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Climate Sense podcast

"Planes, trains, and automobiles (but mostly automobiles)"

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Guests:

ROGER KRANENBURG
Vice President, Energy Strategy & Policy
Eversource Energy

DANIEL SPERLING
Distinguished Blue Planet Prize Professor of Civil Engineering and Environmental Science and Policy; founding director, Institute of Transportation Studies
University of California Davis

Host:

SAMANTHA GROSS
Director, Energy Security and Climate Initiative
Fellow, Foreign Policy, Energy Security and Climate Initiative
The Brookings Institution

Episode Summary:

Americans love cars, and trucks, and SUVs. Our country is designed around the automobile. This episode of Climate Sense, hosted by Samantha Gross, is about transportation–an important part of our culture, our energy use, and our greenhouse gas emissions. She talks with two experts on the use of electric vehicles and seeks answers to the transportation challenge. What is the solution? Expanding our perceptions on the way we get around.

[car engine sound; music]

GROSS: Americans love cars. And trucks. And SUVs. Our country is designed around the car. There are 290 million vehicles registered in the U.S. for 238 million licensed drivers. Yes indeed, there are actually more vehicles in the U.S. than there are people who can drive them.

I'm Samantha Gross, director of the Energy Security and Climate Initiative at the Brookings Institution. I started my career in engineering and have been in Washington for 20 years now, working on energy and environmental policy—practical solutions to some of today's most important problems. Today's episode of Climate Sense is about transportation—an important part of our culture, our energy use, and our greenhouse gas emissions. You can find all the episodes in the series at Brookings dot edu slash Climate Sense Podcast. And, if you have a question that you'd like answered on this podcast, I'd love to hear from you. Send it to Podcasts at Brookings dot edu and I'll try to answer it in the final episode of this series.

Let's get right into the transportation challenge with Dan Sperling. Dan is the director of the Institute of Transportation Studies at the University of California at Davis. I first met him when I was working on a paper on decarbonizing heavy transport, but he's been in this business for more than 30 years and is a renowned expert on all things transportation. He also holds a seat on California's Air Resources Board, an important policymaking body in the state.

I asked Dan to kick off our conversation by explaining transportation's role in U.S. greenhouse gas emissions.

SPERLING: In the U.S., transportation is the largest producer of greenhouse gases of any energy sector, more than industry, more than electric generation. It's about one-third or so of total greenhouse gases in the U.S. Globally, it's a little less, it's more in the 20 to 25% range, mostly because there's less mobility and less vehicles in a lot of countries.

GROSS: So, how much do the cars and trucks that you and I drive contribute? How much of our emissions are from cars and not ships or airplanes or tractor trailers?

SPERLING: Well, our light duty passenger vehicles are cars and light trucks, and that includes SUVs, pickups, and minivans—as a category account for over half of the transportation emissions. So, therefore, we're talking about, over 20% of the total U.S. greenhouse gas emissions from like just from light duty vehicles. So it's a big deal. It's a very big deal.

GROSS: Light duty vehicles—the things most of us drive—produce 20% of U.S. greenhouse gas emissions. That's serious. The answer to reducing and eventually eliminating these emissions goes back to the formula we talked about in the last episode on electricity: decarbonize the electricity system and electrify everything you can. And light vehicles can definitely run on electricity.

SPERLING: So, if you look at climate strategies overall, renewable electricity is number one, electric vehicles is number two strategy overall. And the good news is the batteries have become so inexpensive that actually the cost of owning and operating an electric vehicle within a few

years and actually now in many cases is less than for a gasoline car, and also an electric truck will be less within a few years than a diesel truck. So, we can forget climate—electric vehicles could be an economic strategy. It'll save the economy money, it'll save consumers money.

Well, we've gotten to the point where the technology is well-established, the costs are coming down, and it's a superior technology in most ways to gasoline. It's less polluting, it's a more pleasant drive, it's smooth. And the maintenance costs are much less. The energy costs are less.

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And so, electric vehicles, it's kind of a no brainer at this point. I mean, not kind of. It is a no brainer at this point. And it's really just a question of how fast we do it.

