De-Hyping Hydrogen

https://www.climateone.org/audio/de-hyping-hydrogen
Recorded on October 10, 2025

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Ariana Brocious: This is Climate One. Hydrogen has been touted as the gas that can help decarbonize some of the most difficult sectors.

Hilary Lewis: We use coal today to make iron and steel, but we can replace that coal with clean hydrogen made from 100% renewable energy.

Ariana Brocious: But for some, a hydrogen pipeline proposed across the Navajo Nation feels like more of the same historical energy exploitation:

Eleanor Smith: Water intensity, energy intensity, and none of this hydrogen would benefit their communities, directly. This is all hydrogen for industrial use off the reservation.

Ariana Brocious: And with advances in renewable energy and power storage, for most uses, hydrogen just can't compete.

Joe Romm: As it turns out, it's gonna be a very long time before we ever get green hydrogen near an affordable price.

Ariana Brocious: De-hyping Hydrogen. Up next on Climate One.

Ariana Brocious: Kousha, do you remember the first time you heard about hydrogen? As a technology?

Kousha Navidar: Yes. 2004, and the reason I remember that year is I was in driver's ed and they asked us to do a project on any car technology that interested us. And so I, I asked Jeeps, do you remember that website?

Ariana Brocious: Oh my gosh, that takes me back.

Kousha Navidar: I didn't use Google. I used Ask Jevs and I found this article about a car that runs on hydrogen power and the kicker. And I remember saying this line in driver's ed class, when I reported it, it was like, and the only thing that comes out of the tailpipe is water. And I was so jazzed about it and I thought, when I can afford it, I'm gonna get a car that runs and only emits water 20 years later.

Still haven't gotten that card. How about you?

Ariana Brocious: Yeah, I mean they do exist, but they are certainly not common. Yeah, I have a similar story. Not as long ago. I was doing some reporting a while back, maybe 10 years ago, and ended up talking to someone at NRL, the National Renewable Energy Lab, and this person was just all a buzz about their hydrogen fuel cell cars and telling me all about it, how I had come drive one.

And even then I remember thinking, oh, that's cool. That's like a newer technology. Even though it wasn't, it had been around forever, but was not widely used.

Kousha Navidar: And we both have personal histories. A lot of people do. 'cause there's a lot of hype around it. And that's what we're talking about today. It's what hydrogen energy could promise and where it's fallen flat. I'm Vidar,

Ariana Brocious: I'm Arianna Brocious.

Kousha Navidar: is Climate One.

Ariana Brocious: Over the decades, there has been a lot of hype around hydrogen.

Kousha Navidar: If you will.

Ariana Brocious: No I think I won't. What's the audio version of an eye roll?

Kousha Navidar: Oh man, that's tough. Foot fair. Okay.

Ariana Brocious: Okay. Okay. Anyway, hydrogen fuel cell technology was supposed to make zero emission cars and trucks as convenient as their fossil fuel counterparts.

Kousha Navidar: That didn't happen, but the hype isn't over. President Biden's Inflation Reduction Act provided significant tax credits for clean hydrogen production, but because of the Trump administration, a lot of those incentives have been rolled back and the industry is facing a pretty uncertain future. And of course, not all hydrogen is created equally.

Ariana Brocious: Right. You can make hydrogen a lot of different ways. A lot of it's made from methane gas, but this releases carbon dioxide emissions. If you capture and store those emissions from making hydrogen with natural gas, that's called blue hydrogen, but you can also make hydrogen from renewable energy. This is called green hydrogen, but it takes a lot of energy.

Kousha Navidar: Here's the thing. When hydrogen is burned in a fuel cell, it only produces water. It's amazing.

Ariana Brocious: Right, and that's why hydrogen carries this kind of green halo as a climate friendly energy strategy. So today we're breaking down the hydrogen hype and visiting one place where this is affecting real people.

Kousha Navidar: In 2021, Tallgrass Energy approached the Navajo Nation about developing a

hydrogen pipeline through its territory intended to link up with new hydrogen facilities in the Four Corners region.

Ariana Brocious: The Navajo Nation has been subject to decades of fossil fuel energy production, the benefits of which have largely been exported off the reservation. Think about all the coal-fired electricity sent to cities like Phoenix and Tucson and Las Vegas while the pollution of air, land, and soil has been left behind.

This hydrogen project caught my attention because it doesn't exactly make sense. Hydrogen is hard and dangerous to ship in its gaseous form. It's best to make it and use it on site.

Kousha Navidar: And opponents to the proposal, like the group, Sacred Water Speaks. Say, making hydrogen from methane gas isn't a climate solution, nor is it an economic boon for their tribe.

Ariana Brocious: Now, the company plans to run methane gas through the line instead. But I still wanted to know how this hydrogen pipeline proposal came about. So I spoke with Eleanor Smith – a Community Organizer with Tó Nizhóní Ání or Sacred Water Speaks.

Eleanor Smith: Our former community organizer, Jessica Keetso, she discovered that a company by the name of Tallgrass Energy had approached our Navajo Nation president, who at the time was Jonathan Nez. And they were talking about developing plans for a hydrogen pipeline through our Navajo Nation. It would be over 200 miles in length, coming in at Hogback New Mexico and going across our reservation into Arizona and exiting at Cameron, Arizona. And this pipeline would be carrying hydrogen, which would be produced in this area. I live in the four corners area here, at the intersections of Arizona, Utah, New Mexico, and Colorado. So we call this area the San Juan Basin here in New Mexico, and there's two coal-fired power plants. So the plan was going to be to produce hydrogen here in the San Juan basin and then export the hydrogen across our reservation and down into Arizona, down to Utah or Nevada, and possibly down to California.

Ariana Brocious: And you mentioned the San Juan basin, which in addition to coal-fired power also has a lot of methane gas extraction. So in my understanding, the plan was to make the hydrogen from methane, that was gonna be the source fuel.

