it in the right place on the products and not somehow screwing it up. Here we have a barrel full of damaged effective dirty materials and trying to automate that is a whole different type of challenge.

**Greg Dalton:** Redwood Materials recently announced that after a year-long pilot program. It was able to recover important metals from used batteries at a rate of more than 95%. And last I checked gasoline is 0% recycled.

**JB Straubel:** What's so interesting I think about battery recycling and especially as it relates to EVs is we can imagine this future where you don't need to continually extract and supply some chemical into a whole fleet of cars. The batteries today might be economically 95% but technically they're 99% or more reusable. All the lithium, the nickel, the copper and cobalt all those critical metals. So what goes into that is quite complex. We have to invent ways to neutralize the battery to separate out electrolyte which is somewhat hazardous to make sure they don't catch fire at the wrong time in the process. And then purify and separate each one of these metals from each other. It is a lot harder than notionally taking an old beer can and melting it and then stamping it into a new beer can. You can kind of look at that and very clearly say, oh, it's aluminum it's probably gonna be aluminum in a new shape. But batteries are a kind of a complex mixture of chemistry and chemicals all together.

**Greg Dalton:** So this really is like a dream circular economy. So how does this work? I bought a Nissan Leaf very early EV. It's ranged kind of around 100 miles. It went down 2016 or so. Time to, I actually gave it away to a public radio station, because I didn't know what to do with it. So what would happen to that Nissan Leaf or another used EV. Will you take it back to a dealer? How does the battery get in your hands?

**JB Straubel:** It has a lot of different pathways. We work with auto dismantlers. We work with sometimes consumers directly if that's relevant, we work with service centers that might be associated with an OEM if it's a warranty battery.

**Greg Dalton:** A carmaker.

**JB Straubel:** Carmaker. So it's quite complex. And it's kind of the wild West right now because people haven't really evolved this at scale. we're even having to kind of invent efficient low-cost packaging to be able to get like your old Nissan Leaf battery back from maybe an auto dismantler or wrecking yard where the battery might turn up sort of dead or a scrap and we need to get it from there to a recycling facility. But I'm confident we will electrify everything. That's where we're headed. Every passenger vehicle, every truck boat I think trains it's all going to electrify; it really has to. And once we're in that more steady-state where everything is already been electrified, we don't need to keep mining those materials to make the modern version of the fleet.

**Ariana Brocious:** You're listening to a Climate One conversation about improving the battery supply chain. Please help us get people talking more about climate by giving us a rating or review.

You can do it right now on your device. You can also help by sending a link to this episode to a friend. On our new website you can create and share playlists focused on topics including food, energy, EVs, and more. Coming up, the critical role of batteries in the energy transition,

**JB Straubel:** I don't see how we make the world sustainable without storage. And right now, batteries, lithium ion batteries largely are the scalable economic solution.

**Ariana Brocious::** That's up next, when Climate One continues.

Creating a circular battery production process where the materials from decommissioned batteries are recycled to create new batteries would be the most sustainable way to meet our energy storage needs. But at the moment there simply aren't enough batteries to recycle to meet growing demand. And the recycling process isn't anywhere near the scale it needs to be. So what do we do in the meantime? Let's get back to Greg's conversation with Redwood Materials Founder and CEO JB Straubel.

**JB Straubel:** That's the complexity of this transition as we have to do both things. We have to both support and realize that mining responsibly has to happen or else we won't have a transition to recycle. But we also have to be planning ahead and really keeping an eye toward what is that future look like to be ready to recycle every one of those batteries. The worst thing we could do is go to all this destruction and trouble to mine it refine it build the product and then throw it away. That's the worst pathway.

**Greg Dalton:** So Redwood Materials, your company, is investing three and half billion dollars in a gigantic new South Carolina manufacturing facility that will produce enough battery components to power a million electric cars. What percentage of the raw materials for those million batteries will actually come from recycled batteries and in what timeframe?

**JB Straubel:** Well, we're also building up a large campus in Northern Nevada. So we have sort of two main facilities. Northern Nevada and South Carolina. As part of the materials we make for batteries, the cathode material or the foils that they make up the we'll target between 30 and 50% recycled material. So we blend some mined material along with the material we recycle and refine to go into a new battery. Now there's no reason it has to be blended like that but that's basically the sort of balance that we see is about the maximum rate that we can ramp up the feedstock of recycled material.

**Greg Dalton:** And so I'm thinking about a soda bottle that's like 30% recycled plastic. Will I be able to go to EV and see that like the battery has X percent recycled material. Would that be visible to customers?

**JB Straubel:** There are already some regulations in Europe starting to happen where certain mandates exist around percent recycled content in things like a battery. I don't know if that'll be made visible to the consumer. The batteries generally if it's doing its job right it's pretty out of sight out of mind. It's usually complex. This whole business is the need to get started around basically supply chain traceability and understanding how to really figure out where the materials come from. Was it at the mine that people liked or didn't like or did it route through some country that other people don't like.

