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Cryptocurrency — Legally Navigating The "Highway to Climate Hell"

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Cryptocurrency — Legally Navigating The "Highway to Climate Hell"

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Abstract

The U.S. electric system is regarded as history's greatest engineering achievement and the second most important invention in history. This Article analyzes the provocative legal 'dark side' of crypto currency now compromising the sustainability and resiliency of the U.S. electric system. Crypto currency miners have migrated in mass during the 2020s from Asia to several areas of the U.S., choosing inefficiently to waste large amounts of fossil-fuel and electric power. Scholars suggest that Bitcoin's indirect carbon emissions at the current rate, alone with no other increases by world nations (which in fact are still increasing rapidly) are enough to push global warming beyond the Paris Agreement commitment to stay below an increase in temperature of two degrees Celsius.

The Secretary-General of the United Nations states that we are travelling now on the "highway to climate hell." This Article analyzes the legal 'dark side' of crypto currency, the Constitution, and recent Supreme Court precedent:

- *Notwithstanding that climate policy is federal law and that electric power is the key sector of the economy warming climate, the federal government has no authority over crypto mining and its excessive electric power use emitting greenhouse gases;*
- *Constitutional and common law precedent limiting government crypto control;*
- *Constitutional separation of powers constricting Executive Branch action on climate and electric power matters, culminating in the West Virginia v. EPA (2022) decision;*

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- *Equal Protection Clause precedent blocking state actions restricting crypto power use; and*
- *A suite of failed federal and state attempts to legally regulate crypto mining.*

This Article highlights and analyzes U.S. crypto miners choosing fossil-fuel-fired power extending the life of polluting coal plants otherwise scheduled to close. This frustrates President Biden's Inflation Reduction Act devoting hundreds of billions of dollars to shift the U.S. economy to renewable energy. This frustration is backstopped now by hundreds of cities in 31 states plus several states, supported by Supreme Court precedent, blocking effective rapid deployment of Biden's sustainable renewable energy infrastructure laws and thus significantly warming climate.

In its final sections, this Article constructs legal 'work-arounds' to regulate crypto power that do not require any change of U.S. law or any action that contradicts the Constitution's separation of powers. States have discretion strategically to reconstruct certain incentives and moratoria to reshape the use of power resources for crypto mining that will shift resource use in order better to sustain a fragile climate. These techniques are necessary as well to preserve resiliency of the U.S. electric power system and to meet U.S. international climate pledges to maintain a livable climate. The final sections propose a 'win-win' outcome.

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> "[The world is] on a highway to climate hell with our foot still on the accelerator." "We are in the fight of our lives . . . [a]nd we are losing. Greenhouse gas emissions keep growing[,] . . . [g]lobal temperatures keep rising[,] . . . [a]nd our planet is fast approaching tipping points that will make climate chaos irreversible." "We are getting dangerously close to the point of no return."
>
> - United Nations Secretary-General António Guterres, Nov. 2022[1]

Cryptocurrency dominated the news after the total collapse of FTX, the world's third largest cryptocurrency exchange worth approximately $30 billion. Following immediately were lawsuits against FTX endorsers—including Tom Brady, Gisele Bündchen, Stephen Curry, Larry David, and a host of other celebrities[2]—as well as its former CEO, Sam Bankman-Fried, extradited from Bermuda for felony fraud prosecution thereof and subsequently convicted. This

1. *See* António Guterres, *Secretary-General's Remarks to High-Level Opening of COP27*, U.N. (Nov. 7, 2022), https://perma.cc/4DBH-M2FK.

2. *See Celebrities Who Endorsed FTX Are a 'Juicy Target' for Lawsuits*, PYMNTS (Nov. 23, 2022), https://perma.cc/YTD2-CKXM; *see also* Yvette Brend, *Celebs like Tom Brady, Larry David did ads for crypto giant FTX. Now they're getting sued*, CAN. BROAD. CO. (Nov. 19, 2022), https://perma.cc/9JWE-SCPD.

Article navigates behind these headlines to analyze the understudied 'dark side' of cryptocurrency now undermining sustainability of the critical U.S. electric power system and subverting international climate control.

As a disruptive new technology, cryptocurrency mining is fundamentally destabilizing what may be regarded as the world's greatest technology and engineering achievement essential to operation of the entire U.S. economy: the U.S. electric grid. Cryptocurrency moves the United States into the eye of the electric storm,[3] wastefully consuming unprecedented amounts of electricity that, megawatt by megawatt, irreversibly warm the climate.[4] This Article explores the following issues with cryptocurrency from a legal perspective:[5]

- Demanding exponentially more electricity—while wasting most of it;
- Worsening the impact of supply chain blockages impairing sustainable climate resources;
- Choosing fossil-fuel-fired power, extending the life of polluting coal plants otherwise scheduled to close, and undermining U.S. international climate change obligations;
- Frustrating President Biden's 2021 Infrastructure Investment and Jobs Act[6] and 2022 Inflation Reduction Act (IRA),[7] both of which attempt to finance a rapid shift to renewable energy; and,
- Now with hundreds of cities in thirty-one states relying on Supreme Court precedent, blocking effective deployment of President Biden's roll-out of sustainable renewable energy infrastructure.

When new technology disrupts the legally-regulated energy sector, administrative law could intervene to regulate. FTX's now-convicted CEO once replied, "F—k regulators[,] they make everything worse."[8] Here, with a wasteful disruptive new technology cracking the foundation of what has become one of the most important inventions in history, and one upon which the U.S. economy depends, this Article analyzes strategic legal options to address this 'dark side' of cryptocurrency and climate, including:

- Federal and state government attempts legally to regulate crypto mining;

3. *See* discussion *infra* Part III.E.1.
4. *See* discussion *infra* Part III.D.
5. *See infra* Part III.A.
6. *See* Infrastructure Investment and Jobs Act, Pub. L. No. 117-58, 135 Stat. 429 (codified in scattered sections of 6, 15, 16, 23, 25, 30, 33, 40, 42, 43, 47, 49 U.S.C.).
7. *See* Inflation Reduction Act, Pub. L. No. 117-169, 136 STAT. 1818 (codified in scattered sections of 23, 26, 30, 42, 43 U.S.C.).
8. Brend, *supra* note 3.