Eleanor Smith: Right. So the blue hydrogen would be created with the feedstock of natural gas and methane, steam methane reform, which is very water intensive, very energy intensive. And as you know, here in the southwest, we've been in a decades- long mega drought. We don't have the water to sustain a project like this. And so, you know, we questioned all of those things, but never received an answer either from our tribe or from the companies.

Ariana Brocious: What did your organization think about this when, when you learned of it?

Eleanor Smith: So initially, Jessica, did all her research about blue hydrogen, which was the plan, consulting with scientists. And then in 2023, I believe it was that, the Institute for Energy Economics and Financial Analysis. They did a study of blue hydrogen with carbon capture sequestration, and they found that it's not a solution for climate change. The developers were touting that they could capture 95% of carbon emissions. When IEEFA could only, under the best conditions, could only do a capture rate of around, I believe it was like 65%, which was, you know, exceeding the Department of Energy's clean standards at that time.

Ariana Brocious: And this is interesting because I wanna get into how Greenview, the company, began to kind of market this project to the community on the Navajo Nation. And so the nation's divided into chapters. These are akin to municipalities. There was a need to get a certain number of

them to sign on if, if I'm understanding correctly, in order to give approval to the project. Basically like local approval. So when Greenview came to these chapter house meetings and presented the project, how did they frame it?

Eleanor Smith: So, they really didn't start their community engagement until around about 2023 and 2024. We, on the other hand, have been going as soon as we found out about the project and we gained as much information as we could about it. There's 13 impacted chapters. We went out to each of these chapters to inform them about this coming project, to let them know as much as we knew, and that they had a right to say yes or no, you know, to these kinds of projects. And they have a right to free prior and informed consent as an Indigenous community. Pure hydrogen is highly volatile, highly explosive. Mm-hmm. And so that was one of our concerns. The other of our concern is, you know, water intensity, energy intensity, and none of this hydrogen would benefit their communities, directly. This is all hydrogen for industrial use off the reservation. And so the majority of the chapters said, no, they do not want this pipeline. So they passed a resolution saying so. And I believe it was at that time we had 11 of the 13 chapters voting no, that they do not want this hydrogen Pipeline. Greenview is a subsidiary of Tall Grass. And so Greenview kind of took the lead in doing the community engagement and they were touting that this project would provide money benefits to their tribe, to their communities. But they didn't really specify exactly like an amount or anything like that. And in two communities, they went door to door, is our understanding, because we received the reports from community residents, told them, Hey, come out to our chapter meeting this evening. If you do come out, here's a $50 gift card for your gas and your time. And if you help us vote yes on our resolution supporting this project, then we'll give you another $50 gift card at the end of the evening. And that's how Greenview was able to overturn those resolutions from an opposing to a supporting resolution. They were basically bribing community members to do this. And we called out that behavior to our Navajo Nation and our council delegates, told Greenview and Tallgrass to stop that practice. They basically said that you're making it, it looks like bribery and you need to stop that practice. But regardless, those two chapters still have resolutions supporting, whereas before they had resolutions opposing.

Ariana Brocious: Was climate change or carbon dioxide emissions discussed at all in these meetings by Greenview?

Eleanor Smith: No, not really. I've gone, I had gone to some of their community engagement meetings at the chapters. And they, they just focused on how it's gonna benefit the tribe to provide money, how it's going to provide money to, like the grazing permit holders who would approve to have this go through their land. So here on the reservation, we really don't own the land. The federal government owns the land, and so all we have are grazing permit leases which allow us for our livestock to graze on the lands. And then we have home site leases where we can live on the land. And so they were targeting these grazing permit holders, going door to door to their homes and requesting for them to sign waivers of their grazing permit leases. And then paying them an amount of money, and we've heard that they're, they receive payments of around $500, to have this waiver signed and the waiver would be for like 75 years.

Ariana Brocious: Um, wow.

Eleanor Smith: So yeah, so they would give up their grazing land for that amount of time, for a $500 payment. And I'm sure they probably, I don't know if they were promised more money, but that was our understanding of the initial payments that were made to them.

Ariana Brocious: Wow. There's a long history of energy exploitation on the Navajo Nation, particularly with the coal industry, mining and burning it for power, which provided a lot of jobs and revenue to the tribe, but also exported the power off of the nation. Left a lot of pollution behind.

How do you see this new kind of energy project fitting in with that history?

Eleanor Smith: It's just more of the same. We've been designated as a sacrifice zone since the 1920s. In fact, our Navajo Nation government was established, so that the oil companies, oil and gas companies could have a mechanism, a government mechanism to approve oil and gas leases. That's how our tribal government started. It's been over a hundred years now. And we still are being treated as a sacrifice zone. Developers come in, they use our resources, coal, oil, gas, a lot of fossil fuel exploitation, exportation. That's been going on for over a hundred years now. And what are we left with now? You know, now that the coal plants are shutting down and the coal mines are closing, we're left with waste. We're left with contamination of our water. Our aquifers, our lands have been decimated, and we're littered with oil and gas infrastructure that has been abandoned and methane leaks. I mean, the list just goes on. We're a sacrifice zone. We truly are.

Ariana Brocious: So the company behind this proposal, Tallgrass and their subsidiary Greenview, have changed the proposal now. Instead of a hydrogen pipeline, it's going to be a methane gas pipeline. And from my understanding, the Navajo Nation Tribal government has essentially directed the company to kind of begin the process again, because it's a new project. Would the level of community support or opposition have been different, do you think if this project had been pitched initially as a methane gas pipeline rather than hydrogen?