**Greg Dalton:** According to the Union of Concerned Scientists, US has only about 7% of the global battery recycling capacity while China has 80%. How can US compete China has such a head start and so much lower labor costs?

**JB Straubel:** China in particular but Asia broadly has been investing in the space for decades. Very strategically there have been consistent incentives and consistent support from the governments in those countries to build these industries. The one thing that we have is we're the consumers. we're buying these cars we're bringing them here we're using them. And that is a really unique advantage. So there's sort of an inherent benefit and economic benefit and industrialization benefit to locally reprocessing these materials once they're in a region. That's I think is really part of the toehold. And it's part of why in Redwood we're focused on linking recycling with the material manufacturing. I think we just attacked material manufacturing we're competing head-to-head with China. It's a brutal battle. I don't think it's the best battle to fight if you're linking recycling materials that are already in the region we have a toehold and a leg up to make this economic and to make it scale.

**Greg Dalton:** So you're combining the recycling and the manufacturing. According to testimony you submitted to the U.S. Senate battery minerals typically travel 50,000 miles from mine to refining to cathode production to sell manufacturing. How do we shorten that supply chain? Things are taken from the Global South they go to China perhaps assembled in Japan Northern Europe come to the US. They move like that's just mind-boggling.

**JB Straubel:** Yeah, it's almost a comical supply chain. If you drew this it would look like a joke. It's like a joke of a supply chain you don't want. partly driven by the geology. These minerals are scattered around in their prevalence. Lithium is super prevalent in South America and nickel and Indonesian region or Russia or parts of Canada. The other problem is the countries that have invested very strategically in refining and converting them like in China and other parts of Asia. So you kind of have a geologic spreading mixed with centralization of refining and manufacturing That's all separated from the consumer. So by the time you have the poor consumer buying an EV in California this atom of lithium or nickel has traveled all the way around the world perhaps several times to really make it into that final product before it even drives a mile. And of course, that all has some impact that has, you know, can be somewhat negative. And it contributes to sort of the energy payback in an electric vehicle. Which is still very positive. I want to make sure that's super clear. But, you know, the reason that an electric vehicle has any concept of energy payback just like a solar panel or a wind turbine or something like that is largely because of the embedded energy it took to mine, refine, move these materials around and make the battery itself.

**Greg Dalton:** So some people are saying we should do more mining in the United States. We have stronger environmental protections. There's controversial in Nevada where you spent a lot of your time important is it to have more mining in the US?

**JB Straubel:** I think personally it would be great if we could do more of it responsibly. I think it's going to be very difficult. We don't have excellent deposits of some of these critical metals. We don't really have excellent broad deposits of nickel or cobalt. There are some it's not zero. But that coupled with just a very complex expensive often times process to develop those mines.

**Greg Dalton:** So there's limits to what we can do here. We're gonna need to have get some of it overseas. This is all moving very quickly. I read about iron-air batteries on the horizon and solid-state batteries. have made progress on this front. I'm not sure Toyota seem to maybe recycling some of its announcements. possible chemistries and how close our solid-state batteries and how could they accelerate the transition we're talking about?

**JB Straubel:** There are a lot of different possible chemical couples to make new batteries, but the process to mature a battery into really make sure it's robust and get it to scale is very, very long. There's a lot of companies that have struggled with this and it's I think surprised even some of the smartest people that I know how long that can take. So, I learn to take new battery announcements with a little bit of a grain of salt. frankly we're also at a bit of a tipping point where coming back at

the beginning of our conversation almost more about scale right now than it is about a slightly better newfangled battery. If I had a choice of an electric vehicle that cost half as much, or one that went twice as far, and it's a no-brainer. One of these would result in dramatically, greater adoption. The other one, eh, moderate impact.

**Greg Dalton:** Right. And I think this is a real trouble in the whole climate conversation. That we're sort of have this pull toward the shiny new thing out there rather than the more known, maybe less sexy thing that we need to do more of right now. I saw a presentation recently on solar power from outer space can beam down without wires. And I'm like, yeah, sounds cool. But what about the solar we have today that is economic. Let's do that.

**JB Straubel:** Which is already the cheapest source of energy, yeah.

**Greg Dalton:** As we're talking about electrified system. We've been talking about electrifying mobility, but also batteries have important applications in homes on the grid. So what advances are you seeing in batteries for stationary applications?

**JB Straubel:** Well, it's vast. I mean energy storage and I think electrochemical batteries are kind of the central technology into many, many sustainability products. And I don't see how we make the world sustainable without storage. And right now, batteries, lithium-ion batteries largely, are the scalable economic solution to that. Doesn't mean it'll be the only one forever. As you said there's new technologies coming. But right now, this is kind of the core technology in grid storage at the utility scale, grid storage at the home scale, electric vehicles. It's quite pervasive when you really look across all these different products. It's part of why the bottleneck in getting enough materials to make those batteries and having access to batteries at all is such a scary bottleneck to me. When I looked at this whole transition I said, geez, that could derail simultaneously a whole bunch of different industries and slow this whole transition down.

