

# Make Me Smart October 12, 2021 transcript

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**Kai Ryssdal:** Do that thing you do so well. And a nice lip smack to start the podcast. Hey everybody, I'm Kai Ryssdal, welcome back to Make Me Smart. None of us is as smart as all of us. That's what we say around here.

**Molly Wood:** I'm Molly Wood. That is especially true on Tuesdays when we bring in some help. It is time for our weekly deep dive into a single topic. Today, at long last, we're going to talk about my favorite most boring topic in the world: batteries. This isn't actually even my fault. Like, yes, it is true, I'm doing a whole podcast about batteries, How We Survive, go check it out. Lithium batteries in particular, lithium mining in particular, you should listen to it. But even Kai has been wanting to talk about this topic, long-term energy battery storage, the way that we will power large parts of our economy, not just transportation, and move to a big energy transition with batteries at the heart of it.

**Kai Ryssdal:** Because the wind don't blow all the time. The sun don't shine all the time. So we got to have a way to store the energy. That's the name of the game, how we're going to transition away from fossil fuels we need for homes, for cars, for cities, the whole grid. So how are we going to do that? And also technology, by the way, because it's a, in a lot of ways, in fact, in all ways, it's a technology problem. So Dan Kammen is a professor of energy up at the University of California, Berkeley, also an advisor for innovative energy solutions at the USAID. Dan, thanks for coming on.

**Dan Kammen:** Oh, thank you for having me.

**Kai Ryssdal:** Could you give me just the quick once over on, on why batteries are so critical beyond me being flippant and saying the sun don't shine all the time?

**Dan Kammen:** Well, I think the batteries have really been called the glue of the clean energy economy. Because just like you said, the wind doesn't always blow, the sun doesn't always shine. And we're really moving into a world where we're managing intermittent sources. That's the, kind of the basis of many of the renewables, not all of them, but many. And so we need to have not only enough storage for the few minutes or the few hours between uses, but we need to be able to provide that super high reliability storage for hours, days, weeks and seasons. And that's really why batteries have become the core. So while Molly says they may be a little bit boring, I actually think it's the most exciting part of the story.

**Molly Wood:** I do too! I just meant I had to do a little bit of convincing of some other people. But it is so fascinating. And we should give people a sense, before we kind of dive into the tech, we should give people a sense of the kind of sheer amount of batteries that we're talking about, right? I mean, I visited one battery facility that was an entire, let's say, Walmart sized room with wall to wall batteries. And that only represented about an hour of total energy output for a local utility.

**Dan Kammen:** Well, you must have had a pretty big, big utility because a Walmart sized store can really give a lot of storage. So you're right, they come in different sizes, and they have become the big kind of core facilities. In California alone, we have several former power plants that have been converted to bank after bank of batteries. And they play into the market just like any other kind of merchant provider of power.

**Kai Ryssdal:** Well say, say more about that, right? Give me, yeah, give us a better sense of scale, right.

**Dan Kammen:** So one of the big power plants in Northern California at the Moss landing power plant, had the big classic smokestacks, the whole deal. It has now been converted to be a single facility, it's going to be, at the end, 1.6 gigawatts, or 10 to the nine watt hours of storage. And that's being configured with mainly our current battery technology, lithium ion, and so that facility gives in total, if it was all running at once, a good four or five hours, but of course, you only need to do that when it has to run full out and if you can hold some of the batteries back and bring them on later, you can run kind of much of the day, but that's just lithium ion, which is our current go to technology. And I think what's most exciting is there's now so many different types of energy storage emerging, there's lithium ion, but there's also other chemical types of batteries. And then there are flow batteries. It's a liquid battery that can give you much longer periods of storage. And then there's mechanical storage, you can pump things uphill, we're used to pumping water uphill. But you can pump rock uphill, there are companies that move concrete blocks up on scaffolds. And so probably for me, the most exciting thing as a physicist about energy storage is that it comes in so many flavors, that there's so many companies and technologies that can compete, that it's got good bones, good fundamentals, to really become that ubiquitous, different scale part of our energy system.

**Kai Ryssdal:** It's so funny to hear you talk about raising up blocks of concrete on the scaffolding because that sounds, honestly it sounds like something out of the Flintstones, except that here we are in the 21st century trying to get everything smaller and faster and more powerful.