- Constitutional and common law precedent limiting government crypto control;
- Equal Protection Clause precedent blocking actions discouraging crypto electricity use; and
- The Supreme Court side-stepping the Supremacy Clause of the U.S. Constitution, deferring to Tenth Amendment state/local jurisdiction over cryptocurrency's unprecedented electric power overuse.

Crypto technology flocking to the United States is choosing to avoid renewable energy in favor of burning greater quantities of climate-adverse fossil fuels. The move to implement greater renewable power in the United States faces real hurdles. For example, for President Biden's Inflation Reduction Act to transition the entire American economy to renewable energy, we will need: much more land—ten times more land—than conventional power generation alternatives;[9] and an order of magnitude more rare earth and critical minerals, currently controlled by China and in limited American territorial supply.[10]

This Article analyzes the current legal reality in which permitting control over the land-uses needed for renewable energy lies with states and cities that frequently can, and frequently do, deny those uses, despite their recognized potential to mitigate the crypto energy burden and ameliorate the national and international climate crisis. This Article analyzes recent Supreme Court land-use decisions[11] to identify the levers of power to regulate the 'dark side' of crypto impacts. The final section of this Article proposes options within existing U.S. law and Supreme Court precedent for governments effectively to flex legal muscle to control the negative impacts of crypto technology upon the American economy and world climate.

Part II of this Article connects cryptocurrency mining to its unprecedented and massive use of electric power that is irreversibly warming the climate. Crypto mining accelerates wasteful electricity use that destabilizes the planet. Part III of this Article explores how cryptocurrency uses electricity in very large quantities, and how this use inefficiently increases wasteful entropy of U.S. energy sources. Part III also analyzes where and why mining's exodus from China is now relocating to certain U.S. states, resulting in large-scale impacts on the U.S. power system and world climate. Crypto mining is reinforcing continued use of the dirtiest, most polluting carbon-emitting power resources contrary to current U.S. national policy.

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9. *See* SAMANTHA GROSS, RENEWABLES, LAND USE, AND LOCAL OPPOSITION IN THE UNITED STATES 1 (Foreign Pol'y at Brookings 2020), https://perma.cc/8N4S-BPTK; *see also* Dustin Solberg, *Wind's Big Footprint: Clean Energy Still Needs Safeguards for Nature*, COOL GREEN SCIENCE (Nov. 29, 2017), https://perma.cc/5PVD-ARPJ ("For the energy they produce, wind turbines have a disproportionately large footprint on the land. At 72.1 square kilometers per terawatt, wind's footprint is bigger than natural gas, or coal or petroleum (at 18.6, 9.7 and 44.7, respectively).").

10. *See* discussion *infra* Part VI.C.3.

11. *See* discussion *infra* Part IV.C.

Part IV of this Article analyzes whether federal or state governments retain any effective legal tools to discourage or prohibit waste of electric power given U.S. climate commitments, by exploring the Supreme Court's 'bright line' separating federal and state control over electric power. Federal law prohibits the federal government from exercising any authority over retail electric power rates that crypto miners pay. [12] The Tenth Amendment and the Constitution's separation of powers doctrine separates and isolates all federal government legal options, an issue which culminated in a recent 2022 Supreme Court decision on the "Major Questions Doctrine" which blocked federal executive agency regulation of electricity power operation and climate impacts.[13]

The final Parts V-VII of this Article combine legal precedent for workable strategic solutions under current law to legally re-empower government regulation, given that the current Congress is unlikely to enact additional legal authority in the near future. Part V examines Equal Protection Clause precedent and discrimination decisions in key states with respect to state actions restricting crypto resource use. Part V concludes by analyzing which types of legal regulatory initiatives regarding crypto remain effective and usable, and by which levels of government.

Part VI analyzes the unprecedented Biden Administration one-and-a-half-trillion-dollar investment to transition to all renewable electric power, and why this is not altering the significant climate impacts from growing amounts of crypto mining. After analyzing the recent Inflation Reduction Act and the Infrastructure Investment and Jobs Act, Part VI documents in detail:

- Crypto miners using fossil-fuel-fired power, often extending the life of fossil-fuel plants and their climate-warming emissions that otherwise would close;
- How U.S. power is not yet sustainable to meet exploding crypto demands;[14]
- States and cities, supported by Supreme Court precedent, blocking deployment of sustainable renewable energy supply and infrastructure; and
- Significant supply chain blockages of key rare earth minerals controlled by China, delaying the transition to renewable power for crypto mining in the United States.

Part VII of this Article recognizes the need for alternative viable legal mechanisms and identifies strategic legal approaches to constrain U.S. crypto mining. Part VII suggests alternative legal solutions to implementation, including:

- Special purpose inclining block electric rates to discourage crypto mining;

12. *See infra,* text at notes 168-174.
13. *See* West Virginia v. EPA, 142 S. Ct. 2587 (2022).
14. *See* discussion *infra* Part V.C.1.

- Prohibitions, moratoria, or exactions applied to crypto mining activities;[15]
- Legally withholding or applying conditions for inefficient large crypto consumers using subsidies that are normally provided by the federal government to eighty percent of U.S. states; and
- Establishing long-term revenue assurance mechanisms to protect consumers from stranded crypto costs, some of which are already abandoned by several crypto miners, including customer bonding requirements and letters of credit to secure costs borne by the electric system.

II. The Climate Imperative

> "Our world is hurtling past the 1.5-degree warming limit that a livable future requires, and with present policies, [it] is careening towards 2.8 degrees—a death sentence for vulnerable countries."
>
> United Nations Secretary-General António Guterres, Feb. 2023[16]

The Biden Administration's strategy on climate states that a delayed transition to renewable power would entail a "higher likelihood of reaching catastrophic damages or 'tipping points' and potentially irreversible ecological impacts."[17] More than ninety-nine percent of greenhouse gas (GHG) emissions related to electric power generation emanate from burning fossil fuels to produce power.[18] Any solution centers around electric power in the United States and in the world.