GROSS: Roger Kranenburg is the vice president for policy and strategy at Eversource, a utility in New England. He's also an old friend and a total car guy. Roger's on-board with electric vehicles too.

KRANENBURG: I'm absolutely convinced that light duty vehicles, you know things that you and I think of as cars, those are going electric. And then ultimately, I think you'll get to a point where it's just a better product for consumers, both in terms of if you look at it from transportation the closer and closer you live to a city the more and more you're going to choose not to own a car for transportation because the marginal cost will go down so quickly.

But if you do own a car, I think it'll be essentially a better product. You can imagine a world where you don't go to gas stations per se unless you're on a long business trip or something. Your car is they are fully energized, so to speak, because it's charging at home, you get in it and you drive it and you don't go to the dealer as much. It requires less maintenance. You get higher performance.

I mean, the performance … but other functionality in some of the exciting vehicles, I think, that are coming out is the Ford F-150. And what do they tout? They don't tout the brand and even sort of off-the-line performance. They tout towing capacity. And I grew up in Texas, and Texans are very independent. They tout, you know, if the power goes out, you just plug in your F-150 and you power up your house. So, you're seeing a product evolve into resonating with that consumer base.

And the other one is the electric Hummer that's coming out, it's got this crab walk function. But basically it's leveraging the fact that it can be so precise for the electricity. You can have a vehicle where it's up on a boulder and locked because you're controlling that motor to stay there. You can't do that easily with mechanical system.

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GROSS: [07:29] Electric vehicles aren't just good for the environment, they are cool! They are torque-y, or fast off the line—all their power is available right away—and they're fun to drive. They can do things gasoline and diesel vehicles can't.

Let's go back to Dan Sperling to hear about how the transition to electric vehicles might occur. Are car companies ready to supply electric vehicles? Are people ready to buy them? It's one thing for us to say how cool and functional electric vehicles can be, but another to actually get consumers to feel comfortable and even excited about buying them.

SPERLING: The car companies are completely on board. Every car company you talk to, many of them are already saying they're not going to do another gasoline model again. And most of them are transitioning very quickly. And Europe, 100% requirement for 2035; California, there's going to be a lot of other states that follow California. We're going to see massive increases in electric vehicle sales in the U.S.

And the challenge is going to be making it really happen in a comfortable, easy way. So, it makes sense economically, environmentally, driving experience. But people are resistant. It's a big purchase. People are nervous about charging and range anxiety. So, there are some legitimate concerns.

So, if we look at it from a policy perspective, we need some kind of rules or policies that affect the auto industry to supply the vehicles. We need some kind of approach on the charging infrastructure. And we need a question of incentives both for infrastructure and the consumer. And the question is, how much of each of those.

Infrastructure—the problem there is that it's hard to make money selling electrons, selling electricity to vehicles. You know, you just think about it, the amount of electricity that flows out to a car over a period of half an hour, hour, or two hours is much less than with a gasoline station. So, there's much less revenue. And then you've got the cost of putting the facility in there. And you don't want people waiting. So, you have to overbuild it a little bit. And then psychologically people worry about running out of electricity, so they have to visually see that there's a lot of stations out there just to make them comfortable to buy the vehicle. So, for a variety of reasons we do need to incentivize the charging infrastructure somehow.

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But, you know, it doesn't mean it comes from government necessarily. It can become workplace charging. The employers can subsidize it for their employees. Retail malls can subsidize it for their customers. So, it's not necessarily a heavy lift for government. And electric utilities can justify it because it helps them manage their load better by balancing it when they charge.

GROSS: Okay, we've established that electric vehicles are cool and functional, and the policies that we might need to move along their adoption. The recent Inflation Reduction Act in the U.S. gets us part of the way there, with subsidies for electric vehicles purchases and for building out charging infrastructure. We'll talk more about the Act and its implications in a later episode.

But people often ask me: are electric vehicles really better for the environment? As we talked about in the last episode on electricity, 60% of the electricity in the United States is still generated using fossil fuels, and a significant portion of this is coal—the dirtiest fossil fuel. How

does an electric vehicle compare to a gasoline vehicle in greenhouse gas emissions today, with the electric system we have right now?