**Dan Kammen:** I mean, that's what I thought too. This company came to visit me a while back. And they looked at me and said, so Dan, I see you guys in California live in a drought state. So tell me why you like to do pumped hydro, or pumping water uphill. And I said, well, that's because we're used to it, and he said, well, you know, you have more rocks than water. Why don't you pump rock uphill? And that's become a commercial sector in Switzerland and California, in New Zealand, you can pump other things and use the energy, and get the energy

by bringing them back down. And it makes perfect sense. And of course, one nice thing about pumping stuff uphill is they can last a long time.

**Molly Wood:** Yeah, let's talk a little bit, I do want to talk to you more about this, the sort of future energy storage technologies and how far out they are. And then in the interim, tell us about what we do have now and what the, you know, impediments are to rolling out these huge battery facilities, these big huge power walls, putting batteries on everybody's houses. Like, we keep hearing that this is going to be this big boom, that there are these bottlenecks in lithium and nickel. Like what's your sense of how fast this is all moving, how fast it needs to, and whether this is actually the, you know, only or primary solution?

**Dan Kammen:** Well, it's certainly not moving fast enough. But like I said, batteries have good bones in the sense of the batteries that most of us used to be used to before our electronics were our lead acid batteries in our cars. And then with our cell phones and laptops and other devices, we got into lithium ion batteries. And 10 years ago, it looked really severe, that with the main lithium deposits in China and Bolivia, that we really could run into challenges of the total supply. What we've seen is that now lithium production is going up in the United States and Canada and elsewhere. And so while lithium doesn't do everything we want, it's generally a short term, high voltage supply. It's a good start. And so we're always going to have to worry about this supply in the market because bottlenecks happen, either because production ramps up, we're seeing a bottleneck right now in global shipping after the pandemic. But there's other features too, companies compete, companies try to have the best and latest product. And so one of the things that gives me the most hope just for lithium is that two years ago a discovery was made that we can separate lithium out of seawater. And we can do so more cheaply than any current mining, and the amount of lithium in seawater is huge. So we're not using that commercially yet. But that's the kind of innovative supply solution that comes out of necessity. And lithium isn't the only technology, we have other opportunities. There are air batteries, there are zinc batteries, there's all kinds of different competing technologies. But today we are very much tied to lithium for a lot of our devices. But it's this diversity of opportunities that's gonna, I think, give us the range to supply different types of needs with different devices to really build out storage as the core element of our clean energy network, economy.

**Kai Ryssdal:** You talked about companies competing, so I want to take this a little bit sideways. But I'm sure you've got thoughts and, frankly, experience on this. Do you believe that this can be a market based solution, that is to say that companies in the private sector can get us there by themselves? Or do we need government to, if not lead the way with investment, certainly help things along?

**Dan Kammen:** Well, I certainly think we need government to play a significant role. And the reason why I say that is that the places that have really pushed forward on energy storage as a full competitor in the market have done so in the places in the world where storage has been encouraged. And so in California, we passed our first storage mandate back in 2014, there was an Assembly Bill 2514, that called for a certain amount of storage by 2020. And the utilities in California met that amount. And it corresponded to about 2% of the peak demand in the state.

What's interesting is that facility we mentioned before, the Moss Landing Facility, that one facility opening this year is going to be bigger than that 2% mandate all by itself. So the places that have pushed forward like California and like Germany, and now we're seeing it in New Zealand and we're seeing it in Iceland, and there's talking about some European wide standards, have really had the government not only helping to set the rules in the market but also trying to do what I think has been the hardest part for industry in the past, and that's to do it with any sense of equity. Because normally, when you get fancy new products, they tend to go to the most affluent customers, both businesses and individuals. And if we're really going to move into this 100% clean energy economy that we need to, we have to make sure that not just energy generation but storage is equitable, available to everyone, regardless of income level. And that's a place where the utilities really need to be strongly backstopped by the government to open those markets to make sure they're fair, open, and that low income individuals are not being gouged.

**Molly Wood:** Right. And I think there's a couple things that go into that. First of all, utilities themselves have to be incentivized to make this switch. I mean, in many cases now, wind and solar energy are cheaper than coal and natural gas and oil based energy. But utilities, it's a huge investment for them, let alone whether we can get a battery on every house, right, or a micro grid in every neighborhood.

