

# Power Finance & Risk



## **PFR Q&A: Cryptocurrencies and the Grid 2021**

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## ● PFR Q&A: CRYPTOCURRENCIES AND THE GRID 2021

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### EDITOR'S NOTE

*In 2013, the value of one Bitcoin passed the \$1,000 mark for the first time. A Texas judge declared Bitcoin a currency in the same year, prompting **Bloomberg** to add it to its stock ticker three days later, with the first multi-million-dollar Bitcoin robbery taking place months after that.*

*Fast forward to August 2021, and the value of one Bitcoin stands at about \$48,136 at the time of writing. And since the Bitcoin boom of 2013, a deluge of over 10,000 "Alt coins" – marketed as alternatives to Bitcoin – have spilled into the cryptocurrency market.*

*Bitcoin was able to reach this point just five years after its launch in 2008 because of its underlying blockchain technology – a revolutionary, decentralized electronic cash system that allows payments to be transacted between parties without the need for a trusted financial institution to process them.*

*Some of the most recent examples of blockchain being deployed in the energy sector have been for emissions trading, generating renewable energy certificates and managing load imbalances on the grid. Meanwhile, various exchange platforms are considering using crypto tokens in energy trading, while a number of energy start-ups are utilizing 'initial coin offerings' as a way of raising funds.*

*However, mining bitcoins is known to be a very energy-intensive process, as it requires vast networks of computers to constantly compete against each other to solve complex mathematical problems that result in the addition of blocks of data to an immutable electronic 'ledger,' as well as an incentivizing mining reward in Bitcoin.*

*In this way, Bitcoin mining consumes about 93 TWh of electricity per year, which is more than the electricity consumed annually by countries such as Finland and Kazakhstan, according to the **University of Cambridge's** Bitcoin Electricity Consumption Index.*

*Bitcoin's share of the world's total yearly electricity production is 0.42%, fueled mainly by hydro power, coal and natural gas, as well as oil, nuclear power and renewables, according to a 2020 survey by the university. This electricity can be sourced either from local grids, or by miners directly connecting their equipment to local power plants.*

*In this Q&A interview with **Digital Power Optimization**, CEO **Andrew Webber** and COO **Alex Stoewer** discuss the intersection of cryptocurrency mining and energy project finance, its impact on the market for both renewable and thermal assets in the US, and what independent power producers and financiers need to consider when assessing opportunities within this sector.*

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PFR Q&A: CRYPTOCURRENCIES AND THE GRID 2021 ●

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**Alex Stoewer**, Chief Operating Officer, **Digital Power Optimization**



**Taryana Odayar**, Editor, **Power Finance & Risk** (moderator)

**Taryana Odayar, PFR:** Let’s kick off the discussion with a broad question: how does cryptocurrency mining and blockchain technology fit into the energy sector?

**Andrew Webber, DPO:** Some cryptocurrencies, Bitcoin being one of them and the largest, use a lot of power to maintain the network that they operate on – the blockchain if you will. And so, this global network of computers, several million of them by most estimates, operate constantly and that consumes a large amount of power.

This power traditionally has been drawn mostly from China. There’s been a lot of mining activity in China that is now moving and dispersing around the world to other locations, much of which is going to find its way into North America. North America consumes maybe 1.5 to 1.8 GW of power on an ongoing basis for the or the purpose of cryptocurrency mining. We expect that that could grow by as much as 10 times in the next three years.

And these computers are finding their way to North America. There’s good infrastructure, good power generation, well managed grids, and so this is a natural fit to find its way here.

**Odayar, PFR:** Where are you seeing the most opportunities within this part of the market?

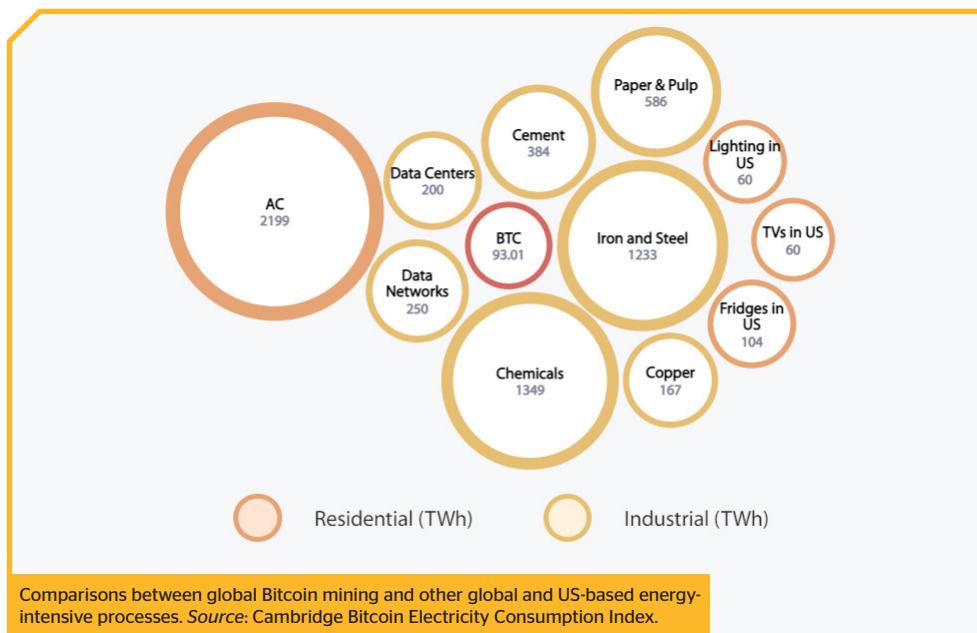
**Webber, DPO:** We think of cryptocurrency mining as a tool to be used by the energy sector for its own benefit. Essentially it allows power producers to capture far more value for their energy than they otherwise could have