The Paris Agreement of the United Nations Framework Convention on Climate Change (UNFCCC) Conference of the Parties (COP), adopted in December 2015 with 186 of the 197 world nations attending, agreed to take all necessary measures to limit "the increase in the global average temperature to well below 2°C above pre-industrial levels and [to pursue] efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change."[19] The Biden

15. *See* discussion *infra* Part V.5.

16. António Guterres, *Secretary-General's remarks to the Security Council Debate on "Sea-level Rise: Implications for International Peace and Security,"* U.N. (Feb. 14, 2023), https://perma.cc/UWM7-FWTU.

17. *The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050,* U.S. DEP'T OF STATE & U.S. EXEC. OFF. OF PRESIDENT 71 (2021), https://perma.cc/S3CW-5M5S.

18. *See* U.S. DEP'T OF ENERGY, TRANSFORMING THE NATION'S ELECTRICITY SYSTEM: THE SECOND INSTALLMENT OF THE QUADRENNIAL ENERGY REVIEW 3–5 (2017), https://perma.cc/K8CG-NS8R.

19. Paris Agreement Under the United Nations Framework Convention on Climate Change art. 2(1)(a), Apr. 22, 2016, T.I.A.S. No. 16-1104.

Administration pledged to replace all electric power generation using fossil fuels with renewable energy by 2035.[20] As part of our global commitments, the United States nationally determined contribution (NDC) pledged, as part of the 2015 Paris Agreement, to cut U.S. emissions by fifty to fifty-two percent below 2005 levels by 2030.[21] Even if this pledge is implemented perfectly and without obstacles, this still only gets the United States eighty percent of the way towards its current pledge to cut emissions.[22]

The World Resource Institute found that current promises by nations would reduce global GHG emissions by approximately seven percent from 2019 levels.[23] However, this falls significantly short, being about one-sixth of the required forty-three percent reduction needed to limit global warming to 1.5°C.[24] In late 2023 reports on climate change, the United Nations noted that:

- Progress on climate adaptation is slowing when it should be accelerating to catch up with rising climate impacts.[25]
- NDC National climate action plans of world nations remain insufficient to limit global temperature rise to 1.5 degrees Celsius to satisfy the goals of the Paris Agreement.[26]
- World nations plan to produce double the fossil fuels in and at the Paris Agreement 2030 deadline that make it impossible, if burned, to limit warming to the Kyoto Agreement's 1.5°C.[27]

The temperature this century is projected to reach far higher than the internationally agreed maximum threshold of 1.5°C set by the Paris Agreement in 2015, and scientists say the likelihood of catastrophic climate impacts will significantly increase.[28] Many nations underreport their GHG emissions and

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20. *See* Patrick Whittle & Cathy Bussewitz, *Biden Faces Steep Challenges to Reach Renewable Energy Goals,* AP NEWS (Mar. 2, 2021, 10:08 PM PT), https://perma.cc/D7YY-VXK6.

21. *See* Paris Agreement Under the United Nations Framework Convention on Climate Change, *supra* note 19, at art. 2(1)(a).

22. Max Bearak, *Climate Pledges Are Falling Short, and a Chaotic Future Looks More Like Reality,* N.Y. TIMES (NOV. 11, 2022), https://perma.cc/HFP7-X3FR.

23. *Id*.

24. *Id*.

25. U.N. Environment Programme, Adaption Gap Report, November 2023. https://perma.cc/X5EE-J835.

26. U.N. Climate Change, New Analysis of National Climate Plans: Insufficient Progress Made, COP28 Must Set Stage for Immediate Action, 14 November 2023, https://perma.cc/L7XD-XF82.

27. U.N. Environment Programme, *The Production Gap Report*, https://perma.cc/N2YP-PZXC (overviewing Production Gap Report).

28. *Id*. *See also* U.N. Environment Program. *2023 Report* (Nov. 2023), https://perma.cc/5HH9-ZB4M (summarizing 2023 Production Gap Report: "Governments, in aggregate, still plan to produce more than double the amount of fossil fuels in 2030 than would be consistent with limiting warming to 1.5°C"); *see also* https://perma.cc/62MA-

exaggerate their mitigating actions, which results in exaggerated data "equivalent to somewhere between the amount of emissions produced in a year by a major industrialized nation (8.5 billion metric tons of greenhouse gases) and on the upper end almost a quarter of humanity's total annual contribution to the climate crisis (13.3 billion metric tons)."[29] Notwithstanding inaccurate data from many world nations claiming more mitigation than has actually been achieved, *even if* all announced country pledges were fully realized on time, the world would still increase its average temperature by at least 2.1°C by the end of the century, according to the International Energy Agency.[30]

The world must cut emissions by forty-three percent by 2030 to meet the Paris Agreement goals. Instead, emissions are rising by 10.6%.[31] Without an abrupt change in the energy use of all nations, there will be an historic increase in temperatures of 1.75-2°C by 2040, with an average temperature rise of 2.8-4.8°C by 2100.[32]

In November 2022, the Wall Street Journal published an article arguing that, even if the United States and Europe get to zero carbon emissions, the abundant carbon-emitting activities in China will still heat the planet.[33] This may be the bitter reality unless India, and similar large countries increasing carbon emissions, join the rest of the world in selecting to implement renewable electricity, which now has the significant advantage of being the cheapest source of power.[34]

When confronting the climate crisis, one would expect policy to discourage additional unnecessary electric power usage. The Inflation Reduction Act attempts

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QWR3; *see also* Columbia Climate School, World Temperatures Will Blow Past Paris Goals This Decade, Asserts New Study, November 3, 2023, https://perma.cc/74LZ-UP9C (According to scientists from a dozen institutions, the world's average temperature will surpass 1.5 degrees Celsius above preindustrial times within the next several years—much faster than most existing forecasts. The study goes on to say that without extreme action by the international community, temperatures will reach 2 degrees C above preindustrial levels before 2050—also faster than most predictions; causing killer heat waves, accelerated sea-level rise, widespread wildfires, droughts and floods).