**Dan Kammen:** It's true. And you start with, I think, the right fundamental, that we've now seen major reports that solar and wind are now the cheapest form of generation, cheaper than any of the fossil fuels. And when you add in storage, it adds, it adds to the price, of course, but it actually allows us to have more reliable systems, ones that at the level of individual homes or mini grids, as you call them, that's community scale projects, or for industrial facilities, that on site or local storage can make them more reliable than we saw in the past. And certainly in California where we've seen fires, we've seen similar episodes in Australia which also has a great deal of solar and a great deal of storage going in, that marriage of clean energy generation and storage at the scale you need it, is really the goal where utilities can do it, manufacturers can do it. But they need to know that the market is going to be there. And that's where both regulation is so important, but also continuing innovation. We need to get more companies involved with more materials and, in particular, more sustainable materials. You know, one of the big challenges of some of the rare earths that are in our cell phones or other devices are they come from conflict areas, and making sure that we can invest in materials that reduce conflict, that produce local employment for some of the most marginalized people, that's what I would call a green and sustainable and just supply chain. And that's really where this process needs to go.

**Kai Ryssdal:** So who has to understand this? And here's why I ask, right, and let me, I'm going to take it a little bit sideways again. Every now and then I do interviews on Marketplace about fashion and style. And one of the things I'm always told is that, you know, haute couture and the stuff that's on the runways, that really filters down and affects what people buy and do in their daily lives when they go to Target or H&M or, or whatever. It seems to me that there is a relevance gap between the work you're doing and the Department of Energy's doing, and these,

these large scale companies are doing, and the fact that my iPhone now won't make it through a day, you know.

**Dan Kammen:** That's a great point. And that's really where you have to, have to do two things at once. And we call it technology push, we need to get better products, longer lifetimes in batteries of our devices, but also demand pull. We need to make sure that developers see clear market opportunities and they can work with utilities. And so one interesting example of this is that the lithium ion battery in your phone has a couple thousand cycles before you can really notice dramatic difference in behavior. But there's other technologies like these flow batteries, for example, that instead of having thousands of cycles, they have millions of cycles. And that's an opportunity to think about technologies, probably not for your cell phone, probably for the stationary batteries that we already see popping up in urban areas, certainly in California and New York State, other parts of the world, where new chemistry, new product materials, allows you to meet those different demands. But to do that, what we need to do is both understand the environmental and the justice aspects of the whole process of mining to use. But we also need to have companies having very clear signals that at the utility and at the regulator level, we are going to be rewarding and demanding the same or better reliability at the clean energy economy than what happened in the fossil economy. That's the place where basically thinking about energy storage as a co equal, it's just like the solar or wind or geothermal generation, it's that same energy but now stored either in battery form, or in what many people think will be the next big partner here. And that's going to be storing energy in the form of hydrogen. You can make hydrogen by disassociating water in electrolysis. And that gives us another form of storage and many of the world's large solar and wind facilities now are saying, well, I can sell electricity when the demand is high. But when demand is low, I will make hydrogen and I will then be able to send that either by pipeline, or by converting it back to electricity down the same power lines. And that allows us to have a more diverse, more robust economy where storage, again, is that, that connecting ingredient, that special sauce of a clean energy system.

**Kai Ryssdal:** Yeah, sorry, just to take my really pedantic question from earlier one step farther, you know, we look at gas, and it goes into our cars, and you know, sparks, and then the cars go, or we heat oil, and then how's it gonna warm, and we don't even think about it. And what you guys are banking on is that eventually, this thing about disassociating hydrogen, and oh, my god, what is just going to become like gas does forever, like yeah, that's what happens. Turn on the lights.

**Dan Kammen:** Well, actually, hydrogen is in many ways so much easier, and so much safer to manage than gasoline. It's the lightest element. So when you have a leak, it floats away, you can produce it very easily. Right now, we're used to producing it through electrolysis, the splitting of water with electricity, but there's also chemical ways to do it. There are bacteria that also do it. So the idea that you might be making hydrogen at large industrial scale from, for example, large solar fields or big offshore wind farms. But in your home, you might be making hydrogen in very small batches from the waste food or organic materials, or excess solar from your rooftop, or your small businesses' solar panels. All of these can be tied together in the grid of the future, the smart grid, which is really just our current grid but just much more monitoring

and managing of which unit needs power, who can sell it to them? Is it a local supplier, is it further off, and that's really the, the, the linkage that energy storage and renewables have going for it, they're easy to link together in, in the networks of power that's our grid.

