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Corn Saves America
Episode 9 – Does Ethanol Have a Future?

Sarah Mock: This is Corn Saves America, a podcast exploring agriculture’s environmental solutions, from ethanol to carbon markets. I’m Sarah Mock.

I find that there are few ideas that inspire existential dread in the minds of the casual ethanol pundits quite like the rise of electric vehicles. Even the threat of the refining industry pales in comparison to a possible future where no one even uses an internal combustion engine.

After all the time I’d spent learning about and understanding the history of the RFS and ethanol’s ongoing issues with everyone from environmentalists to Big Oil, I worried that all of this might soon be moot. But what I learned, about today, the next decade, and the next 30 years and the U.S. transportation sector, is a much more complicated story, especially when we start to think about the possible futures of biofuel policy, and how ag carbon markets might play a role in reducing emissions from ethanol from ethanol production. So, let’s get into it.

Just about every expert I spoke with offered a unique perspective on what could, should, or would be ahead for the RFS and the ethanol sector in the coming years. And all of them start with where we are today. Brent offers one perspective:

Brent Gloy: We're produced pretty much all that we can with the Renewable Fuel Standard and so until either we have higher level blends or something, it's where it's going to be. Looking forward I am not a person who sees the demise of industry. I think ethanol will continue to exist for quite some time, at least any timeframe that I want to forecast over. But I don't, I think the tremendous growth of the industry is probably, in the past.

Sarah Mock: But not everyone is willing to give up on the idea of growing the ethanol sector so easily. Here’s Scott Irwin from the University of Illinois on the current battle to fuel ethanol’s growth into the future.

Scott Irwin: It's a battle over future market share. It's clear that the ethanol industry has never been satisfied with 10% of gasoline. They for sure wanted 15%, the petroleum refining industry doesn't want to give up that 5%. Boom, you have a kind of Clash of the Titans in political terms in D.C.

I think the crude oil industry feels that they got kind snookered, on RFS2 in particular, and gave up more market share to ethanol than they thought that they would. And they’re drawing a line in the sand and saying, “No more, not one more gallon of lost market share to ethanol.” So, it's

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really about where is future growth of market share in ethanol that I believe is where all of the political heat really comes from.

Sarah Mock: It's clear from Scott's comments that the idea that the liquid fuels pie could still be grown to benefit both refiners and ethanol, is a thing of the past. In fact, it's pretty evident, because of the political and social pressure that has arisen around climate mitigation, that the liquid fuels pie is getting smaller all the time as consumers and policymakers alike look to cleaner alternatives. It's for that reason that ASU's Dr. Hanna Breetz argues that this political heat is not actually a good indicator of what's actually important in these discussions.

Hanna Breetz: So much of all this debate focuses on that 10 to 15%, that margin, but it's embedded in something larger that's really talking about the future of transportation and vehicles and like a much bigger trajectory - that's where I think that kind of bigger conversation, more interesting conversation from my perspective is.

Sarah Mock: So, what's out there in the future of transportation? If today's current hype can be summed in a word or phrase, it would be "electrification" or "electric vehicles." And, for the casual observer, the growing prevalence of electrical vehicles might make this battle over 5% of market share looks a bit like a fight over rearranging the deck chairs on the Titanic. But the casual observer might also think, "How hard could it really be to electrify the U.S. fleet?" The answer to which is, probably harder than you'd think.

To dig into this, we're going to spend a lot of time today with Jeremy Martin from the Union of Concerned Scientists, who has spent much of the last few years thinking and writing about the future of the transportation sector, and in particular how oil, biofuels, and electricity fit into what comes next. He says, despite all the hype, the long-term trends give him pause when thinking about the future of electric vehicles.

Jeremy Martin: So, like exactly 50 years petroleum was 95% of transportation energy and the first thing that brought it down was actually the rise of ethanol in 2008. So, when it became 95%, it was actually because of the decline of coal used for steam-fired locomotives.

So, in some sense, I think that's interesting bookends on the kind of petroleum era, but where's electricity on that chart now? It's nowhere. It's not even close to 1%. It's really a rounding error. So, when we think about this opportunity to cut oil use by 50, 80, 90%, there's this massive opportunity for both electricity and biofuels.

Sarah Mock: Jeremy brings an engineer's practical approach to thinking about these possible changes and has done his best to include those harder-to-predict-variables when he looks ahead. When it comes down to thinking about the impact of electric vehicles over the next 50 years, it starts by understanding the timeline.

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Jeremy Martin: So, the number that I think makes sense to start with is – so, people are talking about, “Let's stop selling gasoline powered cars in 2035.” What would that mean if we basically ramped down the sales of gasoline-powered vehicles so that by 2035, we're basically at 100% electric? Cars were on the road for say 15 years. Sometimes they're on the road a little longer, but actually they tend to drive less and less each year. If you stop selling gasoline-powered cars in 2035, then by 2050, you really won't be using much gasoline at all. You'd get down to, 5% or something of where we are now. So that's really the end point, right. But even in that case, it won't be a linear, so if that's 30 years from now, you won't be half at 15 years. The short-term change will be slower and then the long-term change will be faster. So, you sort of expect this, accelerating transition.