**Greg Dalton:** Yeah, we saw that in solar. Solar price has been going down, down, down for decades and then solar ticked up because of the supply constraints. How concerned are you that this country or even your own company will overinvest heavily in a supply chain based on current lithium-ion technology, only to have newer cheaper battery into the market.

**JB Straubel:** I mean that one I'm really not worried about that one. The timeline is so long on some products like a new EV to conceive of it to build a model year to ramp it, lifetime of that product. Even if the battery technology sort of matured and changed of solid-state promises everything it can do it will be wonderful, but it's relevant a product generation or two in the future. So I don't see really any risk right now that overinvesting, in scaling some of these products. From every angle I look at it dramatically underinvesting. And, you know, underinvesting in the supply chain underinvesting in refining infrastructure products. So that's what keeps me up at night. It's not an overinvestment concern.

**Greg Dalton:** Sounds like you're a technologist. You believe in technology. But there's also the other side of JB the human personal side. How do you feel about the broader transition we're making? Are we going fast enough?

**JB Straubel:** As you said, I'm an optimist on the capabilities of what technology can do. I can see a pathway. It's kind of frustrating to both see a pathway that can solve things with known technology. We don't have to invent new physics or chemistry.

**Greg Dalton:** Just use what we have today.



**JB Straubel:** We can do it today. But at the same time, we are not going fast enough. We're absolutely not going fast enough. And I don't think we may be collectively realize how bad it probably will get. There are so much inertia in the system that we're meddling with.

**Greg Dalton:** Or how bad it is 100 million Americans were under heat watches this week.

**JB Straubel:** Yeah. it's part of what lights the urgency for me. Seeing and feeling the fact that this problem is so big it touches every part of our economy. Really, it's not a dramatization to say that. I think it's something we'll be grappling with and changing and working to solve decades. Our kids and our kids are going to be working to solve and transition around this problem.

**Greg Dalton:** There's a handful of people on this planet who've done a lot. And certainly, Tesla has disrupted and changed the whole industry. Not perfect, created a lot of wealth, but certainly Detroit and Tokyo are moving a lot faster. Thanks to you and your work. One of the reasons it is going slow is there is real organized, well-funded opposition. The International Energy Agency, the world's foremost authority in all things energy recently issued a milestone forecast saying it predicts global demand for oil to be burned will peak in just five years. So oil companies are facing a shrinking demand. You and I watched a recent advertisement by an oil company that associates plug-in cars with chains basically enslaved. And that driving a fossil car is liberty and freeing. And this is part of the campaign that really is going more directly at the companies that you're part of Tesla and Redwood saying basically you're enslaving us.

**JB Straubel:** I must take that as a little bit of respect. It's like okay we finally gotten to them a little bit. But unfortunately, it's going to take so long for us to reduce the entire, because really the amount of oil consumption scales with the fleet of cars. Not with the new cars sold. And a lot of times we track our progress on EVs against new cars sold. And we're celebrating 20% which is huge. It's a great milestone. But that's 20% of the new cars going into a pool that takes perhaps 15 years to turn over. So, you know, that's the sort of math around that has a much bigger inertia to it. But anyway, I can't imagine what's more free though than driving an EV powered on solar energy at your own house. I mean to me that's the most free set of products and technology you can possibly have. A cord is linking to your own roof; it's not linking to the Middle East or even a different part of the US.

**Greg Dalton:** UAW negotiations are heating up around job transition to the EV this so-called battery belt. The region with new battery and EV factories in the southeast right to work states are not welcoming to unions. Tesla has been hostile to unions. Where do you and Redwood Materials stand on worker unions?

**JB Straubel:** I mean I think it's important to figure out how we fairly transition. Essentially if you look at this whole movement then it has to happen. We have to transition a whole bunch of people who are working on various fossil fuel products and technologies and minerals. And somehow move all of them, if they're not retiring move them into sustainable industries and sustainable products. So, broadly to me that's sort of probably the most key metric of success is where and when we can do something like that. it's hard to do because their jobs aren't in the same regions or maybe the skill sets are different.

**Greg Dalton:** Very different, yeah.

**JB Straubel:** But I mean that I think is what has to happen for success here. We can't just sort of say okay those jobs all go away and those people won't do anything. But the other problem is we need huge amounts of jobs to do these new things. So we end up spending a lot of time training and recruiting and hiring. And it's a blend of almost vocational training starting even in trade schools

and in community colleges and universities. Because we as a country we don't have enough of the right skills to do some of these things. I would sort of implore students out there right now to really start try and learn little bit more about chemistry, electrical engineering. Some of these sorts of different disciplines that maybe weren't as trendy over the last few years.

**Greg Dalton:** Tesla is battling at least for racism-based lawsuits, including allegations that black workers at the company's Fremont factory are segregated into the hardest, most dangerous and lowest paid jobs in an area of the factory that managers allegedly called the plantation. I recognize that as a board member, you won't comment on ongoing litigation, but generally clean tech companies have less diverse workforces than even fossil fuel companies, old-line auto companies. So as CEO of Redwood Materials what are you doing about equity and inclusion?

