

We're about to give billions of dollars to clean hydrogen. How should we define it?

**A conversation with Rachel Fakhry of NRDC.
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David Roberts

Hello, everyone. Welcome to Volts for March 29, 2023: We're about to give billions of dollars to clean hydrogen. How should we define it? I'm your host, David Roberts. Volts subscribers understand that a decarbonized energy system will require lots and lots of hydrogen to store energy and to serve as a fuel in applications that are otherwise difficult to decarbonize. They also understand that while 95% of the world's hydrogen is currently produced using fossil fuels, there is a carbon free way to produce hydrogen. It involves running electrical current through an electrolyzer, which splits hydrogen out of water.

Volts listeners heard all about electrolyzers a few episodes ago, but the resulting hydrogen is clean only if the electricity that is run through the electrolyzer is clean. That is the recipe for clean hydrogen, clean electricity plus electrolyzers. Democrats also understand the need for clean hydrogen to scale up quickly, and they included tax credits for clean hydrogen production in the Inflation Reduction Act. And therein lies the rub. The IRS is currently in the process of determining exactly how those tax credits will be structured and to whom they will be available. At issue is a question that sounds simple but turns out to be devilishly complex.

What exactly counts as clean hydrogen? More specifically, what exactly counts as clean electricity? The details matter enormously. Up to \$100 billion worth of subsidies are on the line. Big companies from BP to

Next Era are lining up to try to make the standards as lax as possible to maximize their short-term profits. But lax standards could perversely end up increasing greenhouse gas emissions as electrolyzers come online, gobble up the available clean energy, and push grid managers to start up fossil fuel plants. To get to the bottom of all of this. I'm excited today to talk with Rachel Fakhry, who runs the hydrogen and energy innovation portfolio at the Natural Resources Defense Council, about the technical details of this fight, the ability of the industry to meet higher standards, and the enormous stakes involved for the industry and the larger project of Decarbonization in getting it right.

So with no further ado, Rachel Fakhry. Welcome to Volts. Thank you so much for coming.

Rachel Fakhry

Thanks so much for having me Dave.

David Roberts

You're brave to come on and address this subject. It is big and complex and hairy. There's a lot of ins and outs, "a lot of strands in the Duder's head." So let's start. So we get we need a bunch of hydrogen. We get we need it to be clean. We get basically what clean hydrogen is, sort of. So let's just start first by talking about what are these tax credits? What does the Inflation Reduction Act contain for clean hydrogen?

Rachel Fakhry

So the IRA offers one of the largest subsidies for clean hydrogen in the world. It is a production tax credit which ranges between \$0.6 to up to \$3 per kilogram of each hydrogen produced. And the three kilogram, as I'm sure we'll talk, is kind of the big prize that all the projects are gunning for. It is a technology-neutral credit. So there's no colors green, blue, pink, any of that. It all depends and is tied to the life cycle greenhouse gas emissions of hydrogen. That top prize of \$3 can only be eligible for clean hydrogen that achieves zero point 45 kilogram of carbon per kilogram of hydrogen relative to today's status quo hydrogen that's gas derived uncontrolled, which is roughly around ten.

So to get that top rise, you have to reduce emissions from status quo by 95%, which is a lot.

David Roberts

Right.

Rachel Fakhry

You have to be very clean to get that. And it's a very long list credit. It lasts for ten years for each project that gets it, and projects that commence construction as late as early 2033 would still be eligible. So what this means is that by 2045, you could still have hydrogen projects that are getting taxpayers dollars. Even if we think the technology is going to improve and drop in price and so on, there are going to be projects still heavily subsidized.

David Roberts

Yeah, it's a lot of money. One thing I would add, just in case listeners are not familiar ... listeners have probably heard production tax credit and investment tax credit, PTC and ITC, tossed around just for anybody who doesn't know a production credit, you get a certain amount of money per quantity of the subsidized thing produced. So, in other words, this is you get the subsidy per ton or per kilogram of hydrogen produced versus the investment tax credit, which subsidizes capital costs of building the thing in the first place. And these have somewhat different dynamics, which I think we can return to later.

But this is specifically, it's the production of hydrogen per kilogram that gets the subsidy. And you note the subsidy for the lowest, for the cleanest hydrogen, is \$3 a kilogram, which is huge. What's the next tier like? What do you get if you don't quite reach that threshold?

Rachel Fakhry

It's a big cliff. You drop from three to one dollars per kilogram.

David Roberts

What?

Rachel Fakhry

Yeah. And this is, I think, an excellent indicator of the type of hydrogen Congress really wanted to incense. They really wanted to incent the cleanest of the cleanest.

David Roberts

Yeah. So this is actually an important background fact about these subsidies, is they're non-linear. They don't scale up linearly with the cleanness. There's, as you say, a big cliff like the jump from not meeting that top threshold to meeting it gets you from one dollar per kilogram to \$3 per kilogram, which is a huge increment. So all of which is to say, how you define how exactly you structure who is in that top tier matters enormously. There's an enormous amount of money on the line.

Rachel Fakhry

Absolutely, we'll get to that. But it all hinges on how treasury guidelines will look like for determining the life cycle greenhouse gas emissions, which in turn will determine whether you get the top prize or something much more reduced. But since you mentioned that it's a lot of money indeed, this is an uncapped credit. It depends on how much hydrogen you actually produce, but we think this could be more than \$100 billion. Our colleagues at Energy Innovation have produced a really useful number, essentially taking one of the larger hydrogen projects being announced in Texas between AES-Air Products, large electrolyzer powered by wind and solar on-site.

They estimate that between the hydrogen tax credits and the renewable tax credits, it could be a \$30 billion subsidy for just one project.

David Roberts

Holy shit. So I just want to flesh that elbow just to make that clear for listeners. You have a big sort of solar and wind renewable energy installation attached to an electrolyzer in this Texas project and you're getting the tax credits for wind and solar and you're getting the tax credits for producing the hydrogen. That just means like, as you say, \$13 billion. That's a huge ...

Rachel Fakhry

It's a \$30, actually 3-0.

David Roberts

\$30 billion in subsidy. Criminy, yeah. So the point is, as a background for all the rest of this discussion, we are dumping a ton of money on clean hydrogen specifically, all of which is to say this fight over how to define it, over what counts and what doesn't is not an arcane technical matter here.

There are billions and billions and billions of dollars of subsidies on the line depending how we answer these questions that we're going to get into.

Rachel Fakhry

That's absolutely right, Dave. Yeah.

David Roberts

So NRDC and a coalition of partners has put forward what they call the three pillars of clean hydrogen. Did that originate with you? Where did the three pillars framework come from?

Rachel Fakhry

I'm happy to say we had nothing to do with the origination. Also very happy to claim credit. The three pillars are decidedly not new. They're already at the heart of a debate around the effectiveness of voluntary renewable corporate procurement. So these are not new dynamics we're bringing to the hydrogen debate. We're actually having the hydrogen debate ride the broader issues within the market like any other energy resource.

David Roberts

So these three pillars are the idea is if you meet these three criteria, then you count as truly clean hydrogen. And every one of these criteria is controversial. Every one of these is being fought out now between industry that wants lax standards and your coalition that wants strict standards. So let's go through the three pillars.

Rachel Fakhry

Great.

David Roberts

The first one is additionality, which I think people probably have some vague familiarity with. But let's spell out what it means in this context.

Rachel Fakhry

Before we do that actually, just to step back on a couple of things. Yes, you're right. There's a lot of contention around at least two of the three pillars. But it's funny because everyone is kind of picking and choosing what they like and don't like. So you have folks who are fine with hourly matching others who are okay with additionality. So everyone will get to it. But within the opposition, we're seeing this kind of like cherry picking within the bouquet of pillars, what works and what doesn't work. But let's start with why do we even need the pillars? And as you noted, the pillars are additionality, deliverability, and hourly matching.

So why do we even need those pillars? As you've alluded to, the credits entirely hinges on how the lifecycle of hydrogen or lifecycle emissions of hydrogen are determined, which means that the Biden administration treasury, in collaboration with the OE, EPA, and the White House, will essentially determine how this credit will impact our energy system. But calculating life cycle greenhouse gas emissions can be quite tricky, and the complexity really varies from project configuration to another. So, for

example, if you have an AES-Air Products-like project where you have a big electrolyzer not connected to the grids, only powered by renewable energy on-site, easy, that's a zero emissions rate.

However, when you move to a different configuration of electrolyzers that are grid-connected, drawing grid power and buying credits or offsets to net out those emissions, it becomes really complicated. And this is the classic kind of complexity of offset systems.