Sarah Mock: This may seem like an errant detail, but it's actually really important. Another way to capture what Jeremy is saying here is that as humans, we tend to overestimate what change is possible in the short term and underestimate what change is possible in the long term, that's because change often happens exponentially, rather than linearly. In other words, the initial changes are very hard, and happen very slowly, but over time, the effort it takes to change becomes lessened, change becomes easier and easier, and thus happens faster and faster.

Further, to Jeremy's point about radically reducing petroleum demand, it's not just transition to electric vehicles that will be at play here. We can expect vehicle fuel efficiency to continue to improve as well, and it's possible that ethanol could play a key role in that transition to.

Jeremy Martin: In the next decade, you might see a 20%, 30%, probably less than a 30% drop, maybe 25% drop in gasoline sales and then it would, speed up after that. And so, if the transition to E15 happens by early-2030s, that essentially can offset the declining sales of gasoline. I think those two things can happen in parallel. You can basically cut the petroleum component of gasoline faster, and you can do that without, basically making the best use of the ethanol production capacity infrastructure we've got now.

That's not very complicated math, right? If you cut gasoline consumption by a third, but you increase the blending to E15, 50% more than those two things cancel a perfectly and you're basically at the same amount of ethanol, but a steeper cut in petroleum. And I think that's something I wish more people appreciated, but this idea is either, “Well, ethanol is great. We should have a lot more ethanol. We should increase ethanol production as fast as possible. Why wouldn't we do that?” And then on the other hand, right, like we need to go to electricity. “Why would we invest in ethanol when we're going to electricity? Ethanol's finished, forget about it.” And really what this says is, we can go to electricity as fast as possible and not put a lot more money into building ethanol production capacity, but we can continue to improve that capacity, continue to make it cleaner, and continue to use it and take advantage of it for a couple of decades to come.

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So, in the next decade, fairly modest changes – because selling E15, isn't a huge hurdle given where the fleet is and the infrastructure - that's all that's necessary to offset declining sales of gasoline from electricity for the next decade.

Sarah Mock: This message – that ethanol and electricity do not have to be fundamentally competitive in the transportation space, is an idea that was echoed by many of our experts. It's a perspective rooted, in part, in a limited understanding of the sheer scale of the transportation sector.

Jeremy Martin: Sometimes people frame this as like the electric vehicle industry is going to eat ethanol's lunch and it's a battle between the two. But if you actually just take a step back and look at the numbers, biofuels account for about 5% of transportation energy in the United States. And petroleum's like more than 90% and has been for more than 50 years. And you know, it's not like electricity is growing from 1% to 5 and 10% and even 50%, is a threat to biofuels. The way I think about it is, if we can get, in 2035 sell no more gasoline powered cars, then by 2050, we could see total liquid fuels used for transportation fall by 85%. That's three times more than the biofuels we're using now. So, that would still leave room for biofuels to triple in that timeframe. And realistically, right, crop yields in corn have grown by 1% a year actually, right. It's not even a percentage, steady percentage, it's actually sort of number of bushels a year. Like tripling by 2030 is a huge opportunity for, you know, for the existing biofuels, but also to bring on these new feedstocks and that's even without looking at the chemical industry and all these other things that we'll need to replace in a decarbonized economy. So, yeah, this idea that electricity is a threat to ethanol really comes from a lack of kind of thinking creatively about how we can reshape the system.

Sarah Mock: The University of Illinois' Scott Irwin pointed out, too, that there are still serious barriers to electrifying the U.S. fleet, and he agrees that these limitations mean that demand for ethanol is unlikely to seriously diminish in the coming years.

Scott Irwin: I'm convinced that the transition is going to take a lot longer than I thought and I think some of the most aggressive EV proponents think. First off, just the sheer size of the inventory of rolling stock we have that consumes gasoline and diesel is - I think that Americans own something like 300 million cars and 1% are electric.

And then secondly, I think we'll slow things down is the infrastructure needed to support EVs. We can wave our hands all we want, but there are two issues there. One, having an electricity grid that will support that much charging demand. We are a long way from that. And then secondly, even if we have the grid. Are we really getting anywhere in terms of climate change, which is the idea of using dirty electricity to power clean electric vehicles versus petroleum? Are we actually getting anywhere? The reality and the truth of that will come out.

So, I just think 20-30 years from now I can definitely see a future. It's all electric, probably autonomous electric vehicles by then. But we've got a long period of a transition towards that

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future. So, it's 2021 a lot of people think, "Oh my gosh, we're going to be using half as much gasoline in 20, 28 or 2030." I just don't see it.

Electric vehicles are going to, they're going to dent it. They're going to take some, but I don't see any near term, in the immediate future cratering of gasoline usage, as an existential threat to ethanol, at least for the next five, six years, and probably much longer.