29. Zoya Teirstein, *Report Exposes the Shaky Data Undermining the World's Progress on Climate Change*, GRIST (Nov. 8, 2021), https://perma.cc/JW9B-245E (a significant amount of under-reporting was due to over-reporting CO_2-absorbing contributions of local forests and systemic under-reporting of methane and fluorinated gas emission, each of which is a more powerful warming emission than CO_2); *see* Bearak, *supra* note 23; *see also* Steven Ferrey**,** *The Second Element, First Priority*, 24 BOS. UNIV. J. SCI. & TECH. L. 41 (2018) (regarding methane emissions); *see also* Steven Ferrey, *Unforced Errors, Legal Fulcrum & International Climate*, 20 MINN. J.L. SCI. & TECH. 115 (2018); *see generally*, INT'L ENERGY AGENCY, WORLD ENERGY OUTLOOK 2021 (2021), https://perma.cc/8UCR-R9Z9.

30. *See* INT'L ENERGY AGENCY, *supra* note 31.

31. *See* John Mauldin, *Thoughts from the Frontline: Turning Bullish on Energy*, MAULDIN ECONS., (Oct. 29, 2002), https://perma.cc/U6TP-KAFZ.

32. *See* INT'L PANEL ON CLIMATE CHANGE, CLIMATE CHANGE 2022: IMPACTS, ADAPTATION AND VULNERABILITY—WORKING GROUP II CONTRIBUTION TO THE SIXTH ASSESSMENT REPORT OF THE INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE (Hans-Otto Pörtner et al. eds., 2022).

33. *See Climate Doomsday Is Nigh—Again*, WALL ST. J. (Oct. 31, 2022, 6:39 PM), https://archive.li/xjV2C.

34. *See* LAZARD, LAZARD'S LEVELIZED COST OF ENERGY ANALYSIS—VERSION 14.0 (Oct. 2020), https://perma.cc/ZF6Z-4SJJ.

to solidify the U.S. carbon reduction commitment, including authorizing approximately $470 billion dollars in subsidies for clean electric power technologies.[35] The Inflation Reduction Act does not make a significant effort to mandate more efficient use of electric power.

At the same time, there are unprecedented new demands to use exponentially greater amounts of electric power.[36] Some of this greater demand is from an anticipated wholesale transition to electric vehicles, now being subsidized by the IRA, as well as moves in several states to incentivize and force a transition from natural gas and oil to electric to heat buildings.[37] However, another huge increase is driven by the inefficient and duplicative demands of mining cryptocurrency. To date, the unprecedented increase in energy-intensive crypto mining is demonstrating a preference for defunct fossil-fuel-fired electric power rather than new renewable power.[38] These new crypto factors foretell difficulties in meeting U.S. climate commitments, as examined next.

III. Emerging Electricity-Intensive Crypto Power Demands

> "The massive energy consumption of cryptocurrency mining threatens to undermine decades of progress toward achieving climate goals and reducing local pollution."[39]

A. The Electricity Intensity Curve

For the last fifteen years, electricity use in the United States declined.[40] No longer. This has begun to change dramatically: the demand for electricity is predicted to increase dramatically and continuously for the foreseeable future—challenging the country's ability to supply reliable power in America. A significant segment of this burgeoning demand for greater amounts of electricity is for energy-intensive, duplicative substitute services and commodities—which change the complexion of U.S. power.

It is traditionally assumed that electric power drives the U.S. economy: increases in electricity use and increases in gross domestic product once moved in lock-step. In reality, that relationship began to decouple after the Korean War, which accelerated with a more recent emphasis on energy efficiency, lifecycle costing, and energy conservation:

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35. *See* Inflation Reduction Act of 2022, *supra* note 8; *see also* Senate Democrat Caucus, *Summary of the Energy Security and Climate Change Investments in the Inflation Reduction Act of 2022*, SENATE DEMOCRATS (July 27, 2022), https://perma.cc/JEX7-NZR8.

36. *See* discussion *infra* Part III.

37. *See* discussion *infra* Parts VI.A and VI.B.

38. *See* discussion *infra* Part III.E.

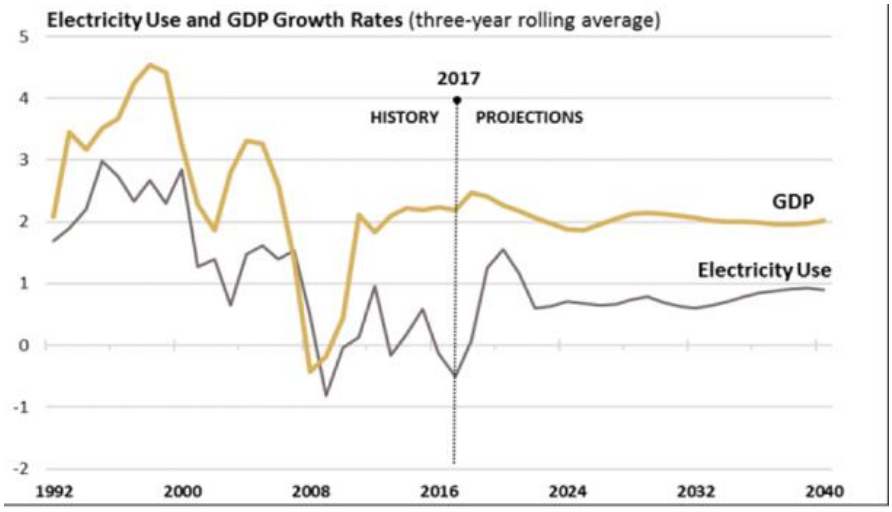
39. Marissa Solomon, *Earthjustice and Sierra Club Release Comprehensive Guide to Environmental Impacts of Cryptomining*, EARTHJUSTICE (Sept. 23, 2022), https://perma.cc/WV2C-Y6TT.