SPERLING: Well, it varies tremendously because, again, it depends where you're getting your electricity and even what time of day. But, there's some states like on the West Coast, like California is way over 50% zero emission electricity. Some nuclear, hydro, but lots of solar and wind. The State of Washington is even more so because of all the hydroelectricity they have.

But, even if you had all coal, if you are feeding your car with just coal, electricity from coal, you'd probably be about breaking even with a gasoline car. And there's almost nowhere where that's the case in the United States anymore. So, on average, in the United States, if you do an electric vehicle today, you're probably getting about a 50 to 60% reduction in greenhouse gases relative to a gasoline car.

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And it's just going to keep getting better because the grid is getting cleaner and the vehicles are getting more efficient, too, by the way.

GROSS: Another hurdle with electric vehicles is the battery. Battery cost has been a big portion of electric vehicle cost, since the rest of the car is actually simpler than a gasoline-powered car. And there's tons of discussions about battery manufacturing and critical minerals needed for batteries.

And this concern is real. China's government has really pushed to create a robust battery industry there. Now 76% of lithium-ion batteries are produced in China. And it's not just the manufacturing, but the raw materials too. China has invested in lithium mines in Australia and Chile, the world's two leading countries for lithium mining. And 15 of 19 cobalt mines in the Democratic Republic of the Congo are Chinese owned. China has nearly cornered the market on processing minerals for batteries—80% of raw material processing for batteries happens in China.

Supply chain concerns after COVID have made policymakers even more concerned about electric vehicles and their batteries. The Inflation Reduction Act focuses on this issue too, by encouraging the mining and refining of battery-related minerals in the U.S. and also on battery manufacturing here.

SPERLING: So, on the minerals side, there's going to be hiccups along the way because you're dramatically increasing the need for certain minerals. But there's so much of it around the world. It's really a question of mining it, and investments. And like lithium, lithium is everywhere. And we have a huge amount of it in California. There's lots of it. But, there is challenges because people don't want mines in their backyard. There's local resistance to anything new that you do, you know, industrial type facilities. There are the geopolitical concerns because right now, China processes a lot of those minerals in China that we do use. But, you know, all that can change.

The battery costs have come down dramatically. So, back in 2010, it was over $1,000 per kilowatt hour. Now it's near $100, $130. It's come down 90% in the last ten, 12 years.

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And that's because of innovation, scale economies. And that's just with basically one battery chemistry. And now there's a lot of investment in new types of battery chemistry with solid batteries and so on. So, the cost is going to keep coming down.

GROSS: Battery technology is good and getting better, but batteries have one important drawback: they are heavy. A state-of-the-art battery weighs more than 40 times as much as the same amount of energy in gasoline or diesel fuel. In a car, you get some of that weight disadvantage back in a couple of ways. The rest of the drivetrain is simpler and lighter than that in a gasoline powered car, and electric motors are much more efficient than gasoline or diesel engines, meaning that you need less energy, and thus a smaller battery, to go the same distance. So, the weight penalty isn't quite as bad as it seems. But still, an electric car is maybe a third heavier than a similar car that runs on gasoline.

This weight difference isn't such a big deal for passenger cars and trucks—they make mostly short journeys carrying light loads with lots of opportunities for refueling. Think of your average errand run or road trip in your car. But for other kinds of vehicles the difference is a big deal. Think of long-haul 18-wheel trucks, where time is money and refueling stops take time. Or cargo ships that cross oceans without refueling. Or airplanes where every pound matters.

Here are Dan's thoughts on where battery-powered transport is more challenging.

SPERLING: Batteries, though, are big and heavy and expensive. And they always will be. And so, there are some limitations where you want to use battery, so you probably don't want to put them in big commercial jet planes. And so, we need to look for other options in planes. Maybe for short haul, smaller planes, we can do battery electric. But then after that, we use hydrogen or we use some kind of low carbon biofuels. And the same for maritime.