Sarah Mock: Given the likelihood that the transition away from liquid fuels could take longer than current EV advocates are hoping, there has been an urgent focus on making corn ethanol itself a cleaner fuel, as part of the overall goal of making the whole transportation sector less of a serious emitter. Jeremy points out that, the first step in cleaning up transport is actually optimizing or even reducing the transportation footprint overall.

Jeremy Martin: So, transportation is a big source of pollution, right? The biggest source of pollution in the United States. And obviously the first thing we want to do is not just assume that every car on the highway and every trip that everybody takes is, is the best possible way to get around, right. We really need to think about how does our system work. How is it serving people and how do we make sure that people have equitable access to mobility? And that our goods movement system is working for people, but also, you know, isn't causing disproportionate air pollution impacts in overburdened communities.

And so, there's a lot to fix in sort of what are the cars and trucks doing? And not just making them a little more efficient or a little less polluting, and then the next piece is, of course we can make the cars more efficient, and we can make the cars electric. And with all of that, we can just reduce demand for all kinds of energy and, and especially demand for liquid fuels. And only after we've done those things, it's in that context that I'm thinking like, "Okay, well now we've got these liquid fuels. How do we make sure that those are as clean as possible?"

And that's the context in which thinking about, you know, biofuels fit in and how do we make sure that the biofuels are getting are getting cleaner makes sense. But certainly, it's no substitute for doing those other things. And I don't see them in competition. It's less about how do you fill up all of the things that oil are doing with biofuels? And more about, how do we make this a decarbonized, clean transportation system? And how do we fuel it with electricity and with low-carbon biofuels, and other solutions?

I think the opportunity comes in thinking about, how do we work together to deliver these emissions reductions? Both from, replacing petroleum with electricity and renewable electricity, but also, at the same time, continuing to make sure, that the biofuels get cleaner and have a productive and useful role in our transportation system and broadly in decarbonizing,

Sarah Mock: Again, Jeremy makes clear hear that encouraging reduced driving or even electric vehicle production, doesn't have to mean reduced ethanol usage, and when it comes to minimizing the overall amount of emissions in the transportation system ethanol, particularly cleaner ethanol, could be a meaningful part of that.

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Hanna Breetz agrees, she sees EVs as an incomplete solution to reduce emissions from transportation, in large part because they are a solution that takes a lot of time because of the long timeline on which vehicles stay on the road. Too much time given the U.S.'s current goals around climate mitigation.

Hanna Breetz: When I look at what it's going to take to try to decarbonize the transportation sector. I don't personally think that EVs are going to be able to do it alone. In part, because all the vehicles that we're selling that are on the road now, internal combustion engines still make up the vast majority of, certainly all heavy-duty vehicles and still the vast majority of light-duty vehicles and passenger vehicles as well. And all those cars are going to be on the road for a long time. And so, if you're only relying on electric vehicles to decarbonize transportation, what you're relying on is a turnover in the fleet. Where you're just saying, "Yep, everything else is getting told right now, we're just going to accept that it'll pollute as much as it is now forever more."

And like that is, that's not acceptable to me. That is not a recipe in my mind for more rapid decarbonization and that's why I still do have an interest in alternative liquid fuels, including biofuels as a way for saying, "How do we not only decarbonize through a fleet turnover, but how do we decarbonize with lower carbon fuels that can actually do something today?"

But then the question is, well, the biofuels, they're not this panacea. They are lower carbon, but they're not as low carbon as we'd like to be. So, how do you figure out ways that you can incentivize lower carbon biofuels? And that's where I think potentially the ag carbon markets can get to be really interesting because there is potential to have much lower carbon biofuels. But right now, they're not economical.

Sarah Mock: Hanna argues that ag carbon credits might be one way to change this economic reality and make a less carbon intensive biofuel more profitable all along the supply chain.

Hanna Breetz: If you were thinking about it more in the context of saying, "How do we play in carbon markets? Or how do you play in LCFS credits?" Not just looking at RFS volumes, then you might be interested more in some of the carbon reductions as a way to maximize the value.

So, there's different ways that you can get volume that you can be trying to increase the per gallon benefit, as opposed to just saying, "How do we get the most gallons?" And that is again, something that I just haven't seen a lot of discussion around. Of saying, "Yeah, let's take this seriously as an industry. How do we really reduce the carbon footprint? How can we find better ways to make this ethanol so that it has a lower carbon footprint?"

What is the way that you can stack these different sorts of incentives? Whether you're earning RFS credits and LCFS credits and some ag carbon market credits, and I think it's going to have to end up being some kind of stacking of lots and lots of different subsidies and incentives in

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order to create ways for farmers to have some transformative land use practices to be figuring out how you build soil carbon at the same time as you're taking off some carbon. But how you actually get there and fine tune it? How do you make sure that those credits are actually meaningful and not just hot air? That's a really tricky kind of policy and market design.