**Molly Wood:** To sort of back up the supply chain even a little bit further, you know, we're now seeing encouragement from the US to build out a battery supply chain here, a domestic lithium supply. And also though, to power this manufacturing of batteries, and or this production of hydrogen, right, in an actual green way. Talk to me about, you know, like, does it matter if we transition to renewable energy stored in batteries and hydrogen and other forms if the way that we get the batteries and hydrogen still burns tons and tons of carbon?

**Dan Kammen:** Right. Well, it definitely matters a lot. President Biden has committed the US to a decarbonized energy sector by 2035. And that's really lit a fire, I guess I shouldn't use fire anymore as the analogy, that's really turned on a LED light bulb in the heads of many people in the private sector at utilities because they're seeing those linkages between not only a reliable energy system but also a sustainable, a socially and racially and ecologically just supply chain. So people used to talk about so called "blue hydrogen," meaning getting hydrogen from natural gas. But that doesn't solve the problem of the natural gas side. And so a transition to green hydrogen produced from solar and wind power, geothermal power, utilizing sustainable waste materials, organic materials, those are all opportunities to produce hydrogen that doesn't have carbon signature in either the manufacturing of the tools to get it, or in its own production. And that's really the long term goal here. And by tying together this now increasingly low cost clean energy, and I might add increasingly inexpensive batteries. One of the exciting things is that today, batteries are getting cheaper as fast as solar and wind ever did. And today, in 2021 and 2019, over 90% of new power generation anywhere in the world that came online was from renewables. And we're seeing batteries catching up to that and meeting and beating one milestone after another as we get down to very low storage costs, so that solar wind power may ultimately be costing us on the order of a cent per kilowatt hour or less. And energy storage might be adding just a fraction of a cent to that. And that's incredibly cheaper than people were forecasting for fossil fuels. And that's even forgetting about the environmental benefits. And so that linked economy you're talking about where we do the life cycle or cradle to grave analysis, as well as providing high reliable energy, that's really the upside of the clean energy transition, which then also cleans our air so we get environmental and health justice benefits. It's a virtuous cycle that batteries enable at every step of the way.

**Molly Wood:** Daniel Kammen, bringing it home with the not boring topic, professor of energy at the University of California, Berkeley.

**Dan Kammen:** Not boring at all. Thank you.

**Kai Ryssdal:** Thanks, Dan.

**Molly Wood:** Thank you so much, professor. Appreciate it.

**Dan Kammen:** My pleasure.

**Kai Ryssdal:** That's pretty good. That's pretty good.

**Molly Wood:** Every solution has a center. Yeah, it's like the, it's the Tootsie Roll and the center of a Tootsie Pop, batteries.

**Kai Ryssdal:** How many licks does it take to get there? That's a whole different podcast. Um, that was cool. That was cool. I'm glad we did that. I'm glad you gave us the benefit of your knowledge in talking about that. That was awesome. It was good stuff.

**Molly Wood:** I know, this is an oddly hopeful make me smart and I'm delighted right now.

**Kai Ryssdal:** All right. We're gonna take a break. Comments on today's show, anything Molly and I said, anything that Dan said, anybody, you can do it by sending us an email or voice memo. [Makemesmart@marketplace.org](mailto:Makemesmart@marketplace.org).

**Molly Wood:** Yes, you can also call us and leave us a voice message at 508-827-6278, also known as 508-82-SMART, and if you liked this conversation about batteries, add in a whole bunch of like, crazy human drama and adventures in the desert and then you have my new podcast called How We Survive, new episodes every Wednesday.

**Molly Wood:** Alright, we're back and it's time for a quick news fix before we get to your feedback. You got a fun one.