David Roberts

Yes, anybody familiar with the arguments over offsets will be somewhat familiar with these concepts.

Rachel Fakhry

Exactly. So we need some parameters and rules around how these offsets are accounted for since there's so much money at stake and so much emissions at stake. And this is especially true for electrolysis. Now, electrolysis is an energy-hungry process, which means that even if it draws small shares of fossil fuel electricity, that would have significant emissions. So, for example, an electrolyzer that is powered by the average grid today would have twice the emissions of status quo hydrogen and 40 times the threshold of 0.45 threshold to be eligible for the \$3 per kilogram.

David Roberts

Yes. That's so wild that I just want to put an exclamation point next to it. So everybody understands our starting point here is if you just make your electrolyzed hydrogen with the average grid electricity, with the sort of average mix of sources that we have on the US grid. Not only will you be 40 times more carbon intensive than the threshold for the subsidy, you'll be twice as carbon-intensive as making the hydrogen directly from fossil fuel. So the difference between drawing on, as you say, this project in Texas has its own renewable energy installation next to it. so right, it's very clear where that's getting energy.

The difference between that getting clearly clean energy and getting average grid energy is not a small increment of greenhouse gases. The average grid electricity is vastly more carbon intensive than what we're aiming for here. So all of which is just to say you can't just build an electrolyzer and plug it into the grid and call it clean because you're not getting clean power. Basically.

Rachel Fakhry

That's absolutely right. So if we are subsidizing projects that have twice the emissions of today's status quo hydrogen, then that's going to increase your emissions of the system as a whole. And now this is inarguable, what we're seeing coming out of Princeton. An upcoming study by Energy Innovation, a recent study by Rhodium Group, all agree that absent the three pillars which we'll discuss, emissions will increase in this decade, completely contrary to where we need to go and subsidized by what is a climate bill.

David Roberts

Yes, it would be wild to spend \$100 billion of public money to substantially raise carbon emissions. That would be a perverse outcome, let's just say.

Rachel Fakhry

Absolutely an awful story. Let's now dig into the pillars. You can think of them as parameters around those offsets that will be used, that are the only ones that will ensure that the offsets are effective at truly netting out all the emissions being driven by electrolysis. Happy to dig into it some more, but I should note from the outset that after a thorough legal analysis, I can announce with confidence that the three pillars are legally necessary and that treasury has all the authority it needs to implement them rigorously.

David Roberts

And I want to get into this a little bit later after we go through them, but my question is, can they not are they legally allowed not to use them? Because the industry is encouraging. But we'll get into that in a minute. First, we've been talking around the three pillars. Let's go through them. The first one is additionality, which people, I think energy aware people understand is if you just plug your electrolyzer into the grid, you're getting grid power, which is dirty. If you plug your electrolyzer into the grid and specifically consume renewable energy from the grid, the way that where you can just buy renewable energy certificates RECs, and say, I consumed this much and I bought this many RECs to offset it.

If you're doing that, you're not necessarily using clean energy because you're drawing from existing renewable energy, which means whoever else was using that existing renewable energy now gets bumped to something else, et cetera, et cetera. Bump, bump, bump down the line until the last person in the line is using whatever gets turned on when demand exceeds supply, which is generally fossil fuels. So all of which is just to say you're not using clean energy unless you're using new clean energy that you are bringing online to power your project. Is that roughly the sum of it?

Rachel Fakhry

That's absolutely correct. If you're going to bring new load on the system as an electrolyzer, you have to support new clean supply or additionality, although we're starting to move more towards new clean supply, which is going to be a more intelligible term for a lot of people. As you said, if you add demand to the grid, you don't bring new supply with it. As you say, the marginal generators will turn on to supply the added demand, and this will be gas. So you're going to end up having highly emitting hydrogen without supporting nuclear supply. And I always like to use this kind of visual of a world where additionality or new clean supply are not required.

This means that technically all existing nuclear generator in the US can sell their credits for hydrogen production because there's absolutely no requirement for the credits that will be used to offset emissions to come from new resources. They can come from existing resources which could be nuclear generators. There is enough nuclear generation to supply enough nuclear credits to dwarf even a high estimate of hydrogen production between now and 2030. So what this means is hydrogen production between now and 2030 where hydrogen electrolyzers could plug to the grid, do absolutely nothing, draw on grid power, have high emissions and purchase these cheap nuclear credits without really doing anything to the grids to really net out their emissions.

David Roberts

Right? And just to reiterate, all that power that is going to the electrolyzers from the nuclear used to be going somewhere else. So whoever was using that power before that's now additional demand on the system. And again, when demand exceeds supply, the marginal generator gets turned on and that's fossil fuels. So all those electrolyzers coming online and simply claiming that nuclear power, you'd get the truly perverse outcome of the electrolyzers claiming to be clean, but total emissions on that grid going up substantially.

Rachel Fakhry

That's correct. Absolutely. This is becoming, I think, inarguable in many sense that additionality is fundamental for the system to remotely work. And again, this is corroborated by all the studies that we're seeing here Princeton Energy Innovation, Rhodium, and many, many EU studies which we can glean a lot of things from.

David Roberts

But you say it's clear and fundamental nonetheless. There are industry players specifically saying that the additionality, I mean, the additionality pillar is sort of the main axis of dispute here. This is precisely what big utilities don't want, an additionality requirement. And they have a lot of arguments for why. But one of the things they say, one of the arguments they had, which struck me as at least semi-plausible, is their sort of thing is you're doing these models like Princeton modeled all these electric ledgers coming online without the additionality requirement showing that it raised substantially raised grid emissions.

The industry's counter is, well, we have all these broad emission reduction policies. We got like cap-and-trade in Washington and California. We got the EPA coming out with standards on power plants and we got blah, blah, blah. So it's just not plausible that emissions overall are going to go up.

It's the broader economy-wide emission reductions that are going to take care of emission reductions that shouldn't be our responsibility, basically, like we should just be able to use the existing clean energy.

Rachel Fakhry

Let's address that because we always hear this argument, right? Like why are you adding all these rules when the grid is getting cleaner and everything's going to be merry and great and we don't need to think about it? Let's take the IRA because it's always posited as the reason why we know the grid is going to get cleaner, so we don't have to worry about anything. The IRA is historic, right, and we're all very excited about it. And it has the potential to be a game-changer for the market. However, it's mostly carrots, very little sticks, so the outcome of it remains really not guaranteed.

We have a lot of work to do to make sure it's implemented in a way that actually delivers on all its potential. That's one, two, no matter how clean the grid gets in the next seven, eight years, you're still going to have the issue of marginal emissions. Right. Because marginal generators for the foreseeable futures will still be gas. So even if the grid is getting on the whole cleaner, and your electrolyzers are still running during those evening hours when the sun isn't shining, the wind isn't great, turning on marginal emissions or marginal generators, that would still be, on the whole, a very dirty hydrogen resource.

So essentially basing loosening up rules based on the hubris that everything is going to become clean. So when I have to worry about it, it's just demonstrably false.

David Roberts

Yes. It seems premature to be making policy premised on the notion that we're going to succeed in this long term thing of reducing emissions. It's a little early for that.

Rachel Fakhry

Exactly. And actually, right before I came in, I was doing a quick back of the napkin envelope calculation. Even if the grid were to be 80 plus percent cleaner than today, by 2030, you really still don't have a lot of margin to use grid power. No more than 10-20%. Again, electrolysis is power hungry, so even the smallest amount of fossil fuels will blow you right out of the IRA threshold.

David Roberts

Right. And I'll pause to say this, and I might repeat it a couple of times throughout the pod. This is not to say that an electrolyzer can't plug into the grid and start making hydrogen. It's just to say you're not going to get \$3 per kilogram of subsidy if you do that. Right. These are not like harsh restrictions. We're talking about whether we're going to give you tens of billions of dollars. That's not the mean parent.

Rachel Fakhry

Exactly.

David Roberts

It's just some basic rules. We don't want to subsidize increased emissions. So it sounds simple, right? Like, if I'm going to bring an electrolyzer online, I just bring a solar farm along with it. I use the solar farm's energy to run my electrolyzer. That's clearly additional, right. If I'm building on site renewable energy next to my electrolyzer at the same time, that's clearly additional. It's not as clear in some other fuzzy cases. So, like, let's say I come online and I sign a PPA for power with a solar and wind farm that was built a year and a half ago.