40. *See* CONG. RSCH. SERV., 21ST CENTURY U.S. ENERGY SOURCES: A PRIMER 21 (2018), https://crsreports.congress.gov/product/pdf/R/R44854 (last accessed Dec. 13, 2023).

> "with energy efficiency in homes and appliances increasing, a decoupling of growth in electricity demand from growth in gross domestic product (GDP) has occurred. According to [the United States Energy Information Administration (EIA)], the linkage has been declining over the last 60 years, as U.S. economic growth is outpacing electricity use."[41]

See Figure 1[42] for this recent decoupling. The U.S. Department of Energy forecasts that this decoupling of power and economic growth will continue.

> "EIA's projections point to a continued decline in electricity use relative to economic growth . . . EIA does not expect a 'sustained return to the situation between 1975 and 1995, when the two growth measures were nearly equal in value, or the earlier period in which the growth rate in electricity use far exceeded the rate of economic growth.'"[43]



Source: Compiled by CRS using data from the Energy Information Administration's *Annual Energy Outlook 2018*, February 2018, https://www.eia.gov/outlooks/aeo/pdf/AEO2018.pdf.

Figure 1: Electricity Demand and GDP

Despite the decoupling in most sectors, this trend is being reversed by more energy-intensive cryptocurrency mining activities. The high electrification scenario developed by the National Renewable Energy Laboratory for its 2018 Electrification Futures Study (EFS) predicts that annual U.S. electricity consumption will increase by a factor of 1.6 by 2050 relative to the 2018 pre-pandemic level of approximately 4,000 annual terawatt-hours (TWh) of U.S.

41. *Id.* at 21.
42. CONG. RSCH. SERV., *supra* note 41.
43. *Id.*

electric use.[44] Such an increase would occur at a time when there is significant retirement of aging coal, nuclear, and gas-fired power generation facilities.[45]

There are rapidly expanding new and more energy-intensive demands for electricity, employing banks of computers consuming large amounts of electricity for duplicative cryptocurrency verification, and minting and duplicative Non-Fungible Token (NFT) electronic image creation, despite many substitutes existing for each currency and art. With 180 currencies in the world recognized by the United Nations, there were almost as many currencies as nations before the advent of Bitcoin and its progeny cryptocurrencies.[46] Cryptocurrency creation adds substantially to the electricity demand and GHG emissions increasing climate warming.[47]

FTX became one of the best-known cryptocurrencies because of its list of popular endorsers and ambassadors, including famous athletes and TV's *Shark Tank* investor.[48]

In addition to such electricity-intensive duplicative new demands, U.S. policy is now facilitating a shift to dramatically greater use of electric power for electrification of two of the largest sectors of the economy: building space conditioning and transportation. Contemporaneously with these new demands, President Biden promised that by 2035 all U.S. electricity will come from zero-carbon renewable sources.[49] Included in this timeframe, new transportation will transition to electric vehicles.[50] And many states are moving to require shifting natural gas and oil heating to electric heating.[51] This alone will be a formidable major transition if, at the same time, demand for power is increasing from other sources. The next subparts examine these new demands.

B. Cryptocurrency Mining Virtual Creation

Cryptocurrency mining creates a way to verify transactions on a digital ledger for a blockchain.[52] A blockchain is a public ledger for every transaction that was processed for a cryptocurrency, such as Bitcoin.[53] The verification process validates new coins in the blockchain and, as an incentive, miners are provided with an award for correctly verifying transactions. Nearly all crypto-asset electricity usage is driven by consensus distributed ledger technologies

44. *See* Mai et al., NAT'L RENEWABLE ENERGY LAB'Y, ELECTRIFICATION FUTURES STUDY: SCENARIOS OF ELECTRIC TECHNOLOGY ADOPTION AND POWER CONSUMPTION FOR THE UNITED STATES (2018), https://perma.cc/QV8L-EXNL.

45. *See id.*

46. *See Buy travel money online*, EUROCHANGE, https://www.eurochange.co.uk/travel-money/home-delivery (last accessed Dec. 13, 2023).

47. *See* discussion *infra* Part III.D.

48. *See* Alyssa Lukpat, *Tom Brady. Stephen Curry. Shaq. See the Celebrities with Ties to FTX*, WALL ST. J., (Nov. 10, 2022), https://perma.cc/L74K-RBLW.

49. *See The Long-Term Strategy of the United States: Pathways to Net-Zero Greenhouse Gas Emissions by 2050*, *supra* note 19, at 8.

50. *See infra* notes 296, 297, 303.

51. *See* discussion *infra* Part IV.B.

52. *See* Mensholong Lepcha, *What is Crypto Mining?*, CAPITAL.COM, https://perma.cc/E5EZ-ZVHA.

53. *Id.*

mechanisms used to mine and verify crypto-assets.[54] The dominant consensus mechanism is called 'Proof of Work (PoW),' which is used by the Bitcoin and Ethereum blockchains and requires the completion of a computationally intensive process before a set of transactions, or "block," is validated and added to the ledger.[55]

As miners dedicate more computing resources to process transactions for a blockchain, the math problems adjust to become more difficult. To improve chances of earning coin, miners add machines to the system consuming more energy, and, in doing so, make the reward harder to earn. Building mining centers as quickly as possible and consuming more electricity improves the miners' chances of 'winning' more cryptocurrency. The "majority of computational energy in the Bitcoin system at any one time is wasted"; notwithstanding whether there are twenty-thousand or millions of mining machines competing.[56] "An alternative, less energy-intensive consensus mechanism, called Proof of Stake (PoS)" can be performed by general-purpose computers or servers located in conventional data centers across a network.[57]

Crypto-assets are digital assets that are implemented using cryptographic techniques and have a total current global market capitalization of nearly $1 trillion.[58] According to some estimates, the crypto mining industry is growing at a rapid pace, with a market size of $2.3 billion in 2021, and is estimated to grow to $5.3 billion by 2028.[59] While Bitcoin has made some investors rich, Bitcoin's trading value was down sixty percent from its previous highs in the summer of 2022.