**Kai Ryssdal:** Mine is super quick. It's also yesterday, and I'm sure everybody's heard it. I just, it's, I don't understand how he thinks this is going to work. The governor of Texas, Greg Abbott, imposing COVID ban on COVID-19 vaccine mandates in the great state of Texas, including for private employers. I'm just not sure how this stands up to scrutiny, legal, political, corporate, business, profit motive. I just, I don't, I don't get it. And I just want to say that on the record.

**Molly Wood:** I just, also isn't there federal?

**Kai Ryssdal:** Yeah, well, that's coming, right? I mean, those, those rules are coming out from OSHA, President Biden said, you know, if you got 100 or more, even if you're a private employer, you got to do the vaccine or you got to have testing every week. And we're gonna--obviously it's a we'll see you in court kind of thing. And, and also obviously with Texas, the I'll see you in court kind of thing, given what happened with SBA, the abortion bill, that takes on a whole new level of, of acting in bad faith, but holy cow, Texas is crazy these days, right?

**Molly Wood:** I mean, it's an executive order so you have to wonder how much of it is like performative, you know?

**Kai Ryssdal:** Well, but yeah, but he's, he's also gonna ask the legislature to put it into law.

**Molly Wood:** Yeah, here's the, and here's the, just to pile on to the, I guess, the logical, I mean, inconsistency isn't even quite the right word. It's like what, what are we going for here? Because there was a poll out today, heard about it on Morning Edition by NPR, the Robert Wood Johnson Foundation and Harvard, saying that the Delta surge in particular, which was of course enabled in this country by vaccination rates that are too low, has meant that a huge number of households are facing serious financial problems, like one in 38% of households across the nation, specifically Latino, Black and Native American households, more than 50% had serious financial problems, 29% of white, white households did. We are seeing, you know, the inability of people to return to work because they don't have childcare or financial safety net to get them back to work. We've seen states with, you know, most of the time Republican governors cut expanded insurance benefits in the hopes that it will force people back to work. So you have this sort of simultaneous thing that's like, not employing or even, you know, not mandating or even encouraging, in some cases, the tools that would get the pandemic under control, while also taking away the support that would allow people to ride out the pandemic that is staying out of control because people aren't getting vaccinated or wearing masks. And I don't, I mean, to your larger question, I don't know what the end goal is here, right? Because it appears to be prolonging both a pandemic and the economic suffering and the sort of recessionary forces that the pandemic has created. Like where do, you know, we just had a nice conversation about solutions and this kind of feels like, you know how sometimes you just encounter people who are like I don't want there to be a solution? That's kind of how this feels.

**Kai Ryssdal:** No, I completely agree. And I just don't, I don't know what to do with that and it goes, sorry, just to circle back to yesterday, it goes to your whole thing are we a nation that's willing to do the work.

**Molly Wood:** Right, or are we just sort of engaging in, I guess I don't know, ideological theater?

**Kai Ryssdal:** I think you know.

**Molly Wood:** I mean, I guess I know. But again, like long term it's suicide, that's the part that makes no sense.

**Kai Ryssdal:** Yes, yes it is, it doesn't have to make sense for it to be real.

**Molly Wood:** Well yeah, exactly. And then that gets back to your question which is what do we do, and it's like, I don't know, just keep doing the work. Um, however, relevant germane to today's other topic, I did want to point out in fact a piece from yesterday also that I cut out of the, the Monday roundup because we didn't have time because I spent so much time analyzing the career of one Andrew Yang, that according to research published Monday in the journal Nature climate change, at least 85% of the global population has now experienced weather events made worse by human caused climate change. It is not going to be long before that's 100% and PS we're like on the, on the brink of mass extinction events and that is also a conversation that people don't agree on. I know it's a hopeful show, I'm not trying to bring us back around now, but

there are solutions, there are solutions, there are people doing the work, it's just like you literally have to put your head down, ignore the noise, don't let everybody fighting around you, and keep doing the work.

**Kai Ryssdal:** But the noise is so tasty and distracting and oh my goodness it scratches the back of my throat like flamin Hot Cheetos, you know.

**Molly Wood:** The noise is candy, right? Right. What did we do, we, there was some like, like years ago we were talking about disinformation and how it's candy and we all have like, information diabetes and we need to put it down right.