Right. So it's new-ish, but it's also the case that maybe if my electrolyzer hadn't come online, that clean power would be going to someone else, so I'm just displacing existing clean energy. So what exactly in these edge cases? What are we defining as new and additional? Is there some sort of threshold like the renewable energy must be built within six months, or how do we get specific there?

Rachel Fakhry

Yeah, that's a great question. There are several schools of thoughts. We haven't settled it. I think everyone agrees that this has to be the most straightforward way for developers, because, believe it or not, we're not in the business of suffocating this industry, Dave. We just want to make sure it's actually clean and in line with what we need. So you have a school of thought that says, look, simplify, just say anything after the IRA, or anything built after the IRA will count as new.

David Roberts

For ten years.

Rachel Fakhry

Yes, exactly. Yes. Pro. It's very easy to administer. I'm not a big fan of it because you put it well, this would have been built anyway. So by adding demand to a system that was being built not for me, something else will turn on the system, and that will likely be at least a mix of fossil fuels. You have another school of thought that wants to mirror what the EU did, the Europeans did. So they adopted a moving vintage, as opposed to that fixed vintage, and said, okay, additionality counts as a PPA signed with a new window solar farm that comes online within 36 months of the electrolyzer.

That is interesting. It's not perfect, but we have to be able to administer the system. I like this moving vintage. You can add the condition that additionality could be met by showing, say, in signing the PPA, that the electrolyzer accounts for much of the financial risk or helps secure the funding. You could add more conditions, but I like the moving vintage a lot more than the fixed vintage. And then you can layer on some PPA conditions to carve out the incremental financial effect of adding electrolyzer on the grid to window solar farm.

David Roberts

Right. And we should acknowledge in the end, there's some element of the arbitrary here because there is no absolute metaphysical correct answer in a lot of these cases. Right. Like, these are all about counterfactuals. Would the renewable energy have been built in the absence of this electrolyzer? And like any counterfactual, there's no definitive ... there's no way of being definitive. Right. You're just using heuristics in the end, you have to define some thresholds somewhere. But this is not an area where sort of precision and certainty are really possible.

Rachel Fakhry

That's correct. A system that works well, that is rigorous enough to minimize against the worst, I think, is good enough for us.

David Roberts

And the last thing about additionality is, of course, the big argument from industry is this will substantially raise costs, it will wipe out the cost advantage we have against existing gray hydrogen and it will strangle the industry in the crib and it will never get going. And in some sense, this is all too about a counterfactual. We're all arguing about what would happen if we did x and so no one can really definitively say, but what evidence do we have that that's wrong?

Rachel Fakhry

The dead on arrival claims obviously are being branded right that we are going to say ...

David Roberts

Yes, dead on arrival.

Rachel Fakhry

Absolutely. So I would love to talk about the costs for the three pillars as a package because I think this is the really interesting one.

David Roberts

Okay, but yeah, let's put the cost off to one side then. That's a good idea. The second pillar is much more simple, we can get through it pretty quick. So the first pillar is additional. For your electrolyzer to be clean, it has to be drawing from new renewable energy. The second is regionality, which means your electrolyzer has to be drawing new clean electricity from the grid you're on, from the regional grid you're consuming on. So you can't just buy like if you're on a super dirty grid and you're buying clean energy, that's made in California, right?

Like clean energy in California is not displacing nearly as much carbon as clean energy on your dirty grid where you're operating would. So grids are not equivalent right, in terms of carbon emissions. So you need to be displacing carbon on your grid. And that's pretty straightforward. And as far as I can tell, most everybody agrees roughly with this idea. I think insofar as there's any controversy, it's just sort of like where do you draw the line? What is the same grid? Is there controversies there worth getting into?

Rachel Fakhry

You're right, this is one of the least contentious pillars. Everyone agrees that there has to be some geographic bound to the clean energy you claim is netting out your effect.

David Roberts

Right.

Rachel Fakhry

In terms of how do you define the boundaries, there are several options that could work. We're still considering which one makes the most sense. The simplest one is to say, look, as long as the electrolyzer and the new clean supply are located in the same load balancing authority, that's good enough for us. That's very simple. However, it could have some issues because some load-balancing authorities are very large and streaked with a lot of congestion. Like for example, MISO is an excellent one, it's the one load-balancing authority and yet there's a big transmission constraint between MISO North and MISO south.

Meanwhile, under that system you could still locate your electrolyzer and your new supply anywhere you want with disregard to the actual congestion and whether you're actually netting out your emissions with this clean energy project that you supported or not. So the other approach, which is a hybrid, quite interesting, and I'm leaning towards that one. It says, okay, let's break it out between RTO regions and non-RTO regions. Within RTO regions like PJM, MISO, ERCOT, so on. We have to look at the LMPS, which are a good proxy for congestion, locational, marginal prices, right?

David Roberts

And those are set around a particular node on the grid. And the node on the grid is what just is there a clear definition of what counts as a node? Is it just where there's a transformer or what?

Rachel Fakhry

That's a good question. I mean, usually, it's going to be the place that sets the price. I don't know how to explain it in engineering terms, unfortunately.

David Roberts

Well, just say it's the atomic unit. Let's say if you're looking at grids, sort of like a grid is made up of nodes.

Rachel Fakhry

Correct. And it's the excellent, kind of the best proxy. We have to understand the supply and demand dynamics around a granular piece of the grid. So I like this because RTOs already report LMPs they already report them and collect them and so on. So the notion is that electrolyzers and the clean energy supply that is netting out their emissions need to be located within a region where the LMP differential is not bigger than X.

David Roberts

Right?

Rachel Fakhry

That is a very good proxy for okay, there's no congestion between the two that's roughly deliverable or mostly deliverable projects. Developers already hedge against LMPS and signing contracts. This is not new to look at forecast of LMPS. So we think this is a familiar tool.

David Roberts

Right, so the data and information is there to make these calculations. Now, we wouldn't have to produce any new data, right?

Rachel Fakhry

But to continue that for non-RTO regions like the Southeast, where utilities don't necessarily report those, we're fine keeping it to the LBA or the load balancing authority because anyway, those tend to fit nicely with state boundaries. So congestion will not be unmanageable there.

David Roberts

Okay, so that's additionality got a new clean energy, regionality it has to be in some definition, local clean energy. And then the third pillar is another controversial one. This is temporal granularity, which to put it in a more human-normal way is just you need to match your consumption to production of renewable energy or clean energy on an hourly basis rather than the more conventional yearly basis. So again, Volts listeners who have been paying attention will be familiar with this general notion. There are lots of corporate players now like Google. Google wants to go zero energy.

And the easiest low-impact way to do that is just say we consume X a year, we're going to go buy renewable energy certificates for X amount. Boom, we offset our use, we're clean. That's sort of like step one. But Google realizes that's not really accurately, that's not accurately about your emissions and how much you're offsetting. So Google wants to move to an hourly system where it's measuring how much its consumption is matching up to renewable energy production on an hour-by-hour basis, so that it can truly be zero carbon, so that it can truly offset its actual emissions in the actual world, not just as an accounting practice, right?

So this notion is out there. So the idea here is that electrolyzers that want to be counted as clean should be required to do that. They should be clean on an hourly basis. This is extremely controversial for a bunch of reasons, but let's start what industry wants, or what the constellation or next era the utilities want is just they're like, look, we have this system of yearly renewable energy certificates, yearly RECs, it works perfectly well. Why can't we just offset our energy on a yearly basis like everyone else does? Why are you making us do this bespoke granular thing?

So just what's wrong with yearly offsetting?

Rachel Fakhry

You've already teed it up really well. This is not a new dynamic, right? This is where there's much more demand for granular tracking to really effectively claim that you are powered by clean energy. Annual matching is just no longer seen as an effective way of reducing emissions and still sends a signal that fossil fuels are needed. And this exact same thing applies to hydrogen, right? So suppose there's a Dave Roberts electrolyzer contracted with a new solar power project, but you run this electrolyzer at night or both when the sun is shining, when there's no sun, turning on the marginal generator and producing very high emissions.

However, you have the sufficient volumetric amount of solar RECs that were produced from the solar project you contracted with that are enough to on paper.

David Roberts

Right. So on an accounting basis ...

Rachel Fakhry

Correct.

David Roberts

I have offset my emissions. But in the real world, the solar is producing the energy during the day, I'm consuming energy during night. So in the real world, I consumed dirty power almost that entire time.