through traditional offtakes – selling into the grid or selling to **Amazon** or **Google** under a PPA – or selling to some third-party cryptocurrency miner.

We advise our power generation partners and clients that, in many cases, the first and best use of their power is going to actually be a vertically integrated cryptocurrency mine, where they use this process for their own benefit on-site, before that energy is ever sold to a third-party or touches someone else’s infrastructure. Otherwise, there is low value power that’s stranded, or assets that are not operating at 100% capacity, renewable resources that are being curtailed for lack of demand, and

prices in some jurisdictions that can even go negative. All of these are situations in which we like to think DPO, as a manager of this as a service, can help these power producers and utilities make better, more efficient use of their energy and their generation assets.

**Alex Stoewer, DPO:** The biggest opportunity here, we think, is for energy companies themselves to get into this business because right now, very few energy companies are doing this and most of them aren’t fully aware of the capabilities of this technology. So, we think this is a huge opportunity over the next few years.





## ● PFR Q&A: CRYPTOCURRENCIES AND THE GRID 2021

**Odayar, PFR:** Cryptocurrency mining is usually scrutinized as being a very energy-intensive process, but enthusiasts tout it as a means of resolving grid demand-response issues and spurring the development of renewables. How does it achieve that?

**Webber, DPO:** These computers generally run most of the time, but you can turn them on and off. This is unlike traditional data centers, like what you would expect with Amazon or Google or Netflix, where those entities want that to be up 24/7 with zero downtime, because their customers want access to that data and those tools that they are supplying.

With cryptocurrency mining, it's much more just an economic calculation where, if grid prices move higher where it becomes uneconomic to mine crypto, you can just turn your computers off, essentially curtailing your own operations. And so, in periods where there's some sort of challenge with the energy grid, be it a heat wave where everyone is running their air conditioning or a winter storm that has knocked out some transmission and prices go higher, cryptocurrency miners don't really want to mine with exceptionally expensive power. \$300/MWh, \$400/MWh becomes unprofitable. And so, they just turn themselves off. That then allows that power to be supplied to a hospital or a middle school, and so this activity automatically and is naturally incentivized to react to situations of varying demand.

It's a very flexible tool which on a grid-wide basis can function very much like a battery. It doesn't replace batteries, but in some ways can be an alternative to a battery where, based on different geographies, you can shut down certain crypto miners to allow that power to be then available in one region but keep other miners up in a different region, all on the same grid. And that allows you to better balance load supply and demand across a given grid, and make it more economic and more profitable for these various entities to operate in this industry.

**Stoewer, DPO:** You also mentioned in the question about it spurring the development of more renewable energy. We think that crypto mining is a huge tool to help to spur the development of additional renewable assets that

otherwise might not have been built because it adds so much revenue to the top line of the new assets faster. That project otherwise might not have been economic, so we think that ultimately the more crypto mining moves to North America and Western Europe, the more renewables will be built there. And the more green energy is going to be available for crypto mining and other uses.

**Webber, DPO:** And not only from the demand side, but also from a development planning component in terms of how large you might size the renewable energy asset. There might be situations where a 100 MW solar development doesn't quite pencil out on its own. The financing won't work, or the market is just not there. But if you could upsize it to a 110 MW or 120 MW asset with a vertically integrated crypto mine as a partial but constant offtaker, you can actually create that project. It can exist in this world because the combined cash flows and the combined profitability make it financeable and it can get done. So, you've created an energy asset through this strategy that otherwise would not have existed, and you can supply a community with the excess that you are not using for the crypto mine.

**Odayar, PFR:** In terms of structuring power purchase agreements with cryptocurrency mining companies as offtakers, what are some of the typical structures available, and how do you think about the credit quality of these companies?