C. Bitcoin Prices Historically

Created in 2008 by an individual under the name Satoshi Nakamoto,[60] Bitcoin is a peer-to-peer version of electronic cash.[61] In theory, an owner can transfer a Bitcoin to the next owner virtually. However, the problem with these transactions is verifying that the coin was not simultaneously transferred to another person. In real property, systems and regulations (*e.g.*, deeds, title searches,

54. *Id.*

55. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, CLIMATE AND ENERGY IMPLICATIONS OF CRYPTO-ASSETS IN THE UNITED STATES 6, 10 (2022), https://perma.cc/SS6F-ETDA.

56. MANDY DEROCHE ET AL., THE ENERGY BOMB: HOW PROOF-OF-WORK CRYPTOCURRENCY MINING WORSENS THE CLIMATE CRISIS AND HARMS COMMUNITIES NOW 8 (Sierra Club & Earthjustice eds., 2022), https://perma.cc/6L97-4QWL.

57. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 6.

58. *See id.* at 13.

59. *See* PRNewswire, *at 28.5% CAGR, Cryptocurrency Mining Market Size to hit USD 5293.9 Million to 2028, says Brandessence Market Research*, BENZINGA (Feb. 28, 2022, 5:40 AM), https://perma.cc/KX8D-A6RD.

60. *See* Daniel Roberts, *Who Is Satoshi Nakamoto, Inventor of Bitcoin? It Doesn't Matter*, FORTUNE (Dec. 9, 2015, 12:52 PM), https://perma.cc/D55F-Y5WH.

61. *See* SATOSHI NAKAMOTO, *BITCOIN: A PEER-TO-PEER ELECTRONIC CASH SYSTEM* 1 (2008), https://perma.cc/VQ5S-YGD6.

warranties, etc.) exist to protect against this type of abuse.[62] These existing legal verification systems necessarily require a central ledger system for recordation. In the context of money, a physical note fills this role. The mint holds the rights to the currency that it creates.[63]

This is where Bitcoin differs: users maintain control and rights to the currency at all stages of its existence, without the need for a mint beyond the cryptocurrency's original creation. It is a decentralized reincarnation of currency.[64] Bitcoin's solution to controlling the challenge of double-spending is the blockchain.[65] The blockchain, and the process the network undertook to create and maintain it, allow its continued existence and widespread adoption.

Eliminating the mint carries with it logistical issues: the first of which is distribution. As an incentive to maintain the electricity-intense network processes, each transaction that is finally verified distributes a "coin" of value to the person whose computer processing verified the transaction.[66] This process of verifying new transactions to claim ownership over newly minted and distributed "coins" is referred to as "mining."[67] Mining applies basic economic principles by rewarding good behavior (correctly verifying transactions) and punishing inappropriate behavior (incorrectly verifying transactions or perpetuating fraudulent transactions). As the same "coin" is traded or exchanged sequentially among owners, the number of "hashes" that need to be verified increases, and so too do the calculations required to verify each new transaction.

D. Duplicative Function; Substantial Risk

Bitcoin and Ether, the largest crypto companies with their respective crypto-assets combined, "represent more than sixty percent of total crypto asset market capitalization."[68] "A 2021 paper from the National Bureau of Economic Research . . . found that ninety percent of rewards (Bitcoin blocks) were received by just ten percent of miners — nearly seventy percent were received by just *half a percent* of miners."[69] While Bitcoin has become a well-known name, there are estimated to be 19,000 different crypto currencies being created and traded.

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62. *See* WILLIAM ATTEBERRY ET AL., REAL ESTATE LAW 196–97 (Wiley 3rd ed., 1984) (describing deeds as valid against all others once filed and stressing the importance of recordation to prevent fraudsters from gaining an interest in a bona fide purchaser's land).

63. *See* M. Todd Henderson & Max Raskin, *A Regulatory Classification of Digital Assets*, 2019 COLUM. BUS. L. REV. 443, 453 (2019).

64. *See* ARTHUR GERVAIS ET AL., IS BITCOIN A DECENTRALIZED CURRENCY? (2013), https://perma.cc/6SGT-RTUG (noting that while Bitcoin is a decentralized currency, large cross sections of the work to maintain the ledger is done by central computing).

65. *See* NAKAMOTO, *supra* note 62, at 2 ("The solution we propose begins with a timestamp server. A timestamp server works by taking a hash of a block of items to be timestamped and widely publishing the hash. . . . The timestamp proves that the data . . . existed at the time. . . . Each timestamp includes the previous timestamp in its hash, forming a chain, with each additional timestamp reinforcing the ones before it.").

66. *See* GERVAIS ET AL., *supra* note 65, at 4.

67. *See How to Mine Bitcoin: A Beginner's Guide to Mine BTC*, COINTELEGRAPH, https://perma.cc/C9V9-D5JA.

68. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 5–6.

69. DEROCHE ET AL., *supra* note 57, at 7.

FTX demonstrated that, while crypto is virtual currency, the risks are real that the massive crypto consumption of electricity with GHG warming emissions to the climate may not add real value. FTX, the world's third largest crypto exchange worth approximately $32 billion, collapsed and filed for Chapter 11 bankruptcy in November 2022, when it failed to raise about $9.4 billion from investors and rivals to meet customer withdrawals.[70] FTX was run by Sam Bankman-Fried, a 30-year-old crypto executive, whose wealth was estimated by Forbes at about $17 billion two months before the collapse, his arrest, and extradition.[71]

E. The Scale of Electric Consumption by Crypto Mining

> "[Meanwhile], the ratio of Bitcoin's energy consumption to human[s who actually have Bitcoin is extremely high]. . . . [The cryptocurrency mining industry] already uses half the electricity of the entire global banking sector and will overtake the banking sector in two years if current trends continue."[72]

While the multi-player crypto mining process helps to increase the validity and security of the cryptocurrency industry, mining has come under fire recently regarding its impact on electric energy demand that could affect electric system stability. Typically, crypto miners operate high-level, energy intensive, computational equipment that consume large amounts of electricity for each crypto transaction: a recent British study found that every bitcoin transaction costs approximately $176 consuming 2,000 kilowatt-hour (kWh) of electricity by many computers involved.[73] If Bitcoin was a country, its energy production would rank in the top thirty international country consumers worldwide for energy use, ranging between the energy consumption of Portugal and Bolivia, both substantial countries with more than ten million citizens.[74]

70. *See* Selena Li & Vidya Ranganathan, *FTX Scrambles for Funds as Regulatory Pressure Builds*, FIN. POST (Nov. 11, 2022), https://perma.cc/2HRK-Z7MF.