Sarah Mock: A tricky design problem indeed. Whether what comes next for ag carbon markets is a policy or a market, is still very much up in the air, but you heard Hanna refer to one possible in these comments, an LCFS, Or a Low Carbon Fuel Standard. The state of California has been a pioneer in developing alternative fuel policy in the U.S., and many of our experts pointed to various state-level LCFS programs – like the one in California - as possible models that could be considered on a federal level, if there was interest in updating the Renewable Fuel Standard. Here's UC Davis's Aaron Smith, describing what, exactly, a low carbon fuel standard is:

Aaron Smith: The low carbon fuel standard, is ostensibly supposed to be fuel neutral. So, essentially what they do is they say, "Let's set a number for what the carbon intensity of diesel and gasoline fuel should be." And so, here's what the standard is, and petroleum is dirtier than the standard. So, in order to sort of hit the standard, what you have to do is you have to mix the supply with some of the dirty stuff. You have to mix in some cleaner stuff. And so, if you're producing a fuel, that's dirtier than what the standard is such as petroleum, gasoline, or diesel, then you earn deficits against the standard. And if you're producing fuel that's cleaner than the standard, then you earn credits, and the credits and deficits have to balance each other out. And so, the thing that makes it fuel neutral is that you can earn credits from using ethanol, you can use credit from a renewable diesel, which is now I think over 20%, 25% of California diesel is actually renewable.

You can earn credits from electric vehicles. You can now earn credits in this program, which is highly relevant for agriculture through processing dairy manure waste into biogas, that's a massive source of credits. And so, in principle the idea would be this is going to let the market figure out which are the cleanest fuels. Because the cleaner is your fuel, the lowered the measured carbon intensity, the more credits you get, and the dirtier is your fuel the more deficits you get. So, you're cleaning up the fuel supply in a way that doesn't force us just to use ethanol.

Sarah Mock: Jeremy, among others, noted that there are a lot of real advantages to a low carbon fuel standard versus the more rigid structure of the current RFS.

Jeremy Martin: The first one is that at the highest level as it says, you know, we need to recognize the importance of electricity and renewable electricity as part of this process. Reducing emissions, cutting oil use, cleaning up our transportation fuels.

So that's someplace where the RFS you know, has fallen short and where these clean fuel standards I think make a lot more sense in the modern world. Recognizing that that's a really

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important part of this project and that we need the liquid fuels and the electricity to work together, pulling in the same direction.

And then the other big thing is thing we talked about earlier that the clean fuel standards recognize that all the fields can get cleaner than they are now, and that it's worthwhile to provide those incentives and recognize that progress. And so, you know, that means that you can make ethanol in a way that's more or less polluting. You can do that for all the fuels. And so, we don't want to only focus on the cellulosic biofuels, or on hitting E10 or a discreet set of targets. We also want to focus on, you know, leaving the door open for innovation in emissions reductions, anywhere in that supply chain.

So, when the RFS and the LCFS were being considered, the scenarios for what kind of fuels would be used to comply with those policies were very similar, right? They both work kind of banking on cellulosic biofuels. And when the cellulosic biofuels didn't show up at the volumes that people had hoped, the more flexible approach of the clean fuel standard was able to say, "Oh, well, there's electrification, there's carbon intensity reductions in corn." They were able to adapt over time. It wasn't that they accurately predicted the future. It was that they were just more flexible about it.

Sarah Mock: This additional flexibility in future federal biofuels policy could be tremendously beneficial, not just for the goals we have around reducing carbon emissions - which apply directly to agriculture, given the impact of climate change on production - but also by creating possibilities to add more value with every gallon. As luck would have it, both 2022 and 2023 promise to be big years for the RFS. A scheduled reset of the law will require the EPA to announce its intentions for administering the RFS going forward. Scott Irwin is already anticipating this being a contentious affair.

Scott Irwin: Oh, that war has already started in Washington, D.C. I call that the big reset, because it's very important to remember the RFS does not sunset as legislation in 2023, nothing changes except the tables that specified the volume mandates that were starting points in setting the annual RVOs end in 2022. Nothing else changes. Now, practically there are some big impacts because the EPA director in consultation with the Department of Energy and USDA then is to set new annual standards - RVOs. This is again, a critical point, there will be, which are their annual, Renewable Volume Obligations for time immemorial until the United States Congress repeals the RFS and as long as Senator [Chuck] Grassley's around, that's never going to happen.

Sarah Mock: The real problem here, according to Scott, is how key players, critics, mainly, might use this opportunity to put pressure on the biofuels marketplace.

Scott Irwin: Basically, the refining industry thinks that the big reset gives them all the tools they need to give the RFS a huge haircut. Clearly, they're angling for that. Ag groups know this, and they are trying to set up, to counter that. All of this is going to just end up in potentially decades

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of court battles. Here's one way - it's probably possible to redo the metrics for which you measure compliance. Right now, it's based on energy equivalents to ethanol. They did that initially when the RFS started, because it was the simplest thing that they could think of, but there is an effort to maybe make that based on carbon intensity scores, which would put ethanol at an even bigger disadvantage relative to advanced biofuels in the accounting for the RFS.