Eleanor Smith: I think it wouldn't have made too much of an impact, I think because, we have natural gas pipelines that run all across our reservation. And so it would've been just kind of like, business as usual. But now that it was a hydrogen pipeline and we didn't know, you know, what the impacts would be. And, we wanted to educate and alert our communities as to what the impacts would be. and yes, earlier this year, Greenview and Tallgrass, changed their plans. They pivoted from a hydrogen pipeline being planned to liquid natural gas. So now the plan is they wanna pipe the liquid natural gas from the San Juan Basin across our reservation and down to Phoenix, Arizona. And we understand for AI centers mainly, I guess. But yeah, that's the current plan that they're trying to implement now. But, they still say in their statement that they still want to leave their option for hydrogen open. So they said at some point in the future they plan on a LNG and hydrogen.

Ariana Brocious: We talk elsewhere in this episode with Joe Romm, who's an expert on hydrogen. And I think the feasibility of that is very complicated in terms of having enough hydrogen that doesn't get overly diluted with the methane gas. We'll get into that more with, with him. but one of the things that's so interesting about this whole story is that hydrogen was what they originally pitched and the logic of that taking fuel stock of methane gas, converting it to hydrogen seems inefficient.

Eleanor Smith: As you might remember, during the Biden administration, there was the funding that came available under Biden's infrastructure law for hydrogen hubs. And so these companies were really going after that funding, hoping to get a piece of it.

Ariana Brocious: Sounds like what you're saying is that they were really seeking to take advantage of some of these federal incentives for the hydrogen industry, and then once those kind of changed, went away, we've seen a lot of changes and pull back under the Trump administration. They've just kind of pivoted as an energy company to something else.

Eleanor Smith: Yeah, so they're basically going after the federal funding, federal incentives that would've been available.

Ariana Brocious: Why does Tó Nizhóní Ání oppose this project?

Eleanor Smith: It's just more fossil fuels. We would like to see a transition, a just and equitable transition to sustainable renewable energies. We've had more than a hundred years of fossil fuel exploitation. And, we're all dealing with climate change. We need to transition to cleaner, sustainable, renewable energies. We really don't have the water to give away to industry. We're very scarce with our water here in the southwest, being in a mega drought. We need to think about real solutions, proven solutions for climate change. That we will support, but we just as an organization, Tó Nizhóní Ání, does not want to support any more fossil fuel development. We all, as a nation, as a world, we really should be transitioning away from fossil fuels.

Ariana Brocious: A year ago we spoke with Tony Skrelunas, who at the time and I think still, is involved in economic development for the Navajo Nation, and he was telling us about some of the things that the nation is, is pursuing as alternate ways of generating revenue. Some of it's tourism based, some of it's tiny home manufacturing, things like that. I'm curious what kinds of energy development you would really like to see the nation pursue, and if that's happening,

Eleanor Smith: Yes, we would like to see more wind, more solar development, geothermal where it's feasible. Those would be the better investments for companies and for our nation really to provide for our people. You know, we still are a nation where, about 30% of our people still do not have access to indoor plumbing to, to water nor electricity. So to move to solar generated power or wind generated power, those would be better for our people. We're hoping that our tribe would make the moves towards this type of development, but they keep going back to fossil fuel development. You know, our current Navajo Nation president, who is Dr. Buu Nygren, was seen in Washington DC with Donald Trump supporting more coal development and that's to us going backwards. We need to move forward. We, are a Navajo Nation who had the richest resources, I think, of any tribe, because we have the largest land base of any tribe. So we should have been the richest tribe, financially we should have been so much better off, but every time, every turn, we just received pennies on the dollar for our coal, for our resources, and we're actually in a worse state now than we were when we, you know, first started, more than a hundred years ago. So, yeah. We need to transition it's way past time to transition to sustainable renewable energies.

Ariana Brocious: Eleanor Smith is a community organizer with Sacred Water Speaks, Tó Nizhóní Ání. Thank you so much for joining us on Climate One.

Eleanor Smith: Thank you.

Ariana Brocious: We invited Tallgrass Energy and the Navajo Nation to discuss this project. Both declined.

Ariana Brocious: Coming up, the benefits of hydrogen just don’t compare to those of low-cost renewable energy storage:

Joe Romm: So what I thought 20 years ago was that if you can make an electric car work, a hydrogen car would never compete 'cause it's gonna use, 20% of the original renewable electricity and the electric car might use 80%. And that factor of four is so much greater efficiency that it's unlikely to win in the marketplace.

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

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Kousha Navidar: This is Climate One. I'm Kousha Navidar.

For decades, hydrogen hypers promised that it'd be a revolutionary tool in the clean energy transition. And that's because hydrogen can be a fuel **and** an energy carrier. And when made with renewable energy, its only byproduct is water, which you may recall from the start of the episode that I learned about in driver's ed. But of course, as with all tools we have to address the climate crisis, there are pros and cons to hydrogen. And if we want to deploy hydrogen widely, it has some major hurdles to overcome. So where does hydrogen fit in the modern energy mix?

To get some answers, I talked with the author of "The Hype about Hydrogen," Joe Romm. He's a senior research fellow at the University of Pennsylvania's Penn Center for Science, Sustainability and the Media.

Joe Romm: Hydrogen has a use today in commercial markets, which is as a chemical feed stock, to make most famously to make ammonia for fertilizer. It's also used for other purposes. For decades, people have tried to turn it into something more than just a chemical feedstock, which is to say an energy carrier that you would make one place and transport to another place, and then use the way we do electricity, right? Electricity is an energy carrier. You make it at a power plant, you have electric power lines and you have a, you know, plug somewhere and you get the electricity from there.

Kousha Navidar: So what made hydrogen appealing as that like electricity replacement?

Joe Romm: Well, what makes it potentially appealing is that it is a molecule that, is the lightest molecule and it does carry energy. And what made it especially compelling is that when you run it through a device called a fuel cell, which is sort of like a continuously fueled battery. You put in hydrogen and oxygen and you get electricity, heat, and water out. So the, the emissions are just water. So people thought, and back when I was at the Department of Energy in the 1990s, there were some breakthroughs that led people to think, oh, we maybe can make fuel cells. That could work in a car, that hey, this car could emit nothing but water. Right? And it would be an efficient device because fuel cells are relatively efficient. There are lots of challenges, but back then we didn't know for sure whether you could run a car on electricity directly, because batteries weren't very good back then and so it was unknown, which would be the winner in the marketplace.