**Stoewer, DPO:** So, our view here is that a PPA is not necessarily the best way to go about this. We think that ultimately this industry is going to move towards energy companies doing this for their own account and not needing to sign a PPA with some third-party who's going to take the lion's share of profits from the crypto mining operation. So, what DPO does is we go straight to the energy companies, and we advise them on how best to take advantage of this opportunity for their own account without needing to sign a PPA that might only be \$1 or \$2 or \$3 more than more than they otherwise would get from somebody else.

There are also no crypto mining companies that we're aware of right now that are anywhere near investment-grade. So, this makes it hard to finance assets if you're looking at it

just as an apples-to-apples comparison with the development of an asset that would be under a long term PPA. You need to rethink the business model a little bit and think about doing this as part of the development itself and it's a portion of the capex that's associated with the development. The asset scale is also associated with the build out of the crypto mine. It's not necessarily going to absorb the entire power generation of the asset, it might be maybe 10% of the asset. The other 90% you could sell under a traditional PPA to a creditworthy offtaker, and you'll still wind up achieving much, much better economics if you do it that way.

From a lending standpoint, there are lenders that are stepping in and are going to be lending against the development of assets that have crypto mining rigs attached, but these are not going to be the same lenders that are providing extremely cheap financing to pure-play PPA-based renewable developments. Now the capital might be a little bit more expensive, but ultimately it's going to be a huge opportunity for everybody.

**Webber, DPO:** It's in the name itself – power purchase agreement – you're selling power to someone else, and we advise people not to do that. Sure, you might make a little extra by doing it that way, but if you're doing what we suggest instead, we can capture two times, three times, maybe even five times the amount of revenue.

That's a hard concept for people to get their head around at first, as pretty much the only reason you talk to a power producer is to buy their product as cheap as you can. We suggest that often the best and first use for that power could be using it for yourself, so there is no PPA, there is no third-party, there is no contract. You control your power generation asset, you control the crypto mine, you own all the cash flows and you keep all of the flexibility inherent with a vertically integrated structure where it's sort of a perpetual option where you can either mine crypto if it's more profitable, or sell power into the grid if that's more profitable. It's a perpetual option that you control by vertically integrating without a PPA.

**Odayar, PFR:** Looking at DPO's own business model, the aim seems to be to resolve

## PFR Q&amp;A: CRYPTOCURRENCIES AND THE GRID 2021 ●

**load imbalances and underutilization problems, while also creating profits for generators, by using any excess power to mine cryptocurrency and sell it for US dollars. In practice, how does this work?**

**Webber, DPO:** Instead of selling energy to someone else and allowing them to create some upside using that commodity, by using it for yourself in this vertically integrated structure where you own and control of the assets and all the cash flow, that gives you flexibility. As you would expect, power producers don't really understand the idea of cryptocurrency mining or how to execute a strategy or build out a crypto mining operation, so DPO brings that expertise to them and we say, 'Let's look at your portfolio. Let's look at your pipeline of new developments. Where are you considering batteries? Where do you have a PPA that might be expiring? Where is the grid offtake just not very good? Where do you have assets that are suffering from curtailment?' All of these are situations where we might be helpful.

And DPO does the work that a power producer doesn't necessarily want to do. We help them source the cryptocurrency mining computers, design and finance the mine, build out the infrastructure, set up and install the computers, operate them on an ongoing basis, manage cryptocurrency wallets, and convert that cryptocurrency back into US dollars or Euros or what have you, on a daily basis if they like. And we put that currency right back into their bank account.

**Odayar, PFR: So, it's about generating a new and novel income stream for these power producers.**

**Webber, DPO:** That's right.

**Odayar, PFR: Any impact that the price fluctuations in Bitcoin or other cryptocurrencies might have on this process and the revenues obtained?**

**Webber, DPO:** The short answer is, it's less than you might think. Cryptocurrencies are a pretty volatile space and from the outside looking in, it can appear that there's a huge amount of risk inherent in doing something along the lines of what we suggest. The reali-

ty is, it's not quite as bad as it looks. There are some shorter-term risks where you know you can certainly have a bad period of a couple of months if the market is trending away from you in a pretty dramatic fashion.

But over the long term, the upsides and downsides tend to balance themselves out. There are a number of ways to hedge out some of the risks. You can use futures contracts to help mitigate some of the spot price fluctuations, you can actually price loans for your equipment in Bitcoin rather than dollars, which removes some of the spot price risk, and then of course there's natural built-in mechanics as to how Bitcoin is mined that benefit those with the lowest cost power and those who would choose to vertically integrate.

So, you can create a more stable downside for yourself by doing it in the way that we're suggesting, rather than trying to buy power from a power producer, or by a power producer trying to sell power to a crypto miner.

**Odayar, PFR: And typically, is it mostly Bitcoin that is being mined, or can it be any other cryptocurrency? Is it up to the power producer to decide?**

**Webber, DPO:** Yes. Without going too far down the rabbit hole, Bitcoin was built on an encryption algorithm called SHA-256. Many other cryptocurrencies are built on the same algorithm. It works quite well in that the computers that you would use to mine Bitcoin can also mine many, many other currencies. It just so happens that Bitcoin is the most liquid market. So, if your intention is to sell your production and create a US dollar or Euro revenue stream, you need a liquid market to sell into, and Bitcoin by far has the largest most liquid markets.