Rachel Fakhry

And there's something perverse here, which is the cleaner the grid gets, the less your solar power will likely start abating emissions during the day because you'll have more solar on the system. And when you turn on at night as an electrolyzer for the foreseeable future, gas will always be the marginal resource. So on the whole, you'll be producing a lot more emissions than you're actually reducing. So it's an interesting perverse effect that may happen with a cleaner grid. All this to say that hourly matching is necessary to meet statutory requirements to meet the IRA threshold of 0.45 kilogram per kilogram to get the \$3 per kilogram.

And this is corroborated by, again, Princeton, upcoming Energy Innovation study, even Rhodium study, which was not very friendly to hourly launching in near term, found that without hourly matching, emissions could increase cumulatively by roughly 100 million metric tons this decade. Enormous, right?

David Roberts

We spent \$100 billion to raise emissions. 100 million tons.

Rachel Fakhry

There we go. That's the US scarce system for you. This is why we absolutely need this. It's corroborated by studies, you cannot reach the IRA threshold without tracking your consumption on an hourly basis with the clean energy project that you procured with.

David Roberts

Right. So there's two big objections to this from industry. The first is from industry and also is shared by some other analysts, which is just that the system of hourly matching, basically producing hourly RECs rather than yearly RECs is just not mature. It's just not ready. There's not enough people doing it. And forcing the industry to wait on that, getting stood up and sophisticated enough to work would delay the industry in these crucial first few years. So a lot of the argument is just over. How baked is hourly matching? How ready is it?

Rachel Fakhry

Yeah. I find this to be a little bit of a lazy argument because it clearly does not look at the state of play on the ground nor what the experts say could happen within less than two years. So I think now even for folks who are out there saying this is not doable in the near term, it needs time. Even those folks agree that there are no technical challenges to doing this. This is really not rocket science. Generation is already metered. Consumption is already metered. You just need a REC in the middle that can capture the hourly variations.

David Roberts

And people are doing it. It's not just that it's doable now, but people are doing it.

Rachel Fakhry

Exactly. The two biggest registries in the US. M-RETS and PJM are now offering hourly tracking. M-RETS has been doing this for three years, even in places where M-RETS and PJM, I mean PJM is new. But even in places where M-RETS does not track, there are third-party tracking mechanisms. There are utilities that are not sophisticated, necessarily smaller, kind of like Madison Gas and Electric, for instance, in Wisconsin offering 24/7 tariffs that require hourly matching. The momentum is in this direction. The Biden administration put out an executive order now requiring that the federal government by 2030 hourly amount.

David Roberts

The federal government's going to have to start accounting for hourly ...

Rachel Fakhry

If the Feds can do it anyone can do it.

David Roberts

Yeah. And let's just pause and stress here that PJM is a big Midwestern wholesale power market and balancing area that has developed and implemented hourly matching just in the last year. So this is like a big industry player. These are not like little startups or whatever that are doing this.

Rachel Fakhry

And they did that because of customer demand. Right. Again, everyone tries to blame the pillars on hydrogen. The market is heading in this direction anyway. This is just about meeting what the law requires and making sure we're actually consistent with the direction of the market. So it's already being done. M-RETS has said multiple times, look, we're willing to track anywhere in the US or roughly anywhere in the US. But if registries want to scale themselves from annual to hourly, experts say, look, you can scale very fast because there are no technical issues here. You could scale within 12 to 18 months.

That is much less than what electrolyzers will need to scale. Right. They'll need two years plus. So again, I always say it's a lazy argument because it doesn't take into account what's already happening, how long it took for it to happen, and how fast things can scale if everyone else wants to do it as well.

David Roberts

Yes, and one thing I also point out is right now the big companies that don't want to mess with it, don't want to mess with hourly matching are whinging and whining about it. But if you put it on paper and made it a requirement, all of a sudden they would be advocates for it and boosters of it and would be accelerating it. This is the thing. It's like if there's \$100 billion pot at the end of the rainbow, of course, utilities are going to figure out how to hourly match. Like utilities will do a lot of things for \$100 billion, you know what I mean?

So this whole idea that like, oh, thanks for offering the \$100 billion, but it's such a hassle, come on guys, if there was \$100 billion on the line, I'm pretty sure you all could figure out how to do this.

Rachel Fakhry

Absolutely. I mean, Hydrogen Europe in the European context was a big trade group for hydrogen companies and so on, who fought the European Commission tooth and nail for two years against hourly branding messages that this is not doable it's. Impossible after the passage of the European rules requiring hourly starting in 2030 but with no grandfathering. Which means project have to start doing hourly really effectively today. Anyway, they came out to say, yeah, this is doable, singing the same song. It's going to be more expensive, but hey, it's going to be doable. So it's a really interesting sneak peek into what you were saying of when there's such a big prize at the end of the tunnel and something already happening with all the technical elements already in place, we should not be worried, it should not happen, it can't happen, it will happen and it can't happen.

David Roberts

Right. Like you say, this whole fight went down in Europe and got settled and now they're doing it. So it's doable. So you're confident that if this was made a requirement by the time the first electrolyzers started coming online, which would be two or three years out at least, just to get them built, hourly matching could be ready. You're confident of that?

Rachel Fakhry

Yes, and I'm definitely not the expert about that. I have listened to the big experts who have done this, who are the ones who have the biggest stake in doing this. They all agree this could be done in a very short period of time and it's already being done. So technically, M-RETS, again, I have to repeat, can do it almost everywhere in the country. If there needs to be some nationwide harmonization between various regions and so on. This could be done really fast.

David Roberts

Right. So the other thing that sometimes comes up in the context of this hourly idea is that if you are really only going to be operating your electrolyzer in the actual hours where clean energy is producing, you are by necessity going to be starting and stopping your electrolyzer. You're going to be cranking it up when the clean power comes online and cranking it back down when the clean power goes offline because there's no point in producing if you're not getting that big fat subsidy. And the sort of conventional wisdom is, I think that electrolyzers are one of these big industrial applications where the finances, the business case depends on it running constantly and that if you force it to ramp up and down to matched coming and going power, you're going to ruin the economics and people won't build them.

What do you say about that flexibility question of electrolyzers?

Rachel Fakhry

Great, let's address that and then definitely want to get to the cost because the jury is no longer out as to whether it's doable. Hourly margin is doable. Now the jury is out as to, wow, is it going to be super costly and suffocate the industry. So I would love to get to the cost piece, but on the flexibility, false period. Electrolyzers are designed for intermittency, specifically PEM electrolyzers. And I know you've had that great conversation with Electric Hydrogen and Raffi Garabedian. They're one of the foremost PEM manufacturers. They're designed for intermittency, so they can absolutely handle that. Now, this is where kind of okay, from a technical standpoint, there's nothing that stops electrolyzers from ramping up and down.

Let's get to the cost piece, which is the real big one here. I think the first question we need to ask is what are the operational parameters that will make electrolyzer pencil out? Is it running 24/7 or something less than that? And what we're seeing is that they don't need to run 24/7 to achieve

cost-competitive economics. It's somewhere closer to 50% to 70%. And the reason is that the more you operate, that's okay for your CapEx, that's good, but you're going to start capturing higher and higher power prices. Electricity prices are the biggest cost component of electrolyzer.

So at some point you're going to start having diminishing returns with higher and higher operations. And that is not at all kind of new information. We've known this for a while. The IEA, IRENA, even Hydrogen Europe. Again, that industry trade group I mentioned have all agreed that or shown that really optimal operations are between 50% to 70%. So we've established it. We don't need 24/7 operations. We need somewhere between 50% and 70%.

David Roberts

And 70% capacity factor, what they call running 50% to 70% of the time.

Rachel Fakhry

Correct. Absolutely. The good news is what we're seeing from a range of analyses being done by developers, OEMs, independent research groups, is that with hourly matching. You can achieve those levels in many places in the US. And the winning strategy is to oversize a wind and solar hybrid in a region with decent wind and solar, it doesn't have to be best in class and you can achieve those levels of operation and be very cost competitive.

David Roberts

Right, just to flesh out that picture you just painted, because I think it's really interesting. So we were talking about how if you build an electrolysis and you build say, a wind and solar hybrid power plant next to it, attached to it, not even attached to the grid, just attached to it, obviously the resulting hydrogen is clean, right? That's the unambiguous case. Then there's a second option which is also unambiguously clean, which is building the same arrangement, connecting it to the grid, but never drawing power from the grid. Right. Only using the locally produced power, but then overbuilding that wind and solar power so that it's producing more than you need.