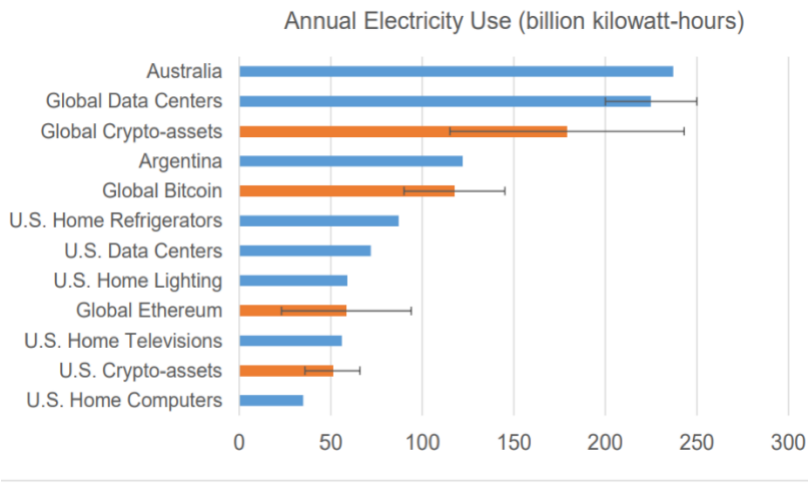
71. *See* Lukpat, *supra* note 49.

72. DEROCHE ET AL., *supra* note 57, at 25.

73. *See* Shawn Tully, *Every Single Bitcoin Transaction—Even Buying a Latte—Consumes Over $100 in Electricity, Says a New Report*, FORTUNE (Oct. 26, 2021, 5:30 PM), https://perma.cc/KQ84-H568; *see also Bitcoin Energy Consumption Index*, DIGICONOMIST, https://perma.cc/ZFM9-9WXJ.

74. *See* Audrey Carroll, *The Other Side of the (Bit)coin: Solutions for the United States to Mitigate the Energy Consumption of Cryptocurrency*, 12 GEO. WASH. J. ENERGY & ENV'T L. 53, 53 (2021).

Figure 2: Electricity Use August 2022[75]



"From 2018 to 2022, annualized electricity used for global crypto-assets grew rapidly with electricity usage doubling to quadrupling . . . [to] between 120-240 billion kWh/year," which is more electricity than used in Argentina or Australia, and equivalent to 0.4-0.9% of annual global electricity usage.[76] As shown in Figure 2, this global use of electricity for crypto assets comprises a use of electricity in an amount that is:

- Comparable to the annual electricity usage of all conventional data centers in the world;
- Approximately double the amount used by home refrigerators which are the largest residential electricity-consuming appliances;
- Three times as consumptive as all U.S. home lighting; and
- More than five times the electricity usage of all U.S. home computers.[77]

"Annualized global crypto-asset electricity usage grew by more than sixty-seven percent from July 2021 to January 2022, and then fell by seventeen percent by August 2022."[78] As of August 2022, Bitcoin is estimated to account for sixty to seventy-seven percent of total global crypto-asset electricity usage, and Ethereum is estimated to account for twenty to thirty-nine percent.[79] "In 2020, Bitcoin and Ethereum [ac]counted for roughly 460 million reported on-chain transactions. That same year, Visa, MasterCard, and American Express

75. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 15 fig.2.1.
76. *Id.* at 5.
77. *See id.*
78. *Id.*
79. *See id.*

collectively processed an estimated 310 billion credit card payment transactions . . . [and] consumed less than one percent of the electricity that Bitcoin and Ethereum used that same year, despite processing many times the number of on-chain transactions."[80]

The energy usage for running cryptocurrency mining operations is principally used to cool the various competing computers used for attempting each to be the winning verification computer, utilizing application-specific integrated circuits (ASICs) which are more energy-intensive and powerful than a standard, at-home laptop.[81] ASICs need to be constantly cooled to ensure they do not overheat; thus, ASICs rely on continuous air conditioning.[82]

Bitcoin and the thousands of other crypto currencies have become popular in part due to the lack of government oversight. Unlike a physical dollar or Euro, which derive value from the guarantees of its distributor, often a government entity, Bitcoin eliminates the government "middleman" by using a decentralized network of Bitcoin users to verify the Bitcoin authenticity.[83] Bitcoin transactions are openly accounted for in a public ledger and are limited by the number of Bitcoins available; with only 21 million Bitcoins in existence, there is no concern of inflation or of the number of units circulating.[84] Cryptocurrency is seen as a way to control and own your assets, and to shelter those assets from a devaluing currency. Likewise, the decentralized nature of Bitcoin has been a positive outlet for oppressed nations seeking to establish a new stream of revenue.[85]

F. Where and Why Energy-Intensive Cryptocurrency Mining Is Relocating

"Most mining facilities draw their power from the grid."[86]

80. *Id.* at 16; *see* DEROCHE ET AL., *supra* note 57, at 21 ("Bitcoin's and Ethereum's blockchains constitute complete payment systems and allows for real-time gross settlement between parties. . . . In other words, these three entities consumed less than 1% of the electricity that Bitcoin and Ethereum used that same year, despite processing many times the number of on-chain transactions and supporting their broader corporate operations. One study estimates that the average electricity footprint of non-cash transactions by the global banking system is no more than 0.4 kWh, while the average electricity footprint per Bitcoin transaction ranges from 491.4 kWh to 765.4 kWh. By some estimates, a single Bitcoin transaction uses more energy than 100,000 Visa transactions").