So, for those power producers that are operating at a relatively large scale, that is going to be the simplest and most consistent place to liquidate their production and therefore where most larger miners will be. Mining Bitcoin, for the most part, but you do have that flexibility. You can mine different coins if there's a significant economic upside to mining one versus the other. On Tuesday, you could be mining Bitcoin, on a Wednesday mining Bitcoin Cash, and on Thursday an entirely different coin.

**Odayar, PFR: There's a finite amount of Bitcoin – 21 million – that can ever be mined. What happens when we hit that number?**

**Webber, DPO:** That's expected to occur in the year 2140, so we have a little time!

In addition to the new coins that are created, as an incentive for miners to continue to operate their computers and secure this network, they also receive their pro rata share of the transaction fees, so whenever someone sends Bitcoin from one on-network wallet to another on-network wallet, there's a transaction fee that's very small, but that does accrue to the miners.

So, as this network expands over the next 119 years, with more adoption, theoretically there will be more transaction volume, and that alone will be enough to sustain the market rather than the new supply of coins being created.

**Odayar, PFR: When you're having these conversations with power producers and grid operators about fitting their power plants with crypto mining rigs, what are some of the most common questions or concerns that you hear?**

**Webber, DPO:** That's a good question. First, this is a relatively regulated environment. In the energy space, their first inclination is to make sure that they're allowed to do this, and we constantly reassure them that we have looked into this and it's not illegal to mine cryptocurrency anywhere in the US or Canada and frankly, most of the world.

The regulations that they *would* run into are how they use that power from the utility regulation side, and so we help them navigate that. But by and large, if you are using your own power, on your own site, for your own purposes, then it's considered self-generation for the most part and you can use it for what you want.

If you were trying to sell that power to a third party, as an IPP you raise the awareness of the regulators and you might end up being considered a utility. So, we think that again, the flexibility of doing it yourself and vertically integrating is a benefit.

On top of that, the power and energy space is just getting its head wrapped around this to

## ● PFR Q&A: CRYPTOCURRENCIES AND THE GRID 2021

some extent, and so there are a lot of questions about how this works. A lot of the questions that you're asking today about how much risk is there in the prices, and how do the mechanics work, and what if it all goes bad – we walk them through that and help offer transparency and alignment. Our partners really value that transparency where we show them these risks and say, 'Look, this might not work with your assets, or there might be some jurisdictions where it's just not going to fly.'

But, for the most part, there are ways to structure that make sense, so those are the risks that you would expect when asked, 'How do you finance this? How do you protect your downside risks?' etc.

**Stoewer, DPO:** The additional question that we get is the capital outlay. It is a relatively capital-intensive project that they're going to be undertaking here, and they want to understand exactly what that's going to be, how long the infrastructure lasts, what the payback period is, and the economics behind it. Things like that.

The real key there is the payback period tends to be under two years for the entire outlay, including the infrastructure and the mining computers. So, you don't necessarily need to believe that this is going to be a great strategy for you for 10 years or more. Unlike with many other energy assets, you only need to believe that over the course of the next two years, something is not going to go wildly wrong and you'll get your money back and probably make an outstanding profit as well.

**Odayar, PFR:** Crypto mining computers have been around for quite a long time, but the hardware has been continuously upgraded over the years. How does that fit into the picture?

**Webber, DPO:** There have been a few iterations. The rate of change in new advancements in terms of gross computing power as well as relative efficiency is plateauing to some degree, and so there hasn't been as much uptick in that piece of this industry lately as people might think.

The lifetime of the computers really does depend on a few factors. It's not so much that the hardware breaks down. The hardware does break down and there's maintenance

capex that's required. Fans, wiring, things that must be replaced, but that's not the major issue. The major issue is that eventually, at some point, when there's enough other competition that has been added to the network, your older computers are capturing only their pro rata share and their pro rata share is just not enough to justify their electrical expenditure, so you'll turn them off.

Basically, they become unprofitable. The time frame over which that happens can depend on a number of factors. One, how quickly new competition is increasing or decreasing. It can go both ways – when people come out of the system, it's good for the participants that remain, and when people are added to the system, it's not as good for the participants that are already there. And then, the second big piece of that is the spot price. So, as Bitcoin's spot price moves around, you can either become more or less profitable. Any given item of hardware, any given computer, will have a certain profitability level. So, your power price or how much you are paying for your power or how much you are producing in the case of a power producer, also plays into that. If someone is buying energy at \$70/MWh, they will become unprofitable and their machines will become obsolete and have to turn them off sooner than yours if you're producing power at \$20/MWh, again as a vertically integrated offtaker. So, it depends. That's a long answer, but it really does depend, and is beneficial to those that are going to be large-scale power producers as they will have the longest machine life and the most profit while they're running.