Kousha Navidar: You mentioned there's some challenges. Let's talk about that briefly. What makes it hard to use in practice or to transport safely?

Joe Romm: Well, the biggest problem for a vehicle is that you have to have the fuel accessible everywhere, right? Petroleum has a big advantage. Over a century we've built in this country, like 150,000 gas stations, right? So no one worries that, oh, I'm gonna show up somewhere and there won't be fuel and I can't get it in my vehicle quickly. Right? That's like a trillion dollar sunk cost of the entire delivery system for the petroleum and refining and all that stuff. So the issue with hydrogen is that hydrogen is not available in very many places because the ways that you can make it are kind of expensive and it's a very dangerous gas, unless you treat it very, very carefully.

Kousha Navidar: So tell me about the safety aspects of it then.

Joe Romm: Well, the hydrogen is the lightest, smallest molecule, so it will leak through almost anything and it will embrittle most metals. You can't, for instance, put hydrogen in a regular natural

gas pipeline. You'd have to design a special pipeline, otherwise it will kind of go through into the steel and embrittle it. It's odorless, it's invisible and it burns invisibly. So if you take this leaky gas that is odorless and invisible, right, you, you can have it build up in buildings and other places. And, and so you have to have massive ventilation and distance between that building and other buildings. And so and if you wanna transport it, you're gonna basically have to compress it or liquefy it, which is going to use energy. Because again, by volume it's the most diffuse gas there is, right? So, you either gonna have a compressed gas canister, but you're moving around mostly the canisters, right? Because there's not much gas in there. And if you liquefy it. Well that uses 40% of the energy in the hydrogen 'cause you're gonna take this down to below negative 400 degrees Fahrenheit. So it has all of these complicating features, which is why no one's ever, no country, including this one's ever built out a hydrogen delivery infrastructure, right?

Kousha Navidar: So, so I hear in there two things. One, the concerns being there are actually more than two things, but two things that just pops up where there's efficiency issues with transporting it. There's safety issues with how it gets into all the cracks and it's volatile. So why is hydrogen billed as a green fuel and a climate solution today?

Joe Romm: The view has been, well, we can make hydrogen from renewable sources, but through electrolysis, right? Maybe people did that in their chemistry class. They run electricity through water at and at the two ends, oxygen bubbles up one place, hydrogen bubbles another. So if you run an electrolyzer on renewable energy, you could say, oh, I'm gonna have green hydrogen. So this would be a green fuel. The challenge, of course, is why didn't you just use the renewable electricity directly?

Kousha Navidar: In the first place. Yeah. Right. Yeah.

Joe Romm: And that, and that was something I pointed out 20 years ago in a book called “The Hype about Hydrogen.” It was not an original idea of mine, but I tried to elevate this notion that you have the renewable electricity, you could run it through an electric power line and charge up a battery on a car. And discharge and then discharge the battery into the electric motor if you had one. Run your car and you would only lose maybe 20% of the electricity along the way. But for hydrogen, you'd have to buy the electrolyzer. You'd have to take the renewable power and throw away about 30% of the energy to electrolyze to create the hydrogen. Then you gotta use energy to compress or liquefy and transport the hydrogen. Then you're gonna run it through the fuel cell. Which is, you're still gonna lose half the energy then, and you're left with maybe 20% of the original electricity and you're just gonna run it through the same electric motor. Right. So what I thought 20 years ago was that if you can make an electric car work, a hydrogen car would never compete 'cause it's gonna use 20% of the original renewable electricity and the electric car might use 80%. And, and that's just a, that factor of four is so much greater efficiency that it's unlikely to win in the marketplace.

Kousha Navidar: So then who is still backing it and why?

Joe Romm: Well first of all, the venture capital community and the startup community gets swept up in bubbles and, and hype, and that has led to staggering amounts of misallocation of funding. You know, I'll just be, you know, be very honest. The people who have taken a very serious look at this do not think there are very many applications of hydrogen as an energy carrier. We are gonna have to replace the hydrogen we use in fertilizer production. And in the other uses we have, it's also actually used to make reformulated gasoline, adding hydrogen to petroleum to make it burn cleaner. But to give you an idea of just how inefficient this whole effort is, if you wanted to just replace current hydrogen use with green hydrogen, you would need the equivalent in electricity generation by renewable sources of the entire US electric grid.

Kousha Navidar: Oh wow.

Joe Romm: of all sources, right? So you have to build a whole ‘nother United States. So the point is, we're gonna eventually may have to do that, but that's probably gonna take up 25 years and I don't if you wanna focus on that, you know, focus on that, but the notion that we're then also gonna run vehicles on it or, do heating with it.

Kousha Navidar: Yeah, it seems pretty far-fetched.

Joe Romm: Right. And what we didn't know then was that there would be all these advances in batteries. Right. Which were the game changers and in electrification technologies.

Kousha Navidar: So you, I wanna touch on this because the costs of solar and wind power and lithium ion batteries, which you're discussing, have dropped dramatically. So how has this affected the relevance of hydrogen in the energy mix?

Joe Romm: Well, I think ironically the drop in the price of solar and wind misled people. It helped bring down the cost of green hydrogen, right? So people thought, oh, green hydrogen is becoming cheaper. It's just gonna keep getting cheaper and cheaper. What I think they missed, the point is that green hydrogen's number one competitor is simply the direct use of that renewables.

Kousha Navidar: You need to make it in the first place.

Joe Romm: So the fact that renewables came down in price doesn't make you more competitive than your chief competitor.

Kousha Navidar: So it's kind of made, has it, has it made hydrogen irrelevant compared to these other fuels?