And then exporting the extra to the grid as another income stream. So you get a couple of things from that. One, wind and solar tend to be anti-correlated, right? So like one's on when the other is not. So you're going to cover more of your get your capacity factor up and you get extra money from selling your extra renewable energy to the grid so that's the completely off-grid and then the sort of one-way connection to the grid. Both those are viable options where you're only consuming the local clean energy you generate. But in the second case, you're also selling excess clean energy, which is improving your economics.

Rachel Fakhry

Absolutely. And it could be good for the grid too because you're probably only going to sell that power during high grid hours or high grid prices.

David Roberts

Right.

Rachel Fakhry

Which means that the grid really needs it, right? So you could actually be helpful. You don't need to sell that much excess, right, because some folks are saying, well, what if you don't have that ability to sell your excess? The economics will still work. Oversizing a wind and solar hybrid seems to be a really interesting case for those early electrolyzers that need to run more than a certain share because they're so expensive.

David Roberts

So you oversize your wind and solar to the point that you get your electrolyzer up to the capacity factor that you need it to be economic. And then if you just curtail the rest of that wind and solar waste, it basically still the economics work out you say.

Rachel Fakhry

What we're seeing, yes, it would still work. The credits are rich enough to make things work. And let's translate the credit from a dollar per kilogram to a dollar per megawatt hour because folks kind of understand the dollar per megawatt hour a little bit more.

David Roberts

Right.

Rachel Fakhry

At the current efficiency of electrolyzers, you can generally produce about 20 kilograms hydrogen per megawatt hour of power you consume. You're getting \$3 per kilogram for every kilogram of hydrogen you're producing. So that's a total of roughly \$60 per megawatt hour of subsidy, which means that you're willing to pay power price of up to \$60 per megawatt hour and the PTC is still going to kind of make you whole. Now, things are a little bit more complicated than that, but this shows you just the significance of this subsidy in terms of how much it could reduce the input costs to your system.

David Roberts

Right. Coming back again to the enormous size of this subsidy relative to the industry. So the industry's sort of complaint, as is familiar with the proposal for any new regulation of any kind, is that this regulation will cripple the industry. It's too much, too restrictive, too much hassle. It's going to strangle the industry in the crib. It's not affordable. And just to throw a specific worry in there amidst that, one of the sort of concrete worries is that if these restrictions raise the price of green hydrogen in the short term, one perverse effect might be that more of the market turns to blue hydrogen, which is hydrogen made with fossil fuels, but then with carbon capture and storage attached to it.

And that carbon capture and storage is also going to get a big fat subsidy out of the inflation reduction act. So the worry here that I've heard articulated is you make truly clean hydrogen more expensive. You're just going to shift the whole market to blue hydrogen and then they're going to get sort of locked in. You're going to get path dependence, you're going to get blue hydrogen sort of making itself a place in the market, even though everybody knows in the long, long term we need it all to be green.

Rachel Fakhry

Right.

David Roberts

Do you think there's anything to those worries?

Rachel Fakhry

I would love to say one more thing before we close up on the pillars because it kind of is related to this argument that oh, we're going to suffocate the market so much that blue is going to win. What is really interesting in what we're seeing from opposition to the pillars is something I alluded to earlier, which is we're now seeing the opposition sort of splitting. And you have renewable developers that do not like any of that starting to come around to additionality or new supply because it's like, hey, I could sell more wind turbines.

David Roberts

Right. Why on earth would they be opposed to this? This is a requirement that a bunch more renewable energy get built.

Rachel Fakhry

Exactly. This is where the hourly matching piece comes in. Right. So you have a next era in Florida that has very little access to wind, if any. Well, maybe it can't do hourly matching because it's going to be pretty low utilization of its electrolyzer if it's only following solar. Today that may not work. Now, in a few years, as electrolyzer prices drop and you can run your electrolyzer much less, hey, let the market be the market. Right? But today what we're subsidizing, we want to make sure they're actually clean projects. NextEra may not be able to do that.

So now you have NextEra kind of saying, "Maybe additionality is fine, hourly matching is out of the picture." Meanwhile, you have Constellation,

the nuclear giant, right? Would love to talk more about their plans because they're truly incredible. They're fiercely fighting additionality or new supply because it doesn't allow them to utilize a lot of their existing nuclear plants. But they love hourly because nuclear generates 24/7.

David Roberts

Hourly is nothing to nuclear.

Rachel Fakhry

Nothing to nuclear, right? They come on top compared to any other resource. So you have Constellation fiercely supporting hourly, fiercely opposing additionality. So it's kind of a bouquet where everyone just chooses whatever maximizes their own.

David Roberts

Whatever is going to work best for their short-term profits. Let's just say.

Rachel Fakhry

Emissions be damned. Right. But let's get to the blue hydrogen question because this is a new argument that I'm truly fascinated by. I don't see any evidence of that. So the 45Q carbon capture and storage tax credits are indeed generous and in some pockets of the US. Yes, indeed. We expect that blue hydrogen could be competitive and be deployed by utilizing the 45Q credits. But we're not seeing blue hydrogen projects' levelized cost of hydrogen dropping to less than \$1, which is kind of the threshold for today's hydrogen, or dropping to even zero and negative, which we're seeing in some places in the US.

Where renewables are particularly great. We're hovering around zero, right? So I don't see the huge subsidy that we're seeing in some pockets for electrolytic hydrogen. And blue deals with its own challenges. Right. You need to be close to a carbon storage basin. You may need carbon pipelines.

David Roberts

Well, you need carbon capture.

Rachel Fakhry

Correct.

David Roberts

That works, which is itself. It's not something that's been shown in the US.

Rachel Fakhry

Exactly. Blue hasn't had a merry, or CCS hasn't had a merry trajectory so far. I don't know why blue hydrogen is going to just mushroom all over the place. If you take the one blue hydrogen project that's been proposed in Louisiana by Air Products, that's been held up in public opposition for months now. So besides the fact that CCS has not been easy to deploy, you have to be close to a carbon storage basin. You may need pipelines. Public opposition is a real thing here for more gas infrastructure. So it's one of these illusory scare tactics being branded that if you actually unpack dynamics, I don't see any evidence of that.

David Roberts

So no worry about blue hydrogen. And I kind of agree. Everybody keeps deploying CCS in these theoretical model ways and I keep kind of thinking like somebody needs to actually go build a couple of these things and show that they work. Before we continue any of these conversations.

Rachel Fakhry

Build a couple that work. First yeah.

David Roberts

One way to address the sort of notion that these three pillars raise costs too much is to point out that there are existing projects being built that will meet the three pillars that are penciling out. Talk a little bit about what we're seeing happen now.

Rachel Fakhry

Sure. The AES-Air Products project that we discussed, that's one of the bigger projects in the US. That's going to be three-pillar compliance.

David Roberts

Are they building on-site? They're entirely on-site renewables?

Rachel Fakhry

I believe so, yes. Fully hourly matched. So it will go up and down with the production of wind and solar. Intersect Power, historically, big solar developer moving into hydrogen. They have a bunch of projects in the pipeline that are three pillars compliant. They're one of the best voices out there demonstrating this is doable. Right. And I do want to point that I know we've joked around and there's a lot of industry players that are trying to steer billions of dollars to maximize their profits. But there's a subset of industry players have been just excellent. Right.

Intersect Power, Electric Hydrogen, whom you met with, Synergetic, others have been really just fantastic at showing that this is absolutely feasible. And if you look at Europe and the rest of the world, these three pillars compliant projects are popping up everywhere.

David Roberts

And the European hydrogen, whatever, body that has more or less came out and said, "We've looked into this, we believe the three pillars are doable."

Rachel Fakhry

Absolutely. I mean, everyone keeps pointing to and happy to speak to the EU case, but everyone keeps saying, look, they pushed their hourly matching to 2030. That's not doable. It's a wildly different context. First of all, if you look at, there's no grandfathering. So projects can start monthly, that's fine, but they have to switch to hourly by 2030. They sign long-term contracts. No one's going to sign a contract for 15-20 years based on first monthly matching and then hourly, they're going to set themselves up from the outset to be able to hourly match that's one.

Two, the Europeans have a regulatory barrier to implementing hourly matching that we don't. They have to pass a federal law first, have it translated to 27 member state laws.

David Roberts

Yeah.

Rachel Fakhry

That was one of the reasons why the delayed hourly matching, again, without allowing grandfathering, we don't have any of that. Right. So just the EU context keeps getting branded left and right, but the devil is in the details and we can glean a lot from that. And I'm hoping we can get back to that because it's an important example.