**Odayar, PFR:** On a state-by-state basis, which US states would you say have the most encouraging policies or incentives for implementing these cryptocurrency-mining-as-a-service solutions for power assets?

**Webber, DPO:** Being an independent power producer versus a utility is the first issue for consideration. We are talking to a number of utilities and we're happy to help them, we're enthusiastically helping them and we're excited that they are taking this seriously. That being said, we think it's easier for an IPP to do this today versus a utility, as there's just less red tape for them to get through.

In terms of geography, the unregulated markets are going to be easier than the regulated markets. In terms of state-by-state, there are some states that are taking the steps of actually trying to incentivize crypto mining – Kentucky being one of them. I think either in Montana, Wyoming, or both actually, it is incentivized.

As this evolves, it's going to get quite interesting because there is an inter-state competitiveness where you can create jobs and you can create tax base with this new cutting-edge industry and some states are going to take advantage of that. Others, maybe less so, but I think even outside the US, this is a global offering. Western Europe is not traditionally heavily into crypto mining, but we think there's a future there as well. We're talking to power producers in Latin America that are developing a huge amount of new renewable energy projects. And they're very open to this because of the flexibility that it offers with how to develop those projects from the planning stages, not even retrofitting an existing asset, but saying, 'How do I integrate this intelligently right from the planning stages?' And we're talking with a huge number of groups that are all across the US and globally about that, so the global nature of this and the even playing field that it presents create a lot of opportunities for groups that otherwise might not have been involved.

**Odayar, PFR:** And what about right here in New York? What have been some of the latest developments on the regulatory side?

**Webber, DPO:** New York state had previously taken the effort of trying to ban cryptocurrency mining completely. I think that effort very quickly shifted into trying to ban cryptocurrency mining using non-renewable energy sources, and that relatively quickly fell away. It doesn't seem that there's a huge appetite to try to ban the usage of the energy itself.

We continue to think that in the long run, this is going to be driven by renewables. By and large, we think it's such a great tool for the renewable space that they can't really help but pay attention to it, and so I think this is naturally going to shift toward renewable energy anyway. But for now, there's certainly no federal ban and it seems to be one of those things where states are mostly taking a wait-



## PFR Q&amp;A: CRYPTOCURRENCIES AND THE GRID 2021 ●

and-see approach. There were a few early moves, but we don't really see a huge amount of effort toward banning this activity right now. Ultimately, the type of generation that you're using, whether it's renewable or fossil fuel-based, whether it's to make neckties or to keep the lights on during a Yankees game, the question that societies are asking, is 'What are we doing with those generation types?' Not, 'Should we allow this use or ban that use?' And I think that's the direction this is going to take.

**Odayar, PFR:** Is there is an education gap when it comes to approaching investors and power producers about retrofitting their plants with crypto mining rigs? And what are some of the most common misconceptions about cryptocurrency mining and the way it fits into the energy sector?

**Webber, DPO:** It's an ongoing debate and I think people have very strong views about this. Frankly, we find a lot of it breaks down into how much they understand or don't understand about cryptocurrency mining and

the objections to it as being wasteful. And again, that comes down to the debate about what is a waste and what is not a waste of energy, and who gets to decide that. And I think this is actually a pretty interesting tool to help people think about that more intelligently and say, 'Should we be using energy for these other uses that maybe don't have that much societal value? Or should it be redirected to where society is in fact placing a high value on that?'

The Bitcoin network use case for energy is a relatively new one, but I think it's grown in importance. Blockchain technology and how that plays out is anyone's guess, but I think it's early days.

**Stoewer, DPO:** There's absolutely an education gap between people in the tech world who are very familiar with blockchain and people in the energy industry who are very familiar with different types of technologies, but not necessarily blockchain or cryptocurrency mining. And that is what DPO works to fill. We spend basically all day, every day, talking to energy companies and explaining

to them how this works and helping them think through how they might be able to use crypto mining in order to boost their own revenue and maximize the efficiency of their own projects.

There are some common misconceptions in the energy industry that we have found. One is that cryptocurrency mining is extremely complicated and it's something that takes months to understand and is totally different from anything else. It really is not. It's an industrial process that converts energy into cryptocurrency, which you can turn into dollars in the same day if you want, and it looks and feels a lot like a traditional data center, except it's actually much simpler than a traditional data center – you don't need the same levels of redundancy that you have in a traditional data center.

Once we help power producers understand that cryptocurrency mining itself is not complicated at all and help them think through exactly what that means, that helps to close the education gap pretty significantly.

And then another common misconception

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is that by entering into cryptocurrency mining, they are effectively just going long Bitcoin and buying into the Bitcoin hype. That's not the case. Like Andrew said before, you're actually relatively insulated from volatility over time from cryptocurrency prices, and we help them understand why exactly that's the case as well.