Joe Romm: Well, I think what made hydrogen irrelevant was the stunning advances in batteries. I think. I think that people are more aware of the tremendous drop in solar and wind prices than they are the fact that battery prices have dropped by a factor of 10 in the past decade, and what's more during the same time, the energy density of the batteries, the amount of energy per unit, volume and weight have also improved dramatically. Right? And that's why electric vehicles have become the fastest growing. In fact, we had peak gasoline vehicles like a decade ago, right? It's all, the growth is in electric vehicles, and, and plugin vehicles. And then there's another revolution that occurred, which is electric heat pumps, right? Because people thought, oh, we are going to need to replace natural gas combustion with something else to create heat, right? 'Cause heat is used in residential buildings, commercial buildings, and of course in industrial settings it's like a third of all CO2 emissions come from heat.

Kousha Navidar: You know what this reminds me of a little bit. Have you seen the movie? Lindsay Lohan was in it, and Tina Fey where they –

Joe Romm: Oh, you mean Mean Girls?

Kousha Navidar: Have you seen Mean Girls?

Joe Romm: Of course.

Kousha Navidar: Okay. You know, the, like they're trying to make fetch happen. It feels like they keep trying to make hydrogen happen. Do you remember that part of the movie? Like for instance, the Biden administration, right. Invest lots of money into hydrogen, including supporting the

creation of like several hydrogen hubs across the country.

Joe Romm: Trying, yes, proposing them. Yes.

Kousha Navidar: Feels like they're trying to make fetch happen a little bit. I don't know if I'm being too glib, but to my knowledge, those haven't really gotten off the ground except perhaps in California, and they were intended to jumpstart the production of clean hydrogen and get it to industrial users. What's the status of them now?

Joe Romm: I agree that these, well, first of all, they're not at all past the initial phases, and the Trump administration is not a big fan of them. And what's more, those aren't actually, mostly green hydrogen, right? This is important, right? The easiest way to make hydrogen is to take natural gas, which is mostly methane. Methane is CH four one carbon, four hydrogen atoms, right? So it's just loaded with hydrogen, right? So vast majority of hydrogen in this country is made by reforming methane, right? Just stripping out the hydrogen and then you release this carbon, into the air as CO2, right? So, if you want, green hydrogen, which is clearly gonna be much more expensive, right? I mean, there's no getting around that. Fossil fuels are, you know, just lying around everywhere, right? So, yeah, the whole idea of hydrogen doesn't really make a lot of sense in the vast majority of applications. And there are certain very problematic sectors that we all want to deal with. And you can imagine hydrogen being used as part of that solution. The problem is it's not necessarily the only potential winner, I mean, let's talk about flying an airplane, right? That's probably the hardest. Replacing jet fuel. That is a very big challenge. For intercontinental travel, it might only be 2% of global emissions. But it is a very intractable problem. Some people say, oh, well we can use hydrogen to make jet fuel or shipping fuel. And, you could spend a lot of money doing that, but maybe you should use renewables first to simply replace fossil fuel generation. Right. And all that.

Kousha Navidar: Let's think about this in another way then, 'cause I really like the idea of where investment should go, which you just touched on. Do you think we need government investment to bring down the cost of green hydrogen and make it competitive with other energy sources? Or would you rather see investments like that go directly to like electrifying the country with renewables?

Joe Romm: Right, right. Well, I think when you do the analysis and, and there's a lot of analysis in the scientific literature, right? It's pretty straightforward that if you can use renewables directly to replace fossil fuels, that's a whole lot better than going through this process of throwing away most of the renewables to get hydrogen right, and, and turn it back into electricity somewhere. And so when battery revolution occurred. It became clear to many of us that that meant ground transport was going to be electrified. And when the heat pump revolution occurred in the last 10 years, these things are kind of miracle workers, right? They actually cause more heat inside than the power you put in, right? And so that's why heat pumps have in the last two years started out selling gas, gas boilers.

So the singular point that people miss is this issue of the opportunity cost. Just because you can turn renewables into hydrogen, it doesn't mean that that's the best use of the renewables. If you could reduce three times as much emissions for the same or lower cost with renewables, right? We don't have an infinite supply of renewables. There's not an infinite amount of places you can put renewables, right? And so when you do the analysis, obviously the first thing you wanna do is use those renewables to replace fossil fuel plants. The second thing you wanna do is use those renewables to run an electric vehicle and replace gasoline vehicles. And then the third thing you wanna do is use the renewable electricity to power a heat pump so you can replace burning natural gas, right?

So the point is you can make a very large amount of reductions without trying to make hydrogen.

And you still have to solve how am I gonna distribute the hydrogen?

Kousha Navidar: Yeah. So just to kind of like sum that up, we look at government investment, right now you're saying the opportunity cost is too high. 'Cause the amount of investment you're putting in one place, you could be focusing on these advances we already have that are so great. Yeah, that makes sense.

Joe Romm: And I have, and I released this year a completely revised version of the hype about hydrogen, it's just very hard in this media environment to, to promote good old fashioned things that could get us, let's say, 70 to 80% of the way on reducing climate emissions.

Kousha Navidar: Yeah. You know, elsewhere in the episode we talk about a proposed pipeline to transport hydrogen across the Navajo Nation. Why is such a project not a great idea in your estimation?

Joe Romm: Well, for the same reason that we've been discussing, hydrogen doesn't have a lot of uses, right? If you wanna use hydrogen for a feedstock or something, you should just make it where you're going to use it. And if you're gonna build a pipeline, you know, if you're gonna build a natural gas pipeline, you're gonna run natural gas. You know, sometimes people say, oh, hydrogen ready, but you'd have to spend a lot of money to design a special pipeline that you're probably not gonna use.

Kousha Navidar: Yeah. You know, some might call you Joseph Romm, a hydrogen skeptic. Is that fair?

Joe Romm: Well I ran the hydrogen program and I was a supporter of it then, but you know, over time the reality became increasingly clear. There really haven't been major advances in hydrogen and fuel cell technology.