**JB Straubel:** Well, I think, you know, basically working to create jobs and to build a company that can grow to me as the first mission. We have to be a sustainable company that can actually provide a sustainable job for someone in the first place. That's what I worry about the majority of my time and then making sure that we are focusing on the sustainability of our overall company. And maybe totally incorrect but I think some of the skewing on this might be that there aren't quite as many manufacturing jobs in some early cleantech companies. We're building a lot of manufacturing very, very hands-on work that has to happen, especially with manufacturing battery components, recycling them. So we're welcoming to any people. In fact, frankly right now the challenge is how do we find enough employees. really a fairly key challenge as we scale this up. And I hear that same refrain from a lot of other leaders who are launching new battery factories or new EV factories.

**Greg Dalton:** You said that you don't think anyone's moving fast enough. How can we move faster?

**JB Straubel:** You know, so much this is driven by consumer choice. It feels both simple and hard. But I really do think that things could move faster if people understood a little bit better how to make truly sustainable choices. That leads to more products that leads to driving behavior of other large companies. So I think we need more investment as I said before in all these different areas, but I'm not sure I have a magic bullet for how to suddenly get more investment. I can see that it's needed but that itself is a slow process.

**Greg Dalton:** Yeah, we're all clinging to the things that we know and kind of the things that got us to where we are. How optimistic are you that technology can make the change and what are the kind of changes do you think we need?

**JB Straubel:** Well, I'm incredibly optimistic about what the technology can do. I'm pessimistic about the speed.

**Greg Dalton:** You're pessimistic about the human part of it?

**JB Straubel:** Well, it's a good question. I think yeah maybe I guess that is one of the complexities. It's the human preferences and choices and all the complexity of changing behavior. As we talked about earlier, this transition will move a lot of wealth from company to another. It moves jobs from one region to another as political impacts it has government impacts. So any time that there is something that some technical shift that affects people in such, you know, personal, visceral ways, it's a very complex thing to affect. So I guess I am a little bit concerned about how fast all those human complexities can sort of work themselves through.

**Greg Dalton:** Yeah. There's lots of systems we need to change. The economy, water, food, the system between our years is one of the most challenging systems to address. Thank you, JB for joining us on Climate One and sharing your insight and stories. And really one of like true climate

heroes for your passion for all that you've disrupted and done.

**Ariana Brocious:** This is Climate One. Coming up, as battery demand grows, how can mining be done more responsibly?

**Aimee Boulanger:** We don't need 20 years of research and technology to get at best practice mining. This is not nuclear fusion. We absolutely know already how to do mining with less harm.

**Ariana Brocious:** That's up next, when Climate One continues.

This is Climate One. I'm Ariana Brocious.

As the demand for batteries continues to grow, mining for the raw materials to make them will be a necessity. Industrial mining has had a troubled history with humanitarian and environmental abuses. Existing oversight and standards are insufficient and vary widely country by country. But Aimee Boulanger, Executive Director at the Initiative for Responsible Mining Assurance, wants to change that.

**Aimee Boulanger:** Well I understand the skepticism people have around this. Industrial scale mining is inherently destructive on a landscape. It leaves the impacts that last not just decades, but centuries. It's why we never use the word sustainable, because unless we are doing a lot better recycling and circular economy, it's not sustainable. But we are in industrialized societies using these materials every day. And so we are complicit in that use and we're talking about using it a lot more for energy transition, for wind turbines and solar panels and electric vehicles. And so if that's gonna happen, we're gonna need to talk about how do we access those materials in a fundamentally more responsible way.

**Ariana Brocious:** One interesting aspect of your organization is that it has representatives from both industry and environmental advocacy groups, and you've described these as having sort of six houses of bosses. So how do you listen to what each member or organization wants?

**Aimee Boulanger:** So IRMA is governed by these six houses, and they agreed to sit at the table to find value together in a system, while also inherently saying they see value in different ways. But the opportunity moment is that those differences can be complimentary to each other. So you've got mining companies, who are being asked to do something very difficult, which is provide materials that people use every day out of the earth, like broken out of the earth. It's really difficult to get these materials and they're frequently in tiny quantities locked in rock, and a lot of the sector knows how to do that in ways that, reduce harm, but the market hasn't really created value for that, and our laws haven't created value for that. So it's about then how do their customers who buy mind materials, which is another house in IRMA, or how do their investors, which is another house in IRMA, lean in to create value for that and how those, customers and investors are moved by nonprofit, environmental and social justice groups, or the communities who are most affected, or indigenous rights holders, sort of using those tensions between them to leverage a market for these materials that cares more about protecting the earth than the people who live on it.

**Ariana Brocious:** Well, so speaking to that power of the purchaser, seven car companies are members of your organization B M W, Mercedes Ford, gm, Tesla, Rivian, and Volkswagen. Those are some of the largest companies and we know that a lot of those are really actively committed to transitioning to EVs. So how much power do they have in determining where the materials come from that go into the cars that they make?