**Odayar, PFR:** Can you name any real-life scenarios where cryptocurrency mining-as-a-service would have been most helpful for power generators, for example in terms of mitigating load imbalances or improving grid resilience?

**Webber, DPO:** The immediate example that comes to mind is what happened in Texas in February this year, with the winter storm and the issues with power generation and transmission. There are crypto miners in Texas and they did turn themselves off because they do not want to keep those computers running when grid prices are \$2000/MWh. That's a bad way of making money, so you turn your computers off, which is a good thing for Texas, because now that power can serve some other use.

That's an interesting model that's going to grow. And if you had had cryptocurrency miners, with a 100 MW mine here and a 200 MW mine there, spread strategically throughout the state, when you have transmission issues, you just call up the local crypto miner. In fact, you don't even need to call him up, because he's going to curtail and turn himself off anyways if the grid prices go higher and it becomes uneconomic. This is a naturally occurring phenomenon where this industry is tailor-made to set itself up to increase grid stability. How regulators, how the utility industry and the power generation industry incorporates this in the coming decade is going to be incredibly interesting and it's going to solve a lot of problems that people have been trying to solve.

Now, we don't think this is the only tool and we don't think it's going to work in every single scenario, but it's a complement in some cases to batteries. In five years, when you're developing a new energy asset, you're going to have to check the box of, 'Do we have a storage strategy for this asset? Do we have a green hydrogen strategy for this asset? Do we have a

crypto mining strategy for this asset?' It's going to be a very standard question that starts to be asked of these groups and most of them today are not quite prepared for it, so we want to help.

**Odayar, PFR:** You mentioned the concept of crypto miners automatically shutting down if it becomes unprofitable to mine coins. How exactly does that work?

**Webber, DPO:** It's fairly simple. If the grid prices go above the amount of revenue you're creating by mining Bitcoin for any given period of time, then you're better off just not running computers because you're going to lose money, and so you have this natural incentive to turn them off. And that's just as simple as throwing a switch and saying, 'Hey, this is costing me money to keep these turned on right now, so I'm just going to flip them off.' It requires no real notice, no forewarning, and you could just turn them back on whenever grid prices come back down to a level that's acceptable.

DPO has actually filed a patent that allows protection of some of our control mechanisms, and some software that we're developing that helps to better manage that process. As grid prices fluctuate, and as a power producer's opportunity costs for their power move around for any given option, we can automate the on-off function of our computers to exactly match the best possible outcome for what they have available versus what their offtake options are.

**Odayar, PFR:** Are there any particular generation types that are most complementary when it comes to selecting which power plants to install crypto mining rigs on?

**Webber, DPO:** It's a different sort of puzzle for each type. Frankly, each one has its benefits and drawbacks with regard to cryptocurrency mining.

A stable, 24-hour source is going to be easier and simpler, but oftentimes that might cost more than renewable intermittent sources like solar or wind. While solar or wind might be cheaper per MWh, but you only get them during certain times a day or when the wind is blowing. So, it creates different challenges,

but it creates different opportunities as well. The short answer is, you have this capital outlay and then you want those computers earning their return as close to 24/7 as possible.

As I mentioned, you can certainly turn them off – it's just an economic calculation. But the longer you run them, the more frequently you run them, the better your return, and so the balancing act for a renewable producer is going to be, how do you deploy this an intelligent way? How do we deploy this in a way that's thoughtful with regard to our asset? What it generates, it's cost of generation, it's time and our opportunity costs. What else could we do with the power instead of what these guys are suggesting?

All of those are pieces of the puzzle that we help put together.

**Odayar, PFR:** What do the profiles of some of the power producers that you've reached out to look like, so far?

**Webber, DPO:** We have been speaking to absolutely everyone. We've talked to hydro groups, we've talked to some of the largest wind and solar developers in North America – easily half of the top 10 largest developers out there today – Wall Street firms that own tens of GWs of power generation assets, and also natural gas.

Even if you are a fossil fuel source today, you're going to have these questions and we want to be thoughtful about what this means for them as well and help them do this in a way that's rational and environmentally friendly. And I think there are ways of doing that. There are crypto miners today operating on fossil fuel assets, but then offsetting their carbon footprint.

Ultimately, we do think of ourselves as an ally to the entire energy space, but again, we do think that 10 years from now, this is going to be an absolute boom for the renewable sector. Even sooner than that. It's going to become kind of a standard practice for the renewable space. It's happening today.