David Roberts

One of the things you hear industry say is if you force us to make the hydrogen in close physical proximity to the renewable energy, we're going to end up like renewable energy far away from load. And that will mean we'll have to transport the hydrogen, we make long distances to where it needs to be used and that transport, the building of that transport infrastructure is going to sort of offset whatever emission gains you think you're making by forcing us to be near the renewable energy. You're not taking hydrogen, the transport of the produced hydrogen into account. So how do you think about that?

Rachel Fakhry

Well, first of all, no one's opposed to grid-connected projects. So I don't know where this hypothesis comes from that we're forcing projects to be very close to renewables.

David Roberts

Hey, if you well, at least in the region, right? The same region.

Rachel Fakhry

Correct. If you can do your three pillars and connect to the grids and produce your hydrogen closer to your load, that's great. We support that as long as you do your pillars. The second kind of comment I have to this is if you look at the map of where hydrogen demand is today, it's going to be in areas where there's a good resource of renewable energy. So it's mostly Texas and the Gulf, but also in the Great Plains midwest region for ammonia and refineries. And we know that those existing customers will likely be the biggest source of demand in this decade for clean hydrogen because they already have existing supply chains, and so on

David Roberts

Making clean fuels.

Rachel Fakhry

Yeah, replacing existing status quo hydrogen with cleaner hydrogen. Let's put it this way. Yeah, that's going to be the bulk of demand in this decade. Which means that if you look at the map, you're not far off from sources of good within solar. Which means that this transport thing looks pretty manageable. If you consider where the sources of clean hydrogen in this decade will likely be, they're in pretty good resource regions. The third piece that I think is key to keep in mind is that the 45V tax credits are not the only subsidy on the table.

Right? They can't solve every single industry problem. This is where it becomes kind of part of a menu of subsidies. So the DOE Hydrogen hubs, money biggest DOE demonstration project in its history, is going to help address a lot of these ecosystem issues.

David Roberts

Yeah, the idea is to build these hubs where you're sort of like you've got the renewable energy and the electrolysis and the hydrogen consuming end use basically being built next to one another. So you eliminate ...

Rachel Fakhry

Absolutely. You have other stuff that you have the hubs. The Doe hydrogen shot is also spending a lot of money to create a hydrogen ecosystem. States are now passing and contemplating hydrogen-specific tax credits for end uses. So all this to say that we can't burden the tax credits with solving every single industry question, we can't gut them just because we want to think about all these things.

David Roberts

And also I'm inclined to say, like, look, guys, we're like we're subsidizing the crap out of the renewable energy, we're subsidizing the crap out of the electrolysis to the point that some of these projects basically the US government is going to be paying you to do this. You guys can maybe cover transport. It doesn't seem like a huge ask.

Rachel Fakhry

I have a feeling they'll figure that one out. This feels to me like a grasping-at-straws kind of thing, but the transport is going to be impossible. There are options. Do grid connections just meet your pillars? Essentially.

David Roberts

Let's go back to Constellation for a minute because this is just a gripe, but I feel like I want to cover it. Constellation is a utility that is benefiting from recently passed subsidies designed to keep existing nuclear plants open. Right? There's a whole separate debate in the energy world. People are familiar with it. Should we let them close on schedule? Should we pay to keep them open? A couple of states have passed these huge subsidies to keep them open, and Constellation is currently wallowing in those subsidies. And it's worth noting a lot of the people who it is now criticizing and fighting against in this hydrogen debate are some of the very people who went to bat for it to get it those nuclear subsidies, right?

Like it's now badmouthing Princeton's modeling. But of course, that crew at Princeton has been laying itself on the railroad tracks trying to get these existing nuclear plants subsidized. So just to say, like, we're wallowing in nuclear subsidies and now we want to turn around and be allowed to just plug electrolyzers into our existing nuclear plants and layer on a whole new giant subsidy is just like I don't know what the right word is. It's

greedy. It seems crude and greedy if I'm being totally honest. Maybe you have nicer words.

Rachel Fakhry

Sadly, don't. Well, yeah, of course, they're not very happy with the Princeton folks who are kind of standing between them and enormous profits above and beyond what they were already doing. So fully agree with you. First of all, I think Constellation is basking in subsidies at this point. They're very well taken care of. Actually, right before this podcast, I was speaking to a nuclear lawyer, NRDC, and kind of asking her, hey, could you just remind me of all the subsidies that the nuclear can now tap into? She actually had to take a couple of seconds just to see where she could where to start because there are so many buckets.

David Roberts

Get the calculator out.

Rachel Fakhry

Exactly. So Constellation, as I alluded to earlier, is fiercely fighting and loving policymakers against requiring additionality or new clean supply because that would not allow them to utilize their existing nuclear plants for hydrogen production and maximum profits. No new clean supply or no additionality would be an absolute gold mine for Constellation.

Yeah.

They have two very lucrative options. One is to divert their existing nuclear power to hydrogen projects. So essentially collocate electrolyzer with their nuclear plant and divert a share of the output of that nuclear plant to hydrogen production. And this seems to be Constellation's main plan.

As I mentioned earlier, the tax credits, the hydrogen tax credits are roughly equivalent to \$60 per megawatt hour. Constellation is not getting that at the market. On the market, power prices are way lower than that. Maybe 2022 was an off-year, but generally, they're way lower than that. So they're like, "Light bulb. There's a huge lucrative opportunity for us to divert our power away from the grid and utilize this very lucrative opportunity to produce hydrogen with our power."

David Roberts

Basically changing nothing else, right, like just harvesting a giant new set of subsidies, having changed operationally almost nothing.

Rachel Fakhry

Absolutely. And that would be terrible for emissions. Could you imagine megawatts and gigawatts of diverted nuclear energy from the grid? That would be terrible for emissions, result in nefarious grid impacts in terms of prices, reliability, and emissions be damned. Actually, this is playing out in Illinois right now. This is Constellation's powerhouse where they have a lot of their nuclear capacity. They have plans to divert their power away from the grid. We estimate that emissions in Illinois could increase by 7% somewhere up to 45%, depending on how much of the output you're actually diverting and completely torpedoing over the state's clean energy goals.

David Roberts

Yeah, basically wiping out the gains of their big, hard-fought, complex clean energy legislation, which they just passed.

Which, by the way, supported Constellation, even if they're not getting a lot of money from it for multiple reasons. But it supported Constellation because supposedly it was helping support that decarbonization. So it's a perilous terrain that's, number one, it's divert our power, get \$60 per

megawatt hour. We're not getting on the market. Hugely lucrative option number two is just sell large volumes of credits, kind of like Rex, but for nuclear from their existing nukes, because there's currently no market for those credits outside of a few states. And this is a huge volume of credits. Right. As I mentioned to earlier, there's enough potential nuclear credits to completely cover all hydrogen production that we could expect between now and 2030.

Rachel Fakhry

So this is the same thing, is you're doing nothing on the grid, getting paid for generation already very heavily subsidized by the US taxpayer, and allowing electrolyzers to just plug on the grid, purchase credits that mean nothing, and increase emissions, right? So to sum up, this is a gold mine for Constellation without doing anything.

David Roberts

I mean, it's a gold mine for them, whichever way it turns out. That's kind of the rub here. Like they're awash in subsidy money no matter what they do. They're just trying to stack it now.

Rachel Fakhry

Absolutely. And again, emissions, impacts on the grid, so on and so forth, to be damned. So it is, unfortunately, blatant greed. And they're out there claiming that nuclear is getting left out and that this is unlawful. And the best part is that no one wants to outlaw the use of nuclear for hydrogen. There are options, right? For instance, if you operate your nuclear plant that can count as nuclear supply, you could do that. They refuse that, not lucrative enough.

David Roberts

You could build new nuclear. Everybody keeps saying how great nuclear is, but why didn't build some new on it and hook that up to electrolyzer?

Rachel Fakhry

We even gave them the option of, hey, look at what the Europeans did. They said during low-priced hours, which are a good proxy for clean grid, we can relax hourly requirements and sell your credits during those low-priced hours because it's a proxy for some generator curtailing somewhere. So this kind of can count as nuclear supply if you spur that generator. Not enough hours for us. So we are not in the business of suffocating nuclear. We're in the business of making sure it meets the same requirements as everyone else.

David Roberts

Right. Or they could just make the hydrogen and not get a giant subsidy. There's no one telling them they can't do that. Again, nothing's being prohibited here.

Rachel Fakhry

Correct.

David Roberts

It's just like if we're going to give you a bunch of money, we'd like to have a few conditions on it.

Rachel Fakhry

Absolutely. That's absolutely right.