**Aimee Boulanger:** It's really difficult to trace back up a supply chain to where the raw materials

come from, and until recently it really wasn't happening. You had. Companies like car makers, who were buying bolts, who were buying sheet metal. They weren't buying raw material from a mining company. And in many cases they wouldn't know the mining companies who were providing the raw material that went into the bolts or the sheet metal they bought. But increasingly they've grown aware that some of the greatest harm and the risks in their supply chain are back at that mine level. And Leveraging their influence there to, expect better performance, to expect more honesty and transparency in the impacts there, and then increasingly they are leaning in, to create value for best practices and for reduced harm.

**Ariana Brocious:** And when we talked before this interview, you mentioned just the simple quantity that car makers purchase and use as opposed to other kinds of precious metal users like electronics or jewelry. Can you explain just like the scale we're talking about there?

**Aimee Boulanger:** So in IRMA's earliest years, the leading companies who were purchasing mined material who got engaged were in the jewelry sector first. they really saw that there's a disconnect between trying to craft something beautiful and something that was gonna stand for love and long-term commitment if those materials that go into that ring, that necklace are inherently tied to harm. And so they really led in this space of saying we're going to drive our suppliers, to meet our values and to reduce harm at the mine level. and then you had the electronic sector coming in, particularly when increasing attention was going to the Democratic Republic of the Congo and cobalt mining there and harm there, but also tin in Indonesia, but they also make small things, you know, the electronics we carry in our hand so to have the car makers come in and say, We also want to leverage improved practices. That completely changed the conversation because of the volume of what car makers buy. They just buy so much more. It was a really important signal to the mining industry over the last couple of years that their customer base cares about these issues and is interested to lean in and provide support to them to do better.

**Ariana Brocious:** So speaking of the Democratic Republic of Congo, there are an estimated 45,000 children involved in cobalt mining, which is just a really horrible thing to think about. What would be the best way to end that practice?

**Aimee Boulanger:** Well, that's really complicated question because, in the mining sector, There, first of all are, are two different kinds of ways and gross generalization that mining happens. There's mining that's done by mining companies who tend to be large corporations. And then there's also what's called artisanal scale mining, which might be an individual or a family or a small cooperative with pick and shovel, and there are challenges in both spaces and there's need for work in both spaces to improve practices, but it needs really different strategies. Where you see child labor most often is not in the mining company, although it can happen. And in that case, we have requirements in our standard for how you monitor that and how you look for young workers because any place where, Where income security is a huge risk, where you've got poverty, you're gonna have people incentivizing for younger and younger people to come in and help support their families. But those companies have an easier way to look at papers, to look at age, and, oversight. But at the artisanal scale site, where you might have a family trying to basically do the subsistence farming version of mining where they're out with a pick and shovel, You may have their children along with them simply because they don't wanna leave them home or alone. So you've got kids there, you've got people hand digging tunnels and things like that. They may be the smallest human that's there. So if you're trying to get into a tight spot, you've got children who may be lower down into holes and things because they're smaller to get into tight spaces. So really, I mean, how you eradicate child labor in these spaces is really about. What kind of formalization do you have at the artisanal scale side? Like what kinds of support do you have for those people to have training, to have incentives for their kids to be in school, for their kids to be safe? Because while the large scale mining companies provide the greatest volume and majority of the flow of our mine materials, the greatest number of

jobs actually is over on the artisanal scale side. So people are going to keep doing this. The question is, what support do they have for their children to be in safe places? And what kind of benefit sharing might be going on between a mining company where there is one, and the government and individual pick and shovel miners like that.

**Ariana Brocious:** So let's get back to the work of IRMA, the Initiative for Responsible Mining Assurance, and to give an example of how members get audited, can you tell us about the audit that Albemarle's Lithium Mine in Chile's. Salar de Atacama recently went through?