**Odayar, PFR:** There are a number of cryptocurrency mining companies that buy generation from coal-fired power plants, like the Colstrip plant and Hardin Generating Station in Montana, via power purchase agreements. Is that something that



## PFR Q&amp;A: CRYPTOCURRENCIES AND THE GRID 2021 ●

**DPO would consider helping power producers with at some point as well?**

**Webber, DPO:** We certainly can, and we do talk to some partners for whom the idea of a vertically integrated self-owned crypto mine might be a step too far at this time and help them think through other options, which include us just buying their power and running our own crypto mine. There are some middle ground options as well which involve them spending some capex for infrastructure, but not necessarily buying mining computers for themselves, and instead potentially bringing third parties on to their site and paying them a higher price for the power plus infrastructure. And we've helped negotiate some arrangements, especially with some of these Chinese groups that are leaving China and trying to redeploy and sign agreements where they can take up space at a location that wouldn't want to purchase its own computers.

So, there are flexible options depending on what someone might want to do. And, of course we can also help find and structure third-party capital for those who like the idea but don't have a balance sheet to do this.

All those are options. It just really boils down to what our partners might want to do and their risk and capex. We've been building relationships with capital partners on the equity and lending side over the course of the past year and a half. And so, if the capex is a hurdle for power producer, we're able to help bridge that gap and create a deal that is good for everybody.

**Odayar, PFR: You mentioned Chinese miners leaving their country and redeploying elsewhere. Can you talk a little bit about what's happening there and why that's the case?**

**Webber, DPO:** Sure. Without getting into too much of the political backdrop of why, ultimately, the situation today is that China has banned cryptocurrency mining, and in fact is severely clamping down on the trading of cryptocurrencies. Their economic structure is one where a certain element of control is required of their capital base. So, this is a bit of a challenge for them to manage and regulate, and so they've made the decision to essentially ban or curtail it completely.

A lot of the world's cryptocurrency mining computers had been operating in China. It has extremely cheap power, especially in the wet season. In the Sichuan Province, there's virtually free hydro energy during that time. And so, there was a huge amount of crypto mining there, upwards of 60% of the global hash rate or global network.

With this ban, which happened in the last three to four months, there's been an exodus of these groups. accounting for upwards of eight to 10 GWs worth of mining computers that need to find a new home. The challenge today, is where are they going? Where is there enough excess power generation to take them as well as the related infrastructure? And the answer is, there's just not enough available. So, DPO can help with the relocation of some of these Chinese mining groups to have access to power generation and access to the infra-

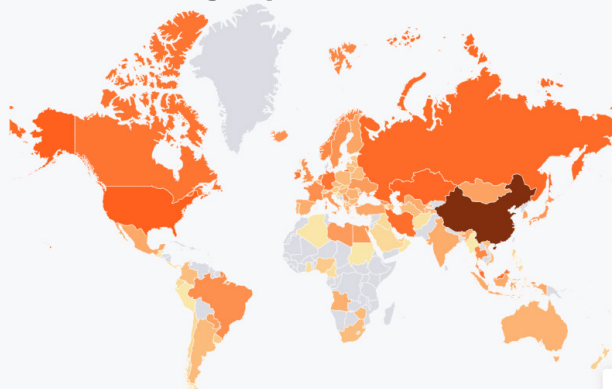
structure allowed around the North American electrical space and secure a great deal for those with excess energy or those willing to sell it to some of these groups.

**Odayar, PFR: Would CFIUS (the Committee on Foreign Investments in the United States) have any sort of jurisdiction over Chinese miners coming into the US and setting up camp at power plants here?**

**Webber, DPO:** It's a fair question. I suppose it very much depends on the structure of the deal being arranged. There are foreign companies operating in the United States and as long as you're checking all the boxes from a regulatory compliance standpoint, there's no real security implications around this. It's just an industrial process, regardless of who owns the power generation or the infrastructure or the computers. It's an unfamiliar process to many, but not one that is necessarily overly complex. DPO helps hold the hand of our partners as they work through this and figure out how to engage, but ultimately, there's nothing around this that should cause too much concern about an international client setting up some of their assets here.

**Odayar, PFR: We've covered state regulations and talked a little bit about federal regulations in this space as well. Do you think further guidance or clarity from the SEC could help too?**

**Webber, DPO:** Absolutely. From here, the story for crypto is going to be one of institutional adoption and integration with existing infrastructure and systems to bring it much more into the mainstream. And it's been happening, it's just not necessarily on the front page of *The New York Times*. They talk about the energy usage and all these things that make headlines, but the reality is that many, many large banking institutions are using this technology today and have been using it for quite some time. **BlackRock** just invested in two cryptocurrency mining entities. So, the story of institutional adoption is here. Further clarity from the regulatory authorities will only increase that. There's plenty of CIOs and CFOs sitting on the sidelines today because they just don't know, and it's just a step too far for them, and frankly they have a day job. They can't

**Global Bitcoin mining map**

Average monthly hashrate share by country based on local mining pool data. Source: Cambridge Bitcoin Electricity Consumption Index.



## ● PFR Q&A: CRYPTOCURRENCIES AND THE GRID 2021

spend their day learning just about crypto. They have a company to run.