David Roberts

So just to review where we've been so far, there's these three pillars that characterize truly clean hydrogen. It's additional. It comes from new energy, comes from energy that's on the same grid you're on and it is matched up hourly with your consumption. Europe has more or less embraced these conditions. It's different timing on the hourly for various reasons. But the European Commission has said these are absolutely doable. This will not strangle the industry in the crib. So I have two questions about this. One is one argument you hear is it just stands to reason that more requirements and tighter requirements are going to slow the pace of development relative to no requirements.

Right. We'd build more electrolyzers if we could get the subsidy for any damn thing we do. So it's going to slow the industry. And what's most important here, and this is the argument I think appeals to a lot of people and this is the argument Rhodium uses, I'm sure you're familiar. Their whole thing is, yes, slightly looser additionality requirements would potentially raise greenhouse gas emissions in the near term. But that is worth it because you're radically accelerating the scaling up of electrolyzers and the scaling up of green hydrogen, which is going to reduce way more emissions in the long term than whatever this short-term surge is.

So basically like the short-term surge is worth it because you're buying huge long-term reductions. So what do you make of that trade-off is my first question.

Rachel Fakhry

First of all, increasing emissions is against statutory requirements.

David Roberts

I want to get back to that. But first, on the merits.

Yeah, you're blatantly flouting the law, right? The IRA is meant to be given to projects that reduce emissions by 95% relative to today's hydrogen. You are subsidizing projects that have twice as much. So if you're already flouting statutory requirements by adopting some sort of a phase-in or transition periods like what Rhodium suggests. That's one. Two, I have full respect for Rhodium and we have worked with them a ton, but fully disagree with this notion of a trade-off. Right. As I mentioned earlier, what we're seeing from financial analyses, from projects already being kind of doing the three pillars.

Rachel Fakhry

The three pillars will not harm scale. They will ensure healthy, durable scale. NRDC has been one of the first big enviros to come out in support of hydrogen three years ago and say, look, this is an important tool in the toolbox, we should scale it. However, this doesn't mean we have to scale it recklessly. Right. We have to make sure it's actually being done right. So I fully disagree with this notion of a trade-off between near-term emission increases against the law and scaling the industry. You could do both. The third piece, which people tend to forget, what will slow down this industry is public opposition.

Could you imagine if the US taxpayer knows that they're subsidizing increased emissions? That's not going to be pretty. And hydrogen is already a very contentious resource.

David Roberts

Yeah, it's contentious, but also it's still a little bit kind of undefined, a little bit it's a little bit fuzzy. So like, these next few years and how it gets treated and how it gets introduced to the broader public is very important. Right.

Rachel Fakhry

That is the first touch point. I fully agree with you and I love one of the quotes by Paul Wilkins, I think is the vice president of Electric Hydrogen in Washington Post. He said, look, if in five years this tax credit shows that this industry is increasing emissions, that's going to be terrible for our industry. So that will slow down scale. It's not the and that always gets just glossed over.

David Roberts

Right.

Rachel Fakhry

Love to discuss this EU approach because I know that Rhodium ended up recommending that, but keeping it quite open ended.

David Roberts

Yeah, and I think Rhodium endorsed the idea is just that you start with yearly accounting and work your way up to hourly. You start with sort of broad regional requirements and then work your way up to more specific. It's same like you start with I think they want to start with monthly RECs and work their way, this idea of phasing in, so you can get started quickly and then phase in tighter requirements over time. What do you think is wrong with that approach?

Rachel Fakhry

It's trying to mirror the EU, and I think this is very misguided. Right. Because the EU has a wildly different context. First of all, the EU has sticks. They have their emissions trading system which will help climb down and really minimize any emissions increases from loose rules in the near term. We don't have that. That's one. Two, the EU does not have a production tax credit like we do. All of their subsidies are more on the demand side. So creating demand signals. That means that there's going to be a rush to the cheapest supply. Cheapest supply generally means that you want to operate during low-priced hours as an electrolyzer because that's the biggest cost for you.

And this generally means you're going to hover around the cleaner hours. We don't have that. We have a production tax credit that is worth \$60 per megawatt hour that will incentivize electrolyzers to keep running as much as they can because ...

David Roberts

They're going to run maximal. When you're paid not for your sort of CapEx to build, but for your output, you obviously are incentivized to output as much as possible, as many hours as possible.

Rachel Fakhry

Absolutely. And then the third piece, which I alluded to earlier, the hourly matching phase in wildly different contexts in the EU, again, they have a regulatory barrier we don't, which is one of the reasons why they delayed it. We don't need to do that. Wildly different context. We should not be blindly mirroring the EU. So I think we're open to discuss what a rigorous phase-in period could look like for the US, but it should not be mirroring the EU.

David Roberts

Right, well, energy Innovation, and by the way, I should just say a lot of what I learned about this, I learned by listening to Chris Nelder's Energy Transition Show where he interviewed Eric Gimon from Energy Innovation. If you want, like the super nerdy technical dive into all this, if this isn't giving you enough, whatever freaks out there who still don't feel like they got enough from this, there's plenty more there. But one of the things energy innovation is recommending is a phase-in but sort of different starting strict but crude, not relying on sort of sophisticated hourly matching at the beginning but just starting with sort of rough and ready but relatively strict guidelines. And then evolving over time to something that's a little bit more granular and precise and a little bit looser.

Because Eric's point, which makes sense to me, is you don't often see industry passively agreeing to standards that they've gotten used to getting tighter. Right. But every industry would welcome standards that they're getting used to getting looser. Right. So his sort of thing is like, we don't have the sophistication to do it precisely. Now let's be strict and crude and then evolve toward slightly looser and smart. What do you make of that?

Rachel Fakhry

Yeah, I think this is more related to the point they made in their comments that the most precise way of calculating life cycle greenhouse gas emissions of hydrogen projects is to adopt the marginal emissions approach, which I know you hate that term, Dave, but emissionality essentially you net out. You have to have a very granular way of accounting for what you're inducing on the grid and what you're netting out by locating somewhere and kind of going that way. I know that they're slightly moving away from that because it's not easily implementable that's something we flirted with as well a few months ago. And what we're hearing is like this is elegant and nice, but from a developer standpoint this may not be very workable.

So the three pillars are very good proxy right, for ensuring that your emissions are close to zero.

David Roberts

Right. The ideal here is a sort of shimmering ideal in the distance is that for any given hour of power consumption, you know, in the end eventually you're going to be able to know specifically which generators provided it and specifically how much greenhouse gas were involved. Like just as you can precisely know how much power you're using, you're eventually going to be able to precisely know how many greenhouse gases you're producing or displacing or avoiding. Right? That's all going to be sort of available in one giant transparent registry and everybody's going to agree how to calculate it and we're going to be able to base a lot of policy on that.

I mean, it's going to solve a lot of tricky kind of short-term accounting and tracking and policy puzzles are going to be solved once all that information is transparent and available. But as you say, that's a ways off.

Rachel Fakhry

Absolutely. We strongly support this move to more granularity to give really the more accurate signals for what to invest in. I don't think it's necessary for this credit. The three pillars are straightforward enough for developers. They're rigorous enough to meet the IOA requirements. I'm supportive of just retaining that. Now one can create a little bit of exceptions or derogations like what the EU did. So for example, if the grid gets really clean, like 90-95% clean, then maybe we can relax the additionality required. Or if LMPS are extremely low, which indicates renewable energy curtailment for instance, then maybe we can relax hourly matching.

We're open to that as long as the rigor of the system is maintained. So I don't think we need to completely overhaul to a marginal emissions approach to bake in a little bit more precisions for the outer years.

David Roberts

Right. And presumably, there'll be a lot of learning as we do this, how to make it work better. So this might be a dumb question but so say you're treasury and you read the Rhodium report and for whatever reason, it strikes you as highly compelling and you're thinking, yeah, let's set some relatively loose additionality requirements. Even though we'll get a little bit more greenhouse gas emissions in the short term, we'll get a lot more reductions in the long term. My thing is which, as you said, that's just against the law. The law says very clearly 0.45 threshold for greenhouse life cycle emissions is very clear.

So I guess my question is just isn't some of this kind of an academic debate? Like the IRS can't just contravene the clear written intent of the law. It's got to hold whatever details it puts in, it's got to result in that threshold, or else it doesn't meet the law. Right. So is a lot of this just an academic

debate? Like, what am I missing? They don't seem to have the latitude that industry is acting like they have.