So that's one sneaky way that ethanol could be disadvantaged. I don't think it would be much of a hit from where we are today on ethanol use and corn ethanol grind. Because again, the economics say you should continue putting 10% ethanol in all the gasoline that we use, regular gasoline. There'd be a lot of fear that wouldn't happen, but that's what the economics predicted would happen if a haircut was given. The haircut would stop the growth of higher ethanol blends. So, it would really cut the potential for future growth of ethanol through higher blends.

Sarah Mock: The EPA, in consultation with USDA, will be in charge of defining this reset. So how are policymakers at USDA thinking about the future years of biofuel policy? Seth Meyer, chief economist at the Department of Ag, says figuring out that policy vision requires updating the data, and the world looks very different in 2021 and 22 then it did in 2007.

Seth Meyer: When we think about the next five years, I think one, you have to have a policy decision about the path going forward. So, hey, folks need to understand the RFS doesn't end in 2022. EPA is supposed to come out and give its vision of what it looks like going forward. Okay. So, what does that vision look like? How is that vision challenged by U.S. gasoline demand? The forecasts, unlike what they were when we pass the ESIA, are for falling gasoline consumption, not rising gasoline consumption. So again, that blend wall keeps coming closer and closer. So, you got realities of the market in terms of what is the potential market for ethanol look like? Policy discussions, court cases, you know, E15. What does the future of E15 look like as a way to say, E15 would offset these issues with falling gasoline consumption as a way to expand the domestic ethanol use.

You've got issues of where oil prices. There's all the usual market uncertainty and mix it in with political uncertainty. And I think there's a lot of combination of both market issues and policy issues that have to come together, but somebody needs to strike a vision and that's up to EPA.

Sarah Mock: What that vision might actually look like is not clear, but Jeremy Martin has some ideas. He says that, though the RFS achieved its goal of radically increasing biofuel production and use in the U.S., the size and pace of the shift, and the pressure that it put on agricultural markets, he says was probably foreseeable and definitely problematic. And he hopes that moving forward, a policy vision might focus on new goals, more similar to the low carbon fuel standard that Hanna described.

Jeremy Martin: That policy was always about making more ethanol and making more biofuels. And I think as we look forward, I would say the question is, okay, ethanol is a big part of our agricultural system. And I don't think just making it a bigger and bigger part and going for bigger

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and bigger numbers, is a good outcome. But taking that part of our agricultural market and making sure that it's really leading the way in emissions reductions, that we're making progress in cutting pollution, this is supposed to be part of the cleaner part of the gasoline. Let's make sure it's as clean as possible., and you know, if this corn is being sold to mitigate climate change, let's make sure we're producing it in a way which also mitigates climate change. I think really getting the most emissions reductions out of that investment that we've already made.

I've been talking mostly about like a national clean fuel standard. And I'm thinking about basically new legislation to sort of take the spirit of the RFS or parts of the spirit of the RFS and really bring it up to date with the kind of current knowledge about what it'll take to decarbonize transportation and what are those kinds of opportunities and policies that have worked?

There's another question about what is the rulemaking that the EPA has to do to set standards that look out past 2022? And you know, of course that's constrained by the legal language of the RFS, the statutory language of the RFS and the stakeholders there. But I don't think that process can really produce as broad a shift. And I don't anticipate that suddenly that will become mostly about transportation electrification, because the key thing there is, you know, what are they going to set for 2023 and 2024? And these things are really coming up soon.

So, I guess setting the standards out past 2023, that's going to be a pretty constrained process, both legally and also, you know, what we've seen over and over again is the political constraints there are really tough.

Sarah Mock: Though the RFS reset probably doesn't provide significant opportunity to increase the flexibility of U.S. biofuel policy, there may be other opportunities to achieve those improvements in the future.

And again, as Hanna noted, a low carbon fuel standard, or another kind of policy that offers farmers and ethanol producers a premium for reducing the carbon intensity of their corn ethanol, could be a promising market for ag carbon credits attached to commodity corn and soybean production. But Jeremy noted here that we should be cautious about focusing on combining ethanol and decarbonization in agriculture in a single policy.

Jeremy Martin: I think it would be a mistake if the way that we tried to improve the sustainability and resilience of our agricultural system was by thinking about the best transportation fuel policy, right. So, we need good agriculture policies that are focused on agriculture and make sense to the stakeholders that really understand. And then on my side, on the transportation-wonk side, we need to say, "Okay, if we're using crops to make fuels, we should use the cleanest crops and we should recognize that, we should support that." But we shouldn't like, try to write the rules for good farming in the context of thinking about, transportation fuels.

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I think it makes a lot of sense for the fuels policies to support and recognize those opportunities in agriculture. But I think it's important that the agricultural space that the stakeholders there work out what makes sense from a business perspective, from equity perspective, from a climate perspective. And when they do, we in the fuel space have a lot of money, if you think about the credits that could come just from this kind of policy, the numbers are significant, obviously, it's not a small share of corn and vegetable oil that goes into fuel markets. And if those markets would recognize a premium for better practices and better crops, that's a significant opportunity.