**Aimee Boulanger:** Yeah. So, in the case of Albemarle and Chile, First of all, they're the third, company to release an IRMA audit report. So while our work building the IRMA standard for responsible mining and the rules for how it's measured started 16 years ago, it's taken much of that time just to get to agreements on that, what is the shared definition of what is responsible mining and what's a trusted way to measure that? So Albemarle was willing to step into that. and in part because the materials they're providing go directly to energy transition. One of the first things that meant for them is that the whole process is going to be transparent. So that means this is not secret. Most audits are secret, they end up being between like an end brand that we buy our stuff from and their suppliers secretly looking at who is the supplier, what impacts, how can I help them do better? But in this case, we say in order to have truthful information that's gonna be meaningful and trusted, the world needs to be able to participate in this process from the beginning. So Albemarle stepped into that. So they knew, we say to the world, hello world. This lithium extraction operation in Chile is beginning. an IRMA audit. If you would like to comment in any way you can. Here is the emails to the auditors or the WhatsApp for those who aren't, using email and on with easy wifi connection. And they can comment on anything. They can comment about is the company responsive to our concerns? What about noise? What about the impacts to flamingos in the region, or the fact that the Atacama is one of the driest places on earth? How do they respond to indigenous rights holders who are in this region who are concerned with extraction and its impact on cultural heritage and the long-term economy after lithium extraction. So, any are welcome to participate in that process. Auditors are then looking at how the company performs over 400 different requirements. So, and they're looking at that from their desks. They're pouring through documents the company has uploaded and turned over to those auditors. But then they go on site and they're on site for several days. It might be a team of four to six auditors who walk the ground, who will talk to indigenous rights holders, who will talk to workers, who will talk to community members willing to speak, and the company. Then they're using that information to basically triangulate what are the stories here, what can we tell that's really going on. And then the audit report that comes out from that is more than a hundred pages long detailing both what the company achieves, but also what they don't achieve. So you can very much see against the IRMA standards best practice definition, how they have their strengths and also where their challenges are. But even as I say that, this is early days, and so if you're an auditor working against the IRMA system and you go out to rural indigenous communities in Chile and say, we wanna get your perspective, we work for IRMA, of course they're gonna go IRMA, who? like, this is not anything I know about. Why would I think I should talk to you? Why would I think I'm safe to talk to you? What's gonna happen with this information? Is there gonna be some kind of repercussion on me for talking? So we know that these first audit reports may not yet have robust community involvement. And we have to be honest, contextualizing that and hope that we build the trust of local communities and nonprofit groups to feel safe. And same of course for workers as well to feel safe that they can participate and offer honest perspectives. And we count on the companies being audited to help us reassure people in their region of the same.

**Ariana Brocious:** And I noticed that looking in the list of participating companies, I didn't see any US or Canadian companies and I wanted to check that that's true and ask why that might be that those companies aren't yet members of IRMA. So

**Aimee Boulanger:** So there are both US and Canadian companies who are confidentially involved using the IRMA self-assessment tool and preparing for independent audit. but. It's a fair question to ask why are US and Canadian companies slower in, and I think some of it is because there has been a perception by some, like maybe we don't need to do this IRMA audit and review because we operate in the US and Canada. So people are probably pretty confident we don't have child labor or gross human rights abuses and that probably our workers are safe and we must be following the Clean Water Act or the Clean Air Act if you're here in the US. In fact, the US has seen a hundred years of impacts from industrial scale extraction. The US Environmental Protection Agency estimates that nearly half of Western watersheds are impacted with mine waste and the pollution that comes from that. and heavy metals that are in our waterways. and even recent mines have had bankruptcies and left impacts for us taxpayers to pick up. And contamination, which continues to flow onto indigenous lands, places like Nevada and Montana, California and otherwise. And so we know we still need to strengthen our laws right here In the US we have the 1872 Mining law, which just like its name says, goes back to 1872. It just infamously celebrated its hundred 50th birthday. It was passed at a time when mining was done with a pick and shovel. It was passed with a set of philosophies of 1872 and European-descended leadership at that time, which was to extract more materials, move more white settlers west, and to, better, control what they saw as a problem with indigenous people in the west and to increase the power of white settlers over Indigenous people. And so the 1872 mining law is outdated for the values of America today. The values of diversity, the values of cultural heritage, the values of protecting our water, um, and the multiple uses of public lands, after a mining company leaves Industrial extraction is a temporary set of jobs. And we wanna know that after those materials come out, can that land be restored in some way to provide economy and wellbeing to the communities who live near?

**Ariana Brocious:** Yeah. And I wanna spend just another minute on this cuz I think it's important and there have been efforts to update the 1872 mining law that have not happened yet, and though the US is often maybe seen as a safer place, a better place to do some of this mining. As you mentioned, there are innumerable impacts that we've seen, including one listeners might recall hearing about in the news, which was the Gold King mine spill in 2015, where 3 million gallons of contaminated mine runoff poured out of a mine that was in the progress of being cleaned up by the EPA, and it turned the Animus river in Colorado bright orange for a while. environmentalists hoped that would spur more effort to continue these reforms and I don't think we've seen significant reforms. So what kind of pressure can be brought here in the US to improve the laws we have on the books?

**Aimee Boulanger:** Well, I think first of all, people have to understand what mining is. I mean, most people really don't know where their stuff comes from if it's mined. They don't know both the countries that it comes from, the process that it comes from. To care about changing the laws, they have to see themselves as connected to the impacts from that industry and to the people who live around that. And most Americans, even though we live in a large mining country, don't feel connected to it and don't see that. you mentioned the Gold King mine that actually was a historic mine. It's many decades old. It was left behind as a mess without a company left to pick it up. So that's what you had the US Environmental Protection Agency in there doing that cleanup. Because there was no longer a company to clean up after itself And that's part of why the IRMA standard has requirements in there that we're measuring against for reclamation and closure. What's the plan even before the mining company starts mining to return this land into some kind of. constructive, useful, productive, healthy state for whatever kind of economy or biodiversity or human settlement is around it in the future. Because we're left with a legacy of abandoned mines across the United States and across the world right now that weren't cleaned up.