Rachel Fakhry

Absolutely fully agree with that. And the treasury has been pretty tight-lipped about all this, so it's really hard to see where they're landing. But you're spot on. Weak rules that clearly flout statutory requirements would be both unlawful and a complete abdication of responsibility. So I wouldn't be surprised at all if many groups end up suing, should the rules be very weak. But let's talk about this legal piece. We have been doing a bunch of legal analyses with other groups, and look, the case for the pillars is ironclad, right? Because the way lifecycle emissions are defined in the law requires that they account for emissions that projects induce on the system.

So if I'm an electrolyzer and I'm purchasing cheap credits from the existing nuke or renewable or so on and driving more gas on the system.

Right, you induce that grid operator to turn on that extra gas.

Correct. There is virtually no project in the US that today will qualify under this boundary of emissions. If they're not driving nuclear supply that is hourly match and deliverable, it's impossible for them to comply with 0.45 without these three pillars.

David Roberts

Right.

Rachel Fakhry

If you want to make this credit workable, those need to be in. If you want no projects to qualify unless they're colocated with a new source of supply, then you can do that. But I don't think that's the intent of the law. I don't think developers will be happy with that if it's only the behind-the-meter projects are able to qualify. So the three pillars are absolutely necessary, and if they're flouted so blatantly then that's just unlawful in a sense.

David Roberts

All this feels a little bit pointless to me because the law is super clear and if they come out with standards that allow higher threshold they're just going to get sued by a bunch of environmental groups. I mean that would be a crappy outcome to have to wait. We don't have a lot of time to wait and mess around with lawsuits. But surely treasury knows it doesn't have as much latitude as industry seems to frame it as having.

Rachel Fakhry

Hopefully, Dave, let's send them this little excerpt.

David Roberts

You don't have to; it's crazy. I'm not a lawyer, but the law is so clearly written that there just doesn't seem to be a lot of fuzziness here. But who knows what our beloved Supreme Court could find if it ever finds its way up there. It's just a small side question in terms of projects built entirely off-grid, right? One and then projects built with a one-way connection to the grid. Two and then projects that are just grid connected that just contract to have new solar and wind added to that grid. Do you have any sense of what the balance will be like right now?

There's some off-grid projects being built. Right. So clearly, those are workable. Are people going to gravitate toward grid-connected over the

long term because it's cheaper, or do you have any sense of what kinds of projects are most likely to get built?

Rachel Fakhry

Yeah, that's very unclear. What we're seeing is most of the projects moving now are behind a meter. Indeed.

David Roberts

Do you know why? Is there a clear answer to why?

Rachel Fakhry

If I had to speculate, there's so much less risk.

David Roberts

Yeah, everything's much cleaner. Every answer is much clearer.

Rachel Fakhry

Exactly. There's less risk overall, which I'm sure is very great for your rate of capital and so on.

David Roberts

Yeah, right.

Rachel Fakhry

But the level of fierce opposition we're seeing for the grid-connected kind of three-pillar system tells me, oh, there's a lot of interest in connecting to the grid at some point soon. So we're seeing mostly behind the meter. But I expect that the grid-connected projects will certainly start popping up soon.

David Roberts

Be really interesting to see how that plays out. Okay, final question, and God bless all you listeners for your extraordinary patience. This is a complicated one. There was really no way to boil this one down. But final question. This is like everything in IRA. This is a carrot, right? A big subsidy, a big payout, and specifically, it's a supply-side subsidy. This is literally a per kilogram of output subsidy. So it's all about supply. If you are taking a step back and thinking about, in the long term, how to construct a robust and effective market for hydrogen in the clean energy system, are there demand-side policies that you think would work well to complement this really giant battering ram of a supply-side subsidy?

What should we be doing on the demand side? Or is supply side is the battering ram enough?

Rachel Fakhry

Great question. And this really gets to the core of, look, the tax credits are a big prize. They're not the only one, right? So we can't burden them and loosen the crap out of them because we're worried that the industry won't scale otherwise. I disagree with that. I think there's a good analogy to the renewable energy growth. The wind and solar tax credits obviously were a big driver of deployment. They were not the only driver. Right. State RTS has played an important role, corporate voluntary procurements played a really big role.

David Roberts

Yeah, demand side was huge all along.

Rachel Fakhry

Absolutely. So that's exactly the same case here. There's this giant, generous supply side push. It has to be and already is coupled by subsidies on the other side. What we're seeing globally, and this applies to the US, is one of the main barriers of getting hydrogen projects built is the lack of end uses. It's the lack of demand. Right. That's why only a very small share of projects go from announcement to FID.

David Roberts

And just to be clear, this is not lack of demand for hydrogen. There's lots of hydrogen used. It's lack of specifically demand for the still slightly, somewhat more expensive clean hydrogen.

Rachel Fakhry

Correct. No longer in many places. Yes, spurring end-use is going to be important, especially since we didn't speak of that, but maybe that's another episode. Hydrogen should not be used everywhere. Right. This is a resource that is energy intensive. It has its place in some important hard-to-electrify sectors like steel and maybe shipping and so on. Not widespread in the economy. So focus demand side policies could be really interesting here to really divert the market to the, quote unquote, "good uses." Right. So the hydrogen hubs are going to be really interesting. And again, this is a big subsidy we keep forgetting.

David Roberts

Yeah. Have they talked about what end uses qualify or what they're going to put in those hubs as end uses?

Rachel Fakhry

It's very unclear. But the DOE's hydrogen roadmap, which kind of sets the vision for the department, for how they will go about their hydrogen deployment, is pretty damn good. It's all focused on deploying hydrogen in hard-to-electrify applications where it's actually needed and doesn't have better alternatives. So if they were to make good on that roadmap, and I really hope they do, they will select the hubs that actually have the high-value end uses and not the low-value end uses like blending in pipes.

David Roberts

Yes. Let's just say when we talk about low value, like the idea of blending hydrogen into natural gas pipelines to marginally reduce the climate impact of natural gas just seems to me like the lowest possible use of what is effectively like champagne. Be like dumping champagne in your water supply or something. I don't know what the right analogy is. You want to save champagne, it's expensive and you want to save it for the best highest uses of it. And this is a big fight with the natural gas industry, of course, because they want their natural gas pipelines to stay up and running as long as possible.

They want all that infrastructure, they want themselves to survive. And so the idea that they could mix in a little hydrogen and go on, they love it. But as you say, that's a whole separate fight, a whole separate pod about hydrogen end uses.

Rachel Fakhry

Absolutely. And this has a real implication on the production because if we recklessly open the floodgates of supply in this decade with very loose rules, then where is this hydrogen all going to go? Right. The end uses that are the most primed to go, unfortunately, today are the ... Barring, replacing existing hydrogen with cleaner, which is good. It's all these other bad end-uses, including blending, because steel and other good end uses aren't quite commercially viable just yet. So all this to say the hubs are going to be a big end-use driver. Public procurement tools are really interesting.

So the federal government is one of the largest buyers, for instance, of steel for public infrastructure projects. There's a lot of money in the IRA now for the federal government to clean up some of their cement and steel and so on that they purchase. If there is a procurement for green steel that is hydrogen derived, then that's really interesting. Right. You're trying to create a very strong, stable demand signal, and we're seeing some states like Colorado, Illinois, Pennsylvania starting to contemplate state-specific tax credits focused on using hydrogen in specific end uses. I'm not going to get behind those proposals.

They're not great, but I think it's the right kind of thinking, right? Let's start trying to be more targeted with where we're driving this resource in the economy.

David Roberts

Right. So you're saying if we're going to sort of jam an enormous amount of supply into the system really quickly, we should also implement some demand-side policies to guide the hydrogen thusly produced to its highest and best uses?

Rachel Fakhry

Absolutely. We have to be very cautious about where we're using it and divert it to the right places, for sure.

David Roberts

Okay. Goodness, that's a lot. It just goes to show in the energy world, you're like, clean hydrogen. Let's do that. And then so many devils in the details.

Rachel Fakhry

I'm hoping this was less wonky than Eric Gimon, whom I have utmost respect to, but even my mind was turned into a pretzel listening to that episode.

David Roberts

Yeah, I think we hit a nice, good middle spot. This is like the 301 class. More than the 101, but less than the grad seminar. That's my aspiration.

Rachel Fakhry

That's where students either drop or ...

David Roberts

The ones who can get past this pod. They're definitely headed for expert expertise. Rachel Fakhry of NRDC, thank you so much for coming on and talking through this all so plainly and simply and clearly. I super appreciate it.

Rachel Fakhry

Thanks so much, Dave.

David Roberts

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