Sarah Mock: Given the possibility that simply deriving more value for cleaner corn ethanol may not be an economical anytime soon, another option, both as a focus for industry advocates and for policymakers who hope to maintain and growth ethanol moving forward, is, according to Hanna, to look to parts of the transportation sector, where ethanol still has considerable opportunity to displace a fossil fuel.

Hanna Breetz: I still see there as being sectors where ethanol and other biofuels may have an important role to play in terms of decarbonization, because we're not likely to electrify them anytime soon. And that includes both the heavy-duty sector as well as aviation, as well as certain segments of passenger vehicles that I don't think will be electrified. And that includes for a lot of rural communities. Batteries are still expensive, and I'm not drinking the Kool-Aid on electric pickup trucks. So, I think there will probably still be a role to play, and the onus is on the ethanol industry to figure out where are those niches where they can still have a large benefit in terms of the environmental impact and how to get there. Because if it just becomes a zero-sum game about EVs versus ethanol, ethanol is not going to win. And so, it's about figuring out where these niches, where we, you're not going to electrify that you really still can have a very important impact in decarbonization.

And where can you find opportunities perhaps with plugin hybrids so that it, again, doesn't become a zero-sum game, but you're really trying to figure out ways where you can work together with electrification as well. And that's partly from an environmental perspective, and that's partly from a resilience perspective too. There are many reasons that you might want to have plugin hybrids from purely a resilience way of thinking about things. So, I think there's some potentially some really interesting reframing to go on whereas an industry ethanol and other biofuels are going to have to find new ways to sell themselves based on these niches where they think they can have an environmental benefit. Because obviously there's going to be segments that care more about agricultural interest and rural development and that kind of bedrock of political support, isn't going to go away anytime soon. But if you need to build a bigger coalition, you have to find ways to have those environmental benefits. And I don't think they've necessarily done a great job of that yet. And they certainly have not done a good job of selling themselves.

Sarah Mock: But from Jeremy's perspective, serving these smaller, more specialized markets will not be enough in the near future, to maintain the ethanol sector or to meet the U.S.'s

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environmental goals. Instead, there will have to be some improvement, either through policy, market design, or some other measure, to improve the carbon efficiency of corn ethanol.

Jeremy Martin: In the next decade or so, I think it's really about, continuing to make progress in reducing the emissions and reducing the environmental impact of the fuels we're producing. So, I see that as the key, to show that the biofuels industry can actually deliver these big emissions reductions and can address some of the other environmental concerns, whether that's, water quality, and soil health and runoff, and all the other things that are part of the set of concerns around corn and soybean production is how do you do that? How do you show that you're on the right path there? And I think that sort of brings us to these carbon markets.

So, in my mind, the big picture is, we have a decade or so where we could not see the biofuels industry collapsed, but also not see it skyrocket. And if we can use that time to show like, we can really be smart about how we're doing this. We can enhance soil health. We can justify investments, so that if these policies are, supporting incentives for building soil health. We can show that we can actually deliver on that. And I think, if you're doing that, then that puts you in a strong position to get into these other markets. Maybe that's my difference in perspective of mine and, I worked for a long time as an engineer and it's nice to imagine the completely different future where we just like erase everything we have now, and we start over with a clean sheet of paper.

How do we get from here to there? And really showing like, “Okay, that's where I want to go. Here's the steps I need to take to get there. And here's the progress I made on those steps in the last five or 10 years.” And I think if we can really show that that will really build confidence that this is a smart thing to do, and we should keep doing it and we should keep supporting it.

Sarah Mock: This final note from Jeremy is an important one to consider. When we think about the future of biofuels policy, it can be nice to imagine a world where the past doesn't necessarily dictate, or even impact, the possible futures. But in the real world, we know that it does, and that's critical to keep in mind as we imagine the future of the RFS. In other words, whatever improvements we want to make, we don't get to make those changes in the past. We aren't starting from square one.
Here's David:

David Widmar: We can all, society can collectively wake up and say, “Wow, RFS was a big, giant flop and we should've never done it,” but that's a very different conclusion than saying we should repeal RFS today. And I think part of this is recognizing that you can agree that the decision was bad, but it's a very different starting point or very different sunk costs from this line - should we, or should we not pursue this technology in the future? And I think that's something that we don't think about a lot today. Cause I think it's easy to use today's information, look at RFS and say, “It's bad policy. Then we should do something about it.” But I think we have to realize we made the decision at a very different point in time, but now the decision to undo it is a completely different set of criteria that we'd have to evaluate. And so, there is a lot of sunk costs. There's a lot of things baked into it and it's not as easy as undoing it as we might initially think.

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Sarah Mock: We'll talk a lot more about sunk cost and evaluating past decisions and how we should deal with them in the present in our wrap up episode next week. But for now, let's look beyond the next decade. What lies in the more distant future for biofuels? That's after the break.

[[COMMERCIAL]]

Sarah Mock: According to George Washington University Energy Expert Scott Sklar, a key reason why ethanol must remain part of the U.S.'s energy picture is because of the uncertainties that lie ahead in the U.S.'s near- and more long-term future.