**Kai Ryssdal:** All right, let us, Lianna, please.

**Kai Ryssdal:** Alright, first up today, Daniel after a recent trip to Southern California. Here's what he sent us.

**Daniel:** Hi, Molly and Kai. I spent last Sunday on the beach at Crystal Cove State Park. It was hot and sunny and the water was cool and refreshing. You really couldn't ask for better beach weather. Later that day, I was saddened to hear that the beach would be closing due to the oil spill reaching its shores. And then the next morning I took a flight from Orange County Airport that flew out over the ocean. And I was able to actually see a trail of oil extending for miles along the shoreline. I'm really saddened by the environmental harm of the spill, it's a good reminder that reducing our dependence on fossil fuels would have a positive impact beyond just global warming. Thank you for all that you do, love the show, bye.

**Kai Ryssdal:** Birds chirping in the background of a really grim message.

**Molly Wood:** Well, thanks for calling in about that, though, because this oil spill, in case you haven't, I mean, we haven't even been able to find space to talk about it. And yet I've been reading about it since it happened, I think last week, mid to last week, that an oil pipeline was damaged in Southern California. And it seems like it's just a terrible spill. That's, you know, that is once again going to take years, years to clean up. That's really heartbreaking.

**Kai Ryssdal:** Okay, JP in Melbourne, Australia wrote in, here's the email. Listening to Friday's show and thinking the USPS US Postal Service should figure out how to offer full service banking at every USPS office. I moved from Montana to Melbourne, Australia five years ago and until the pandemic commuted between Montana and Australia every three weeks, editor's note here, holy cow, that's a long flight to commute. One of the best banking options Australia offers is bank at post. You can go to any AUS post office, that's AUS post and deposit or withdraw from your bank account. Every major bank and most local banks utilize auspost as essentially a branch office. Thanks for making me smart. You helped me get through the past 20 months of lockdown in the most COVID lockdown city in the world. Currently 255 days of lockdown, they write. Yeah, USPS banking and all that jazz. We talked about that a little bit it's, you know, finances decentralizing, post office and everything

**Molly Wood:** Yeah, and the USPS has made like, some noises about this and I think we talked about on the show and and yes, I mean it seems like it would be a really accessible thing for the unbanked and everybody else potentially.

**Kai Ryssdal:** Yeah, alright, you do this one, it's three in a row for me, man.

**Molly Wood:** Now we're gonna leave you with this week's answer to the make me smart question. They know we don't care about what the lineup says to do, we just we just roll with it. This week's answer to the make me smart question which is what is something you thought you knew that you later found out you were wrong about. Today's answer comes from Lisa in Pasadena, California.

**Lisa:** Something that I thought I knew but it turns out I was wrong about is that my electric toothbrush is too loud to use while listening to your show. Turns out it is not too loud. And also turns out that its hum harmonizes beautifully with the closing theme music on a perfect middle C.

**Kai Ryssdal:** Oh my god. Well number one, you can always turn up the volume on this podcast, also we have to get a hold of Daniel Ramirez and Ben Tolliday, speaking of Australia, and ask them if they ended on a perfect middle C on purpose. I don't know.

**Molly Wood:** Hey, totally. Oh my god, I love these answers. I never get tired of these. Don't forget to send us yours. You can call us and leave a voice message, of course, like we said, 508-82-SMART. You can also go to our website, [makemesmart.org](http://makemesmart.org) and submit a comment with an audio message which is so handy dandy, it's basically like you're still on a zoom call at work. We really appreciate it. Bye.

**Kai Ryssdal:** Make Me Smart is produced and directed by Marissa Cabrera. Tony Wagner writes our newsletters. Our intern is the one and only Grace Rubin.

**Molly Wood:** I'm still up in the, I'm still looking at the electric toothbrush thing. Today's program is engineered by Lianna Squillace with mixing by Emma Erdbrink. Ben Tolliday and Daniel Ramirez composed our theme music, I hope it's the long one this time. The senior producer is Bridget Bodnar. Donna Tam is the director of on demand and Marketplace's vice president and general manager, or as we like to call him, the new guy, is Neil Scarborough.

**Kai Ryssdal:** Alright wait, I'm waiting for that to see. Somebody tell me if that's the C.

**Molly Wood:** I'm taking Lisa's word for it.

**Kai Ryssdal:** It sounds like a C. Lianna says it sounds like a C. I'm like, okay.