Kousha Navidar: Let's talk about it more generally, like where you see the, the, the narrative. Do you consider yourself an outlier in holding that view?

Joe Romm: I could give you the names of, you know, several of the leading experts, who make the same point. And I would say a reality came crashing down on the hydrogen myth in the last 12 to 18 months because yes, there were projections by the Department of Energy where I used to work a long time ago that the price of hydrogen green hydrogen would drop 80%, 10% a year from 2020 to 2030. But they were assuming that these electrolyzers would come down in price down a learning curve. But most technologies do not come down a learning curve because electrolyzers are an old technology, a lot of steel and cement things that don't come down, we don't get smarter at doing. And so what happened was when COVID hit and then when inflation hit, electrolyzers jumped up in price, 50% between 2020 and 2023 instead of going down 10% a year. And so places like Bloomberg New Energy Finance and others redid their analysis and said, oh, we were wrong. This is not coming down a learning curve. And as it turns out, it's gonna be a very long time before we ever get green hydrogen near an affordable price.

Kousha Navidar: I think that's a great place to come to the last question about hydrogen, because we've gone through a lot of the misconceptions, a lot of the challenges, a lot of the opportunity costs. So you're in an elevator with somebody and they wanna talk to you about hydrogen. You've got like five floors before the elevator dings. What do you wish that person better understood about hydrogen?

Joe Romm: That it's a very inefficient gas as an energy carrier. Yes. Use it as a chemical feed stock.

Maybe we can green it over time, but it's not gonna replace electricity or natural gas or gasoline as an energy carrier, I'd also want them to know, because we didn't get to this, that because it's the leakiest gas, it actually has a very high global warming potential. It doesn't directly warm the planet, but it extends the lifetime of methane, which is a major short-term warmer. So in fact, over a 20 year period. It will heat up the atmosphere 35 times faster than CO2. So, it's just got a lot of problems that haven't been solved. Let's keep doing R&D for some certain niche applications, but we have so much work to do, just electrifying the economy and building out the renewables, plus storage and improving storage so that it works over longer and longer periods of time.

Kousha Navidar: Yeah, hydrogen seems enticing. But buyer beware, there's a lot else that you could do that's better bang for the, the buck and for the planet.

Joe Romm: Absolutely. Much better bang for the buck. Yes.

Kousha Navidar: While I've got you listeners, please indulge me because I'm very interested in this as well. When you, Joe, are not talking about hydrogen renewables, I found out you are also working on a podcast, one with your daughter, and it's about not hydrogen, right? Think it's Taylor Swift. You wanna tell me about that a little bit?

Joe Romm: Yes. I've used to blog a lot. Climate progress. So I learned a lot and I studied a lot about storytelling and in fact, I also had a daughter.

Kousha Navidar: What's her name? What's your daughter's name?

Antonia is her name, but she's gotten to the name Tony these days. And so I learned, you know, I had a PhD in physics, so I thought I knew a lot about communications, but I only knew about narrow communications. And so I ended up realizing that telling stories is what, you know, communicating is really about. So I learned that you could teach storytelling with lyrics. And then along came Taylor Swift, who has really emerged as one of the great storytellers of our time and Time magazine, you know, named her, you know, the, the person of the year, December 2023, and said she was the master storyteller of the modern era. And so. I realized, oh, she's using the same tricks that Shakespeare does, and she's sort of a modern day Shakespeare, and so why don't we use the lyrics of Taylor Swift to teach the elements of storytelling? And so this podcast decoding Taylor Swift, we launched in July. And it's become pretty popular. Uh, it's like number two on the music, uh, category of Apple podcasts. And we got a production deal at the end of August.

Kousha Navidar: How was it making a podcast with your daughter?

Joe Romm: You know, it is the most fun. And there's a lot of, you know, back and forth, kind of boomer zoomer discussions.

But it's good because I look at Taylor's songs one way,

Kousha Navidar: And she looks at them another.

Joe Romm: She looks 'em at another way, and then we sort of come to this synthesis. Um, and, uh, you know, I think people will, if they listen to the podcast, the goal is okay, entertainment.

Kousha Navidar: Mm-hmm.

Joe Romm: Maybe learn, more about Taylor's skills, how good she is, the storytelling, but also what her songs, some of her songs, some of the deeper meaning in her songs, but also how to do right stories, because storytelling is like one of the most important skills any human being can have,

right? So it's a good, these are important skills to know how to tell a story, how to use, tell the hero your hero's journey story, right? All of that stuff.

Kousha Navidar: That's great. Well, Joe, it's been such a pleasure getting to talk to you, Joseph Rahm is the senior research fellow at the University of Pennsylvania's Penn Center for Science Sustainability and the media. He's also the author of "The Hype about Hydrogen," which was originally published in 2003 and like we mentioned, was revised and re-released this year.

And along with his daughter, he is the co-host of the podcast we were just talking about, Decoding Taylor Swift. Joe, thanks for hanging out with us.

Joe Romm: Oh, thank you so much for having me.

Kousha Navidar: Coming up, steel production helped build the American middle class, but it's been built on coal – harming our health and atmosphere. Green hydrogen could change that.

Hilary Lewis: The good news is that we can keep the jobs in the economic investment of steel making and get rid of the harmful pollution.

Kousha Navidar: That's up next, when Climate One continues.

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

So as we've heard today, maybe hydrogen isn't the magic energy some hoped it would be. But it still has a role to play in certain industries. One major one is the manufacturing of steel. We rely on steel for so many things – it's in our cars, in office buildings, in our homes. It makes modern life possible. And… about 70% of global steel is made with coal, accounting for about 8% of global emissions. It's considered one of the hard to decarbonize sectors.

But green steel – made with hydrogen from renewable energy – could help slash emissions. And to find how green steel could affect the industry and the environment, I talked to Hilary Lewis, Steel Director at Industrious Labs.