Scott Sklar: We are going to have disruptions in energy, period. I am telling you [through] no fault of our own - it's going to be, in some cases, weather, in some cases, terrorism, some cases just faulty infrastructure, like we saw with the gas pipeline. So, we're going to see all that, and we want to have options, viable options, and ethanol is one of those industries that it is a viable option and could be even a greater viable option. What if the unthinkable happens, right? What happens if your oil pipelines go down? Whether they're old, whether it's a cybersecurity issue, whether it's an earthquake, I don't care, tornado. And we, by the way, we have pipeline breaks all over all the damn place all the time. I keep track it, I have a whole class about it, it's very depressing. What do you do? What happens in fact, converges, like we saw the whole grid go down in Texas, and what does that mean?

And so really prepare and create systems that can withstand or are more viable on what's becoming just more frequent occurrences. I mean, in addition to all that, I mentioned, we have a pandemic going on - so we have a lot of stuff coming together that heretofore hadn't and we have very old infrastructure. And we need to make sure that the agricultural sector and the food processing sector is functioning 100% of the time period, just period. You need water. You need food, you need electricity, you need communication. Those are the big four. And ethanol is part of that.

So, ethanol is a great fuel and there's no reason we shouldn't use it and use it more and make sure the energy balance is good and make sure the whole resource system within it is sustainable. It doesn't cause any other environmental problems, all that's true.

And then of course there's hydrogen - that could be made from renewables and also from biomass. And we should use that. And of course, there's electric. If you can charge it with renewables, it makes sense. So, we have lots of options and we should promote them all. They're not one or another, and actually you don't want one option because they're not all right for all the things we need to do in one of the largest industrialized nations in the world.

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Sarah Mock: Scott argues that this is a question of resilience, in other words, of having many viable options and backup plans ready to go so that if and when the worst happens, we aren't left scrambling. And agriculture, in particular, he says, needs more thinking about resiliency.

Scott Sklar: Electric vehicles are great, but they're really not great for farm vehicles. They're really not great for heavy trucks. They're not great for lots of other things. So, as with everything else, we're talking about, you want a lot of options in the market so that consumers can choose. Really you want a maximum amount of choice. And so, what biofuels does is give, rural communities that have access to the fuel, agricultural vehicles that tend to be heavier and, less acclimated to an electric solution and heavy-duty trucks.

Don't get into cat fights between clean technologies. I think that's always silly and, the goal ought to be, we want to maximize clean options and bring as much as we can, as fast as we can and create as many jobs and reduce as much emissions as possible. And we ought to do it fast. And we need every single thing, every tool, every option at our disposal, and that will strengthen the country and the global economy in huge ways.

So, if I was a king of ethanol, I would say, I want to still keep the RFS strengthened, get rid of all these damn waivers most of the time, and keep it going. Increase the consumer awareness of how it helps the agricultural community. But also, to understand that there are going to be other tools and we ought to look at tools. There are the tools on decarbonization, there's ways to reduce emissions, not just, the Clean Air Act emissions, but greenhouse gas emissions. And step out of just the RFS paradigm into what are some of the other tools being used? Maybe in other areas of sustainable energy, and say, "How does that fit to us? And how do we embrace it?"

Sarah Mock: Seth Meyers also believes that ethanol advocates should be thinking about resiliency within their strategies, given that the previous narrow focus of what constitutes the ethanol market, has left the industry in such a vulnerable position:

Seth Meyer: So, I think you can continue to pursue - I think gasoline demand is in flux absolutely, but there is an opportunity here. You know, I see folks, with the court cases on E15 as absolutely an opportunity, but sustainable aviation fuel -opportunity, more bio-based products - big opportunity. So, I absolutely think that there are opportunities there. And I think agriculture has to have its fingers on all of these things. Don't put any egg, don't put eggs in any single basket.

I think we saw some of what happened a lot of eggs in a basket is going all the way back to the beginning of our conversation about the depressed mood in the ag sector prior to August 2020 sparked by the fact that, I don't know about you, but I had the same tank of gas in my car for three or four months.

That's the destruction of ethanol demand right there. So, you have all your eggs in that basket. It makes that basket vulnerable from market disruptions and policy disruptions. So, get yourself

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into aviation fuel, get yourself into bioproducts, get yourself into all these things for which ag is, could be a good contributor.

Sarah Mock: So where does all of this leave us? I think unfortunately, despite the possibilities that are out there in the ethanol space, it's certainly lost the glow that lured so many smart, enthusiastic people to it in the beginning. Perhaps it's just a sign of ethanol "living long enough to become the villain," as David said in Episode 1. There are many reasons that we've touched on over the course of this series, that would explain where ethanol has found itself, but I think ASU's Hanna Breetz captured it well.

Hanna Breetz: I've kind of have turned a little bit away from biofuels as an area of study in part because it's so unpopular. Nobody wants to publish papers on ethanol. Nobody wants to listen to these things at conferences. Everyone just wants to talk about EVs. So, I've shifted over some of my research to look at EVs and renewable electricity and things like that. So, I'm a little bit, I'd say the last two or three years, I've kind of stopped going to the ethanol conferences and like stepped a little bit out of the loop on that.