**Ariana Brocious:** 79% of extractable lithium in the US is within 35 miles of Indigenous

reservations. The Ninth Circuit Court just denied a bid by tribes to block a new lithium mine at Thacker Pass in Nevada. Do you think there's enough industry oversight to ensure that Indigenous people won't once again bear the burden of consequences of this kind of industrial action?

**Aimee Boulanger:** There is not enough oversight to ensure that Indigenous people won't bear the burden of extraction. There is not a country in the world with laws sufficient to prevent significant harm where mining happens. And you have Indigenous communities who are saying, We are being asked to provide our lands and the resources under them to address the climate crisis. We are not ignorant of the climate crisis, but this still looks like the same white guy with the same briefcase and the same shovel who arrived here a hundred years ago looking for gold and now says, I'm looking for lithium, or I'm looking for nickel, or I'm looking for cobalt, and I'm doing so in the name of protecting the planet from a climate crisis. It sure seems like this is what brought us the climate crisis in the first place. So it is a difficult sell to these communities and it's a particularly difficult sell when we don't have a lot of existing mines that we can show have not harmed water, that their communities are happy to have them as a neighbor. But it doesn't have to be that way. We don't need 20 years of research and technology to get at best practice mining. This is not nuclear fusion. We absolutely know already how to do mining with less harm, and there are a set of companies who are stepping into that space right now, but they haven't had markets that valued it that much. There was a lot of pressure for least cost production of materials that could be sold at the lowest cost. I feel like part of my work is to write a permission slip through markets to lean in and give reward to those geologists and economists working in those companies who already know how to do it better, and who often live in these communities where extraction is happening themselves and who are ready to go and we need to create a set of values that support them to do it better.

**Ariana Brocious:** What do you think of the idea of sacrifice zones, where those in power agree that, you know, this particular place we can allow destruction to happen here in the, for sort of the greater benefit?

**Aimee Boulanger:** I think there's a lot of talk about sacrifice zones right now. I mean, I think one hard thing is when it comes to mining, minerals are in the ground where they are. So first of all, you're not gonna just go choose a sacrifice zone. You're not gonna say, okay, over here, no one's living here. So this is a convenient place. I mean, I could do that, you know, with a different kind of manufacturing plant, for example, I'm gonna place this away from human society, or I'm gonna place this in the least biodiverse place. Minerals are in the ground where they are. and I haven't heard too many people who live around those places saying, I'm raising my hand to be a willing participant in a sacrifice zone. in addition, while our soaring temperatures and changing precipitation and floods and fires of climate change are a global experience for us all, so is this tremendous risk moment for biodiversity. we've got, you know, habitats under great stress. We have watersheds that aren't our drinking water right now, but they might be our drinking water in 10 years or 20 years as the planet continues to change, we have watersheds that span hundreds if not thousands of miles or kilometers across countries where we need that clean water for agriculture in the future as well. So while I agree we don't have time to waste in addressing the climate crisis, and we must move off of fossil fuels saying we will just extract lithium, cobalt and nickel with the same disdain and with the same carelessness that we extracted oil and gas is not a path you take when your planet is already living through the climate crisis right now, especially since we have the technology to do it better. Writing permission slips to say we'll just waive permit requirements and we'll say it can be weaker water laws and a planet that's already struggling right now doesn't add up to a solution that is really a solution. We may be trading one problem off of another, which is still global in nature.

**Ariana Brocious:** You mentioned that, it took 16 years to get to the point now where these companies are submitting themselves to some voluntary audits and beginning to do reviews of the practices under IRMA's standards. What is your projected timeline, if you have one, for when we

might see, you know, a significant number of these companies participating in the process and having sort of that tipping point moment where really we begin to see a big shift?

**Aimee Boulanger:** We are definitely in the middle of a tipping point moment right now. I mean if you and I spoke three years ago, the IRMA standard wasn't really known. It was very much driven by jewelry based materials. The early attention that came to issues like blood diamonds and jewelry really had stayed just around gold and diamonds. And climate change and Covid arriving at the same time in the sense of a global crisis, which was then a sense of a need of global action and that future plans should have resilience, future plans, should have environmental health, and social wellbeing at their core mean that all of a sudden the attention was right onto well, what is gonna happen with wind and solar and electric vehicles? How are we gonna power ourselves in a different way? So while the first 15 independent audits are happening in IRMA right now, there are more than 70 companies with more than 95 mine sites who have already registered in and started their self-assessments are coming over and they are looking at the first mines coming out saying, okay, what happens when you're honest? What happens when you say, out of a potential a hundred points in the water chapter or the waste chapter, human rights, what happens if you only get 35% against the best practice measure, or 41% there, or 18% there. How does the world react? Can we tolerate hearing the truth about how we've allowed existing practices to do harm now, but how we want to create incentive to reduce that harm? Because the truth is, existing mines right now are the places where we've got existing jobs and we have existing impacts. so while we might be able to create a set of better mines that are better designed and constructed in the future, and we will, because we're gonna need those materials, It will be less harm as well to take those existing mines and really invest in getting efficiency out of those, getting more materials out of those ones, keeping jobs there where they are and ensuring those communities who've already hosted the mining industry for the last a hundred years feel that they get some kind of benefit sharing and it's not a resource curse, that there really is some kind of shared value for them and investment in their future. And when that reclamation finally does need to be done there, that it happens and it's not just move on to the next site, which will be done better than we did 30 years ago.