Hilary Lewis: So today we make most new steel from iron ore. And the way that we get the iron out of the iron ore is we use coal. And coal as we know, is a super polluting fossil fuel. And similar to how we make electricity with coal when we burn it, and use it in the steel making process, it releases a ton of climate pollution, but also health harm and pollution.

Ariana Brocious: Right. And today, in the US, most of the industry, the steel making industry is concentrated around the Great Lakes because of its historical needs to acquire raw materials, right?

Hilary Lewis: Yes, exactly. So in order to make, steel from iron, you need a few ingredients. One, you need iron ore that comes from Minnesota typically, and the iron range. And then you also need coal, which comes from Appalachia and they kind of meet in the middle around the Great Lakes. And that's why the industry is really centralized there.

Ariana Brocious: And these US steel producers are employers and they contribute to, you know, a whole bunch of different industries that depend on steel, but the process of making steel with coal does result in a lot of human and environmental health impacts that come from this industry.

Hilary Lewis: Yes, there is good and bad associated with the way we make steel today. It is important to remember that these industries helped build a modern middle class. In places like Indiana, the great migration, this helped build, particularly the Black middle class. And today what

we're seeing is that the health harming pollution is also burdening these communities with legacy pollutants and health harms that are hard to escape. So our analysis most recently showed that, the current industry is responsible for almost 900 premature deaths annually because of the pollution from this coal-based process. But the good news is that we can keep the jobs in the economic investment of steel making and get rid of the harmful pollution. So that's what I'm excited about in the future of the steel industry.

Ariana Brocious: Yeah. Well thank you for that very nice segue. So, how does hydrogen fit into this process of decarbonizing?

Hilary Lewis: Yeah, so we use coal today to make iron and steel, but we can replace that coal with clean hydrogen made from 100% renewable energy, and that dramatically reduces both the climate and health-harming pollution. To give you like a very simple chemistry lesson, essentially when you mine iron ore in places like Minnesota, you're getting FE, which is iron. And O, oxygen or rust, and the process to make steel is the process of removing that rust. So you need something to bind with that oxygen. Today, that's coal or carbon C, and you're making CO2, also known as carbon dioxide or climate pollution. But if you replace that C with an H, H2 from hydrogen, then you have H2O, water, a much friendlier byproduct of the process. And so that's essentially the process that we're looking to create here is moving from carbon and coal to hydrogen and water.

Ariana Brocious: And what's the cost difference today between these different fuel types or, yeah. Would you call it a fuel?

Hilary Lewis: Yes, it is a fuel, so it is both a fuel and it's a reducing agent, you can think of a blast furnace or this newer type of furnace called a direct reduced iron furnace as like a cauldron, and you have something heating the cauldron underneath, and that can be, one use for coal or hydrogen or gas or some other fuel, but also within the cauldron you're removing that oxygen. And so that's the role. It plays a reducing agent. So these fuels have two different roles.

Ariana Brocious: Okay.

Hilary Lewis: And you were asking about cost. So most people, myself included, are never going to buy a coil of steel. What we're going to do instead is we're going to buy a car, and that uses about a ton of steel.

And what the head of ArcelorMittal, one of the biggest steel manufacturers globally has said about price, is that it would increase the price of a car, approximately $100 to $200. And we know that the average car in the US is pushing $40,000. So $100 to $200 on the price of a car is not that significant.

Ariana Brocious: So for a consumer, this cost really won't come down to mean that much, but I can see it being a hurdle for industries adopting to a new fuel that might be much more expensive on their end.

Hilary Lewis: It is a hurdle. But when companies are making decisions about where to spend money and where to increase expenses, they're also looking down the line at the final buyer or their next buyer. Do they have the ability to absorb those costs? And so I guess what I would offer is that, yes, for the biggest markets, and in the US the biggest market for coal-based steel is the automotive industry, accounting for about 60% of that market, there is an ability to absorb these costs.

Ariana Brocious: So you mentioned this different kind of furnace, which I think is interesting to point out to listeners. So there's already a few facilities in the country that have this Direct Reduced

Iron furnace that could burn hydrogen. It's ready for that. At present, they use methane gas. There are no green steel facilities in the US right now, but Hyundai is planning to build one in Louisiana. So I wanna talk about that project as well as some other developments that we're seeing. So let's start with that project. Why is Hyundai into this industry wanting to build green steel here in the US?

Hilary Lewis: Yeah, so this is a very exciting development. Hyundai has announced that they're planning to build a new direct reduced iron furnace in Louisiana. And the, you know, key market that they're planning to serve as the automotive market makes a lot of sense. Of course. Hyundai is both a steel company and an automotive company.

And so they're going to have a built-in customer, but they're also going to have excess capacity from what we understand. And so they can sell to their competitors, their automotive competitors, and help clean up the entire industry in the US. So that is very exciting. And I think the reason why they are interested in entering this market is because of the opportunity. Automakers in the US and globally have set climate targets that commit them to transitioning to cleaner materials, including steel. And so someone needs to be making that steel and we aren't seeing that from the legacy steel producers in the US. And so they're coming in with their own new innovative technology, and their workforce and their investment and making it happen here.

Ariana Brocious: So to recap, there is a demand among US automakers is what I hear you saying for green steel, for, steel made with renewable energy. However, there's really no supply chain for that in the US right now.

Hilary Lewis: Yeah, so the way that I would kind of characterize the demand is that some major companies like Ford and GM have signed the First Movers commitment, which is a commitment that any company can join to buy green steel, you know, made without fossil fuels or with a meeting, a very low threshold of pollution.

And so what they need to be doing right now is figuring out how to actually meet that commitment. And this is one way to do that.

Ariana Brocious: And as I understand, there's also some really new news from GE about acquiring some clean steel. Is that right?