And so, I think getting a little additional clarity from the appropriate regulators will give a lot of confidence for these entities to actually start to partake and benefit from all of this. Again, this isn't something that people should be afraid of. It's something that they are afraid of because they just don't understand it yet. The more they understand it, the more clarity there is going to be, the less scary it all looks and then you're going to see huge uptake and adoption in my opinion.

**Odayar, PFR:** You noted that this is something to watch out for over the next decade. Apart from further regulatory guidance and investor education or comfort around all this, what else do you think might aid or speed up the adoption of cryptocurrency-mining-as-a-service in the energy sector?

**Webber, DPO:** The last six months has done a lot. **Elon Musk's** tweets, the headlines that **Tesla** can make in and around this space, the dramatic movement in spot prices over the last eight to 10 months, and then the China ban has all brought to the forefront much of this conversation. I think the last six months has dramatically accelerated the pace at which power producers should be thinking about this. It really has forced their hand a bit, and if you're a power producer and you think your peers and competitors aren't looking into this, you're crazy, because they absolutely are.

People think everybody owns Bitcoin already and they think everybody already understands cryptocurrency and it's already in the past. I think that's like saying the Internet had its day back in 1995. 25 years from now, you're going to look back at the amount of influence that this activity had across the energy sector and it will be immense.

**Stoewer, DPO:** This is also part of the wider story of the transition of energy grids worldwide from traditional fossil fuel-based power plants to largely intermittent green renewable energy. There's also obviously been a massive uptick in interest around energy storage and investments into different types of energy storage companies. Everybody is searching for that Holy Grail that's going to make it so you can turn off those last fossil fuel power

plants, and crypto mining is going to be part of that transition. This is an alternative to energy storage and a much more cost effective one today.

**Odayar, PFR:** On a related note, what is the potential for creating blockchain-based platforms for trading renewable energy certificates (RECs) here in the US? And using tokens in energy trading as well?

**Webber, DPO:** There are some miners that operate off of fossil fuel sources, who then essentially use RECs as an offset and say, 'Look, we're behaving environmentally responsibly here by offsetting our emissions.' That market is something that is just now starting to grow. From a technology standpoint, blockchain actually is a really great technology upon which to base these trading applications and the tracking of green energy production versus non-green energy. RECs themselves will likely start to trade on a blockchain of some sort, which again will just ease transaction friction for the power producers that use these RECs as a tool.

And then, of course, there's the ability for a new type of coin or token that can track and reflect the value of green energy relative to fossil fuel-based energy as it applies to the production of Bitcoin. In other words, we think there's a way in the relatively near future where those entities mining off of truly, demonstrably green energy will actually be able to capture a higher value for their cryptocurrency production than if they had they been mining off of fossil fuel sources, and so that will further incentivize more and more of this activity to be undertaken at green assets rather than fossil fuel-based assets.

It's a bit of a rabbit hole, but suffice to say, it's something that matches well with blockchain technology, and it seems there's a lot of demand for something like that, and therefore there are a lot of people working on it.

**Odayar, PFR:** On a broader level, it seems that blockchain is being used to track pretty much anything these days – from Cargill tracking Thanksgiving turkeys from farm to store, to De Beers tracking diamonds from mines to retailers. What's the scope for using blockchain in contract negotiations and execution in the power space?

**Webber, DPO:** The good thing for the energy space is a lot of this will be invisible and frictionless, where they won't even necessarily know that things are being done differently. But you might have some fees that get lowered because there used to be an intermediary in this process that isn't there anymore, because blockchain created a more effective or quicker and cheaper way of doing what used to be done.

These improvements will be happening all around you, from the tracking of individual electrons that are hitting a PV panel to where they went, where they were used. All of these things lend themselves well to being tracked in a distributed, immutable ledger, much like Bitcoin or some other blockchain. All of these technologies will ultimately be built into tools that will look familiar and easy to use. The companies that make the best user interface will succeed because they're making it easy for people to do this.

**Odayar, PFR:** Any other interesting developments at the intersection of blockchain, cryptocurrency mining and energy?

**Webber, DPO:** I think it's just the pace at which this is evolving, probably unexpectedly and perhaps unbeknownst to many in the energy industry, that are still not fully familiar with what's happening and to what degree. DPO has been around a little while. We've been here since February of 2020, telling this exact same story all through COVID all through **Elon Musk's** tweets and all through the China shut down and really explaining what was going to happen and what was happening. And so, I think the speed with which this is changing is catching people off guard.

I would just encourage people to sit up and start subscribing to some newsletters and seeing what's happening because this is coming. It's coming relatively quickly, and the ways that you can take advantage of it and use it to your benefit are many and varied.

I firmly believe that those who identify this as something worth paying attention to are going to look back in five years and be very happy they did. Those who do not are going to kick themselves a little. ■