But really, batteries are definitely a good fit for light-duty vehicles and for almost all heavy-duty vehicles, and maybe even all heavy duty vehicles. Because the same thing has happened on the truck side. Battery costs have come down and now it's going to be soon cheaper to have an electric truck than it is a diesel truck. But the only place where that there's a caveat are on the big, long haul trucks, the classic long haul trucks, and we're a little less certain. But even there, companies like Volvo, Freightliner, Daimler, they're all going into heavy-duty battery trucks, but they're also looking at hydrogen.

GROSS: Zero-carbon fuels, or something that looks like a fuel, could be the answer when the drawbacks of batteries are problematic. Like I said before, fuels are more energy dense than batteries—meaning that they carry more energy per unit of weight. And as we described in earlier episodes, hydrogen is an energy carrier that acts like a fuel—you can move it and store it and it is energy dense, like the natural gas it's often compared to and aims to replace.

SPERLING: Almost for sure we're going to need liquid a liquid fuel for planes. It's much more energy dense. You just can't carry heavy weight on a plane. It just doesn't make sense. So, some of the advanced biofuels is probably the best answer there.

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GROSS: Dan's most recent book is called *Three Revolutions: Steering Automated, Shared and Electric Vehicles to a Better Future*. He has a vision of what transportation might look like in the future, to provide the mobility people want with the convenience we've all come to expect. I asked him to share his vision with us.

SPERLING: So, we've created a car monoculture in the U.S. We use cars or light-duty vehicles for almost everything. Mass transit in the U.S. accounts for less than 2% of passenger miles. Less than 2%. So, it's really important in Manhattan, it's really important in San Francisco, Chicago, and the downtown cities. But once you get out there, it's very lightly used out of some of those major older cities.

But we built up our land use system, our cities, around the car, especially in in the Sunbelt and West, and the suburban areas of the even of the northeast and the north and the Midwest. So, it's very difficult to talk about getting rid of the car. And there is this in the enviro world, there's a lot of talk about reducing VMT—vehicle miles traveled. And it's problematic strategy. We've been trying to do it for 50 years unsuccessfully.

And so the question is, what do we do about that? So, one, of course, is you electrify everything and then you get rid of the greenhouse gases and the air pollution anyway. But you still have a city and a mobility system that's very expensive because owning and operating a car, even an electric car, is very expensive. It takes up a lot of space, so, we have to spend huge amounts of money on roads and parking—many of our cities are 40% devoted to parking and roads. So, it's a very inefficient use of land. It's a very expensive way for individuals.

And it has a mobility equity impact also, because what about all those people that have physical limitations? What about all the people that don't have the money? Even if you have a car, a household that has a car, then you have a group of people depending on one car. It's an older car. It's not reliable. You've got to share it. So, even though the numbers look impressive in terms of everyone owning cars, even a lot of people owning cars don't get good accessibility and mobility. And then you get older people, you get young people.

So, we have probably, you know, maybe 20% of our population is marginalized by this car-centric monoculture we created in the U.S.

GROSS: We've built our country and our cities around the car and we're all used to that landscape and that way of getting around. But are there better options?

SPERLING: I think there's only two strategies to significantly change that. One is just a straight policy instrument in pricing, and that is, you know, have people pay for the full cost of owning and operating their vehicle. That's not going to get very far politically.

So, the other part, the necessary part of it is shared, automated vehicles. And I know that sounds far out to a lot of people, but that really is our only hope, I think. And that is because what you can do is when you have shared, automated vehicles, you reduce the cost of mobility and you have vehicles that can go everywhere. And now people, whether you're physically limited or whatever, you know, you get access to it. The cost of providing it is much less than the cost of mass transit will be per passenger mile. So, that means we can with the same amount of subsidy money we use for transit, we could serve many, many more people.

I did a book called *The Three Transportation Revolutions*, bringing together automation, sharing, and electrification. And really that is the answer, by the way, sharing automated vehicles, electrification. And we have a dramatically more sustainable transportation system in an economic sense, in an equity sense, and in an environmental sense.

GROSS: The idea behind this vision is that shared rides in self-driving vehicles could provide much more door-to-door convenience than public transit today, while still costing much less than owning your own car, and even less than today's less convenient public transport or ride hailing services. It really sounds like a win-win for people, if we can pull it off.