**Ariana Brocious:** Last June, Nauru, the smallest island nation in the world, invoked a legal provision that forces the hand of regulators to finalize rules for deep sea mining. But the International Seabed Authority missed its July 9th deadline to finalize the mining code. Could you give us an update on where that stands and where you stand on deep sea mining?

**Aimee Boulanger:** The initiative for Responsible Mining Assurance does not currently allow its standard to be used to measure how responsible would a deep sea mining operation be. Foremost, that's because it was not written with the sea in mind when it was constructed some 15 years ago it was written thinking about mining on land. And it is a completely different context when you take this to the sea and miles down into the ocean. If deep sea mining is going to happen on a commercial scale, it absolutely needs something like IRMA, because existing laws and structure to protect the oceans are not sufficient on their own right now, the same way they're not sufficient on land. But at this moment right now, what we do know about the ocean and the seas, as we know, they're under tremendous stress. We know they are suffering from increasing temperatures from ocean acidification, from increasing pressures of different commercial and military uses of the ocean. And it's its own carbon sink for us, it's its own biodiversity. and this is a space where we don't know what we don't know there right now. We know it's fragile, but we don't know how this industry is going to impact that. We also do hear the case that if we are taking some of these nodules off the sea floor in some way, well it will do less harm and have fewer human rights abuses than if we take them from the Congo or we take them from the Atacama. But I haven't heard any companies operating in the Congo or the Atacama agreeing that if deep sea mining goes forward, they'll opt out and stop mining on land. It will be most like a both and obviously it will force those on land to have to compete at a



different level. But I think we'll see more. And I think until we feel some confidence that we've got assurance of best practices in place, I think we better walk pretty soberly into our oceans under stress.

**Ariana Brocious:** We recently had Ian Urbana, founder of the Outlaw Ocean Project on Climate One, and he spoke about the difficulty of enforcing environmental laws on the high seas, How difficult do you think it would be even if there were a set of agreed upon practices to enforce those for deep sea mining?

**Aimee Boulanger:** At this moment right now, it's difficult to enforce best practices no matter where in the world we're talking about mining. What I'm doing with IRMA will never replace the critical role of laws and government enforcing those laws and holding accountability because I don't have that authority. and when you don't have that authority, it offers an awful lot of latitude for people to just opt out when they don't like it, or when the market signals to them they just don't need to do as much, and we need to send really clear signals right now. The market expects that if you're providing materials that are supposed to be part of the climate solution, they better not be adding to the problem.

**Ariana Brocious:** As we wrap up here, are there any examples of countries or companies that are moving in the right direction when it comes to mining?

**Aimee Boulanger:** Oh, there's some great examples of things going well right now. First of all, we don't need 20 years of new research for best practice mining. We've got companies who already know how to do it. We have companies who are being open. That alone is a best practice that is underrated, who are being open about how hard it is to get these materials out and what the impacts are. So transparency itself is a best practice. And then that offers space for innovation to come up with new ways to reduce harm. There are companies who are providing resources to community-based environmental groups to then hire their own scientists to review water quality data, air quality data, to negotiate with a mining company. That is a wonderful construct. It's happening right here in the US right now. It's not a company buying off a community. It's a company investing in basically a watchdog group who has their own independent rights to use those resources to be able to operate on a more level playing field by hiring their own PhD hydrologists to look at the water data and to press companies to do better. And in the places where we've seen companies do that, we have some of the better operating mines, of any in the world.

**Ariana Brocious:** Well, that's very encouraging to hear. Aimee Boulanger is Executive Director of the Initiative for Responsible Mining Assurance. Aimee, thank you so much for joining us on Climate One.

**Aimee Boulanger:** Thanks so much for having me.

**Ariana Brocious:** On this Climate One... We've been talking about building a better battery supply chain.

Climate One's empowering conversations connect all aspects of the climate emergency. To hear more, subscribe wherever you get your pods. Talking about climate can be hard-- AND it's critical to address the transitions we need to make in all parts of society. Please help us get people talking more about climate by giving us a rating or review. You can do it right now on your device. You can also help by sending a link to this episode to a friend. On our new website you can create and share playlists focused on topics including food, energy, EVs, activism. By sharing you can help people have their own deeper climate conversations.

Brad Marshland is our senior producer; Our managing director is Jenny Park. Austin Colón is producer and editor. Megan Bisciegliia is our production manager. Wency Shaida is our development manager, Ben Testani is our communications manager. Our theme music was composed by George Young and arranged by Matt Willcox. Gloria Duffy is CEO of The Commonwealth Club of California, the nonprofit and nonpartisan forum where our program originates. I'm Ariana Brocious.