Hilary Lewis: Yes, so just last week we saw a very exciting announcement from SSAB, which is a Swedish company and GE and their wind turbine department. They've announced an offtake agreement to build some of the first wind turbines in the US with low embodied emission steel. And this is the first time we've seen green steel on the market in the US going into a real product. So what's interesting about this, particularly from a competitiveness angle, is that the green iron made without fossil fuels is being made in Sweden and then shipped to the US and finished in one of our steel making facilities. In Iowa that's owned by SSAB, and that's how they're able to come up with a clean steel product.

But today, we don't have the technology within the United States to make that product. So if we want to be serving these types of customers that GE is proving to be, we need to onshore that whole supply chain and be making iron in the US also without fossil fuels.

Ariana Brocious: Mm-hmm. And there's discussion in the space, especially around hydrogen manufacturing, that there's kind of like a chicken and egg dilemma where you need to have sufficient demand in order to, you know, incentivize the creation of it, and vice versa. So, you mentioned when we spoke before, the importance of off-take agreements essentially committing to

purchasing a certain amount of this material before it's made.

Are we seeing other steps by industry, by major steel consumers or other expressions of interest, that indicate that there's a growing demand?

Hilary Lewis: Yeah, I mean I do think that this GE commitment, and the First Movers Coalition commitments are some of the first that I would point to. But there are other commitments like the SteelZero commitment. And other companies that are interested in buying low-embodied emissions materials.

There are also government programs, some of which have been delayed or canceled that were part of the Inflation reduction Act, to get governments to buy low-embodied emission materials as well. So I think we are, we can see in, in the market that there's a lot of interest, but getting that interest to that final signature has definitely been a challenge.

Ariana Brocious: Yeah, you just touched on the federal incentives, and I wanna quickly address that 'cause I think it's important. The Biden administration put something like $6 billion towards funding industrial decarbonization projects. That included some of these projects around iron and steel. A lot of those were, as you mentioned, frozen, the funding was frozen and then canceled ultimately or defunded, by the Trump administration.

So are there any of those projects that got some federal funding that are still going on?

Hilary Lewis: There are a few that are hanging on, but I think they are all at risk. So yes, as you mentioned, some of them had their funding pulled already. Some of them are appealing. Others do seem to be moving forward. But I guess why I say they're at risk is because, you know, it seems to be mostly on paper and it's unclear exactly where this is going.

But there are some really exciting projects that I do hope move forward. You know, one I had mentioned, there's an aluminum smelter, it would be one of the first aluminum smelters built in the US in like 40 years. And then we know that the Cleveland-Cliffs facility that was supposed to get $500 million in Ohio has not actually had their grant canceled, although they've said that they're no longer pursuing their original project. So that's both a risk and an opportunity. It's really important that whatever Cleveland-Cliffs puts forward is really a fossil free alternative, and it's not clear that that's what they're planning to do. And it's also important that, you know, the government keeps its commitments and when they offer these transformative grants, follows through on these projects.

And that's not something we're seeing from the Trump administration.

Ariana Brocious: Right. And there's a lot of talk from the Trump administration kind of in the, in the national moment we're in around competitiveness, US competitiveness, particularly in the energy space. And I'm wondering, you mentioned a Swedish company that's doing some green steel. Outside of the US, what is the landscape like in terms of advancing in this, in this industry? Are we losing pace? Are we not keeping pace with other countries that might be developing this faster?

Hilary Lewis: Yeah, I mean I do think Sweden is the example to point to here, and it is very telling that there's at least one example of us importing iron from Sweden to finish here, and eventually sell in the domestic market. I don't think that's anyone's vision of reshoring and reinvigorating American manufacturing, and that's certainly not how we stay competitive.

Just expanding a little bit more globally, there are other examples, certainly of direct reduced iron investments. There are fewer examples that are going to use green hydrogen. I think globally that market needs more incentives and investments to develop. But there are other projects across

Europe.There are some in Mexico and Canada. And I think notably China, when it decides to invest in these types of technologies, can make big leaps and bounds quickly. And so I think that's another place to keep our eye on.

Ariana Brocious: So I wanna come back just once again to hydrogen and kind of reiterate for listeners why we're talking about steel, in a conversation about hydrogen. So why is making steel with green hydrogen such a good solution?

Hilary Lewis: Yeah, I think steel, and I think there are a few other examples – fertilizer is one other one that I would name is one of the few places where we don't have a ton of alternatives. And so we need to be saving our green hydrogen for these applications where we don't have great alternatives.

Ariana Brocious: So when we talk about decarbonizing, a lot of that really comes down to electrification. In many places, just substituting electricity made from renewable energy is a way to decarbonize that isn't true in the steel making industry.

Is that right? That's really not very possible.

Hilary Lewis: That isn't true, yet. There are some exciting startups that are looking at how to move directly from electricity to iron and steel making, and I hope that they are successful and they are making great progress. But today the only commercially viable alternative that we have to coal-based steel making is this direct reduced iron process and using green hydrogen, that's how we can get closest to a fossil free steel product.

Ariana Brocious: Hillary Lewis is the steel Director for Industrious Labs. Thank you so much for joining us on Climate One and sharing your expertise.

Thanks for having me.

Kousha Navidar: Hey listeners, it's the end of our show, and that means it's time for Climate One More Thing Ariana. Fun fact. Thursday, October 8th was National Hydrogen Day. Happy Hydrogen Day to you.

Ariana Brocious: Oh, I don't know. That feels like a made up thing. It's like National Donut Day or national, like Green Parrot Day or

Kousha Navidar: Fair enough. What did you get?

Ariana Brocious: Mine is also related to hydrogen because if after this entire hour you still wanna know more, I have a great podcast recommendation. It's called the Big Switch, the Hydrogen Rainbow.

The episode is the Hydrogen Rainbow Podcast, is called the Big Switch. It's great. It's a very funny and educational explainer on all the different colors of hydrogen and what they mean, and it opens with a great little song about all the different colors. So highly recommend if you just wanna know even more about hydrogen.

Kousha Navidar: Oh, that's great. I'm definitely gonna check that out. Also. Happy birthday. Hydrogen

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