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This is a super interesting vision, but how far away is it? What technologies do we need to get there?

SPERLING: Well, the two key features from a technology sense are the electric vehicles, and that means mostly the battery, and the automated vehicle. And so, the electric vehicle is pretty much here. It keeps getting better as we build more of them. The scale economies will get better. There will be more investment in R&D and innovation. So, the costs are going to keep coming down for electric vehicles.

But the automated vehicle part of it is trickier. There's a lot of money still going into it, and big companies are, you know, investing in it. The technology keeps getting better and the question becomes, how good does it have to be?

It's probably the case in many situations an automated vehicle today with the technology on average is better than the average driver. And that's because the average driver falls asleep, the average driver drinks, the average driver texts. Right? So, this technology, you know, it's not perfect yet and it's got a ways to go. It'll never be perfect. But the question is, when is it good enough? And we're not good at making those decisions. We don't have a good policy framework to do that, and we're going to struggle with it.

And so, I think what's going to happen is they're going to start out geofencing these cars. That means you find an area where the vehicles operate, the infrastructure is well known, they map the hell out of everything so they know where everything is, the car knows where everything is, and you operate within that area. And so, if someone calls up and says, I want to ride from here to there and it's within that geofenced area, then you get a ride with an automated car. And then

gradually you expand that geofenced area out. And that's how it's going to play out. And I think it'll be in some areas that are more receptive because at the end of the day, it's going to be local and state governments that are going to be making most of the decisions on how this rolls out.

GROSS: Automated driving may be better in many circumstances than human drivers, but the exceptions will prove difficult to deal with. We're already seeing this in controversies over accidents that have occurred with partially automated cars, like Tesla's autopilot system. We'll have to make policy decisions about how good these systems need to be, knowing that we'll always be more forgiving of a human making a mistake than that same mistake made by an automated system.

SPERLING: The challenge here is automated vehicles can go in a way that's in the public interest or not. So, if these automated vehicles just replace our manually driven vehicles, then it's just a toy of the rich. And it's worse than that because now they'll have an incentive to be in that vehicle a lot. You know, you can eat, sleep, it can be your hotel room, it can be your office.

We've done research at UC Davis and others where we see probably a doubling of vehicle use when if a person has an automated vehicle versus a manual one, just because of all those advantages. But that's not what we want.

So, I think that's the big challenge, is getting the policies in place now to encourage these companies to have shared vehicles. We're not swimming upstream on this. So, General Motors with their Cruise company, is committed to exactly that. Zoox, the company bought by Amazon, is committed to that. You know, this idea, they actually built vehicles that are intended to carry five or six people as a shared rides. So, they're all on board and those are electric also.

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So, you know, we're swimming upstream in terms of personal behavior, so we need government to provide the incentives. And it's local government, state government, national government.

GROSS: This vision sounds like something out of the *Jetsons*—fleets of shared driverless vehicles whisking us from place to place in comfort. But we may be farther along than we think. Already we use our phones to summon shared vehicles to take us where we want to go—the business model of Uber or Lyft. Greater ride sharing and the lower energy prices that electric vehicles enjoy could make these rides downright cheap and remove some of the financial and cultural incentives to own a car. Just think, going where you want to go inexpensively without car payments, or gas station visits, or regular car maintenance costs. Not to mention without greenhouse gas emissions or other pollution. The future sounds pretty good to me.

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GROSS: Many thanks to the experts I talked to in this episode. Fred Dews is the producer; Gastón Reboredo the audio engineer; and Matt Murphy the audio intern. My thanks also to Louison Sall and the communications teams in Brookings Foreign Policy and the Office of Communications. Show art was designed by Shavanthi Mendis.

You can find episodes of “Climate Sense” wherever you get your podcasts, and learn more about this show on our website at Brookings dot edu slash Climate Sense Podcast. You’ll also find my work on climate change and research from the Brookings Initiative on Climate Research and Action on the Brookings website.

I’m Samantha Gross, and this is “Climate Sense.”