Sarah Mock: But where have the experts, the interest, and perhaps most importantly, the money gone instead? Vonnie Estes offered one observation:

Vonnie Estes: Suddenly all the people that have been put putting money in clean tech, which cellulosic ethanol was part of, start - they kind of did the same pivot towards because people were starting to talk about ag tech. And so, I sat on probably five panels of clean tech investors trying to pivot to ag tech and the title of the panel was always, "Is ag tech, the new clean tech?" So, there was this whole industry just kind of pivoted to, "Okay, agriculture looks good. Let's look over here."

Sarah Mock: Many of these investors who were initially intrigued by the promises of corn or cellulosic ethanol, have likely moved on to invest in technologies like ag carbon markets. Hanna says that when surveying this world, especially at the intersection of liquid fuel and carbon markets, farmers and investors alike should exercise caution.

Hanna Breetz: The over-promising in emerging technologies for de-carbonization and energy, there's so much hype, everyone's always over-promising and sometimes they over-deliver.

But I have, I played a fun game with my students almost where I love to show headlines and over and over the way that everybody's described things as a "game changer" – "this technology is going to be game changer." "This is a game changer." I just tell them every time you see that word, be very cautious. It's a joke. It's a joke in my class, game changers, because they're the history of over-promising in clean energy has been bad for many things, except, solar and wind have over-delivered, but for many other things, there's always a lot of over promising.

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Sarah Mock: And yet, despite all the headwinds and disinterest and the problematic over promising, Hanna herself hasn't given up biofuels, not only as a market, but as an interesting idea, worthy of seeing into the future.

Hanna Breetz: It's like in one little microcosm, all these different complex systems coming together of ag and energy and everything else, and like human society and urban planning and blah, blah, blah. And it's just like, God, just such a rich area. And I wish more people were interested in talking about it and that's been. I have one other colleague at ASU who has studied biofuels. And both of us will laugh sometimes where we're like, "Oh my God, he's been all these years building up our expertise during our PhDs in this area because at that time that's what everyone thought the future was going to be. And now not only does like no one care in environmental land, they don't even want to hear about it." Even though, I'm like, whether you think ethanol is good or bad, it is a huge part of our energy sector. You can't ignore it. Like you need to talk about it and think about it and figure out ways to make it better and figure out ways to make it work or not - but it's an important thing to be discussing and everyone's attention is just like solely focused on EVs as this silver bullet. I have to believe that at some point the pendulum is going to swing away from EVs to where, I don't know.

Sarah Mock: Hanna's comments brought me all the way back around, to the conversation David and Brent had at the very beginning of this podcast.

David Widmar: It's human nature to look for quick solutions to hard problems. Society will very likely be thinking about different challenges that it needs to tackle in 10 or 20 years down the road. And so, ag carbon could find itself on the other side of that argument. And in fact, I think there are a lot of technologies out there that are going to think about this. So, right, batteries - batteries right now are sort of going to solve all a lot of problems. How long will that still be a problem that we need to solve and how long until, society views, you know, lithium-ion batteries as having a bigger footprint than we currently see, right? Or more negatives than maybe positives. So, it's just always important to recognize the problems that society wants to tackle changes. And as we do that the methods that we use to size up the challenges change. And so, we might have different calculus for how we evaluate these priorities.

Sarah Mock: David's mention of batteries here is telling, because what do electric vehicles use, but a lot of lithium batteries. Lithium mines in Nevada are already raising environmental concerns, and it seems more than possible that at some future time, we take as skeptical a view of lithium batteries as we currently are of corn ethanol. Will ag carbon markets have helped clean up corn ethanol by then? Or will some kind of cellulosic ethanol or other advanced biofuel be more economically viable? Without policy intervention, it's difficult to predict which technologies will triumph, but what's clear at this point is, every solution has its tradeoffs. The best solution depends on what we care about the most, and the solution that we actually end up choosing, depends on even more variables, people, and priorities than that.

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There are still many, many uncertainties in the future of the ethanol sector. Many of which are dictated by events happening well outside the ag space and beyond agriculture's sphere of influence. But for the time being, it seems likely that corn does not have an uncertain future as part of the fuel market, because regardless of the consequences, internal combustion engines seem here to stay, at least for the next 30 years.

We didn't talk very much about ag carbon markets today, mostly because these markets have a long way to go before, they face the challenges that the ethanol sector is dealing with today.

Nevertheless, here we are. We have one episode left, where David, Brent, and I will look back at the lessons we've learned this season, about both ethanol and ag carbon markets. We'll tie up a few loose ends, and see what we've found as far as answers, to whether or not, corn will save America.

Next time.

AEI Presents Corn Saves America is a production of AEI Premium, produced and edited by me, Sarah Mock, with special thanks to David Widmar, Brent Gloy, and Sarah Hubbard.

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