81. *See* Logan Kugler, *Why Cryptocurrencies Use So Much Energy*, 61 COMMC'NS OF THE ACM 15 (July 2018); *see also* DEROCHE ET AL., *supra* note 57, at 7 (beginning a decade ago, crypto miners began switching to application-specific integrated circuit (ASIC) machines).

82. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 5.

83. *See* Jon Huang et al., *Bitcoin Uses More Electricity Than Many Countries. How Is That Possible?*, N.Y. TIMES (Sept. 3, 2021), https://perma.cc/JQ58-XQYS.

84. *See id.*

85. *See* Aubrey Strobel, *Bitcoin Gets Wall Street's Attention. But its Power Lies in Aiding Oppressed Peoples.*, NBC NEWS (May 7, 2021, 1:30 AM), https://perma.cc/4VM3-MRL5; *see also* David Hollerith, *Bitcoin Mining in Navajo Land Yields Jobs, Revenues While Revealing Economic Disparity*, YAHOO! FIN. (May 7, 2021, 1:30 AM), https://perma.cc/2MJC-AFZA; *see also* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 14.

86. DEROCHE ET AL., *supra* note 57, at 4.

United States

"The United States currently hosts the world's largest Bitcoin mining industry, comprising approximately thirty-eight percent of the total global Bitcoin network 'hashrate.'"[87] A hashrate is the total computational power used each second to mine and process PoW blockchains. The U.S. share of global mining from Bitcoin, the largest crypto-asset, rose from 3.5% in 2020 to thirty-eight percent today.[88] The exodus of energy-intensive cryptocurrency miners from the majority located in China to predominately in the United States happened in the most recent two years.[89]

"U.S. electricity consumption to mine Bitcoin has increased from 8-11 billion kWh in early 2021, to 33-55 billion kWh in mid-2022"—an increase of 400%.[90] The United States hosts approximately one-third of global crypto-asset operations, which currently consume approximately 0.9-1.7% of total U.S. electricity usage, equivalent to the amount of the power use by all home computers or all residential lighting in the United States.[91] "Crypto-asset activity in the United States is estimated to result in the emission of approximately 25-50 Mt CO_2/year, which is 0.4-0.8% of total U.S. GHG emissions, similar to emissions from diesel fuel used by railroads in the United States."[92]

Given its high use of electricity and electricity waste from operation of competitive cryptocurrency mining, crypto mining is drawn to areas where energy is cheap to produce and where regulations favor production. Colorado, at one time, actively allocated state funds towards development of cryptocurrency technologies.[93] Ohio allowed state taxpayers to pay taxes in the form of cryptocurrency.[94]

For every state with crypto-friendly regulations, there is a state with anti-crypto policy. New York enacted "BitLicense" regulations.[95] Other states, meanwhile, took less forceful measures and issued opinion letters as to whether

87. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 14.
88. *See id.* at 5.
89. *See* DEROCHE ET AL., *supra* note 57, at 5; *see also*, Appendix (1).
90. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 23.
91. *See id.* at 5.
92. *Id.* at 6.
93. *See* COLO. REV. STAT. § 24-37.5-407 (repealed 2021); *see also* Jared Verner, *Gov. Hickenlooper Signs Bill for Cyber Workforce Development and Research Funding*, UNIV. COLO. COLO. SPRINGS (May 30, 2018), https://perma.cc/49ZY-LKL5.
94. *See* Paul Vigna, *Pay Taxes with Bitcoin? Ohio Says Sure*, WALL ST. J. (Nov. 26, 2018, 9:41 AM), https://perma.cc/DN3R-MXN4.
95. *See* N.Y. COMP. CODES R. & REGS. tit. 23, §200.3(a) (2023) ("No Person shall, without a license obtained from the superintendent . . . , engage in any Virtual Currency Business Activity."); *see also Virtual Currency Business Activity (BitLicense)*, N.Y. STATE DEP'T FIN. SERVS., https://perma.cc/D6WM-UDR9 (Virtual Currency Business means storing virtual currencies on behalf of others, "buying and selling Virtual Currencies as a customer business," "performing Exchange Services as a customer business, or issuing virtual currencies.").

crypto is deemed to be a currency or amended existing legislation to specifically include or exclude crypto as currency.[96]

Table 1 shows the electricity sources utilized by the states with the lowest retail energy costs. Notably, a majority of the states with cheapest energy are relying on fossil fuel, except for hydroelectric-dependent states in the Pacific Northwest, which have cheaper electricity prices due to large federal hydro facilities operated by the Bonneville Power Administration. While regions like the Pacific Northwest with cheap hydro power may be attractive to crypto miners, only thirty-nine percent of PoW mining is performed using renewable energy.[97]

Table 1: Lowest State Electricity Rates and Power Sources in the United States [98]

	Resource				
State	**Coal**	**Natural Gas**	**Oil**	**Nuclear**	**Renewable & Biomass**
Washington	3.8%	12.1%	–	8.3%	75.8%
Idaho	–	21%	–	–	79%
Nevada	05%	66%	–	–	29%
Utah	55%	25%	–	–	20%
Wyoming	73%	03%	–	–	24%
North Dakota	52%	04%	–	–	44%
Texas	15%	52%	–	9%	24%
Oklahoma	06%	52%	–	–	42%
Arizona	13%	46%	–	29%	12%
Louisiana	04%	70%	03%	17%	06%
Kentucky	62%	23%	–	–	15%
West Virginia	80%	05%	–	–	15%

The Pacific Northwest

The Pacific Northwest region of the United States has abundant and relatively inexpensive hydro resources. The Columbia River and the towns and cities lining its shores have a long history with electricity-intensive aluminum

96. *See* Matthew E. Kohen & Justin S. Wales, *State Regulations on Virtual Currency and Blockchain Technologies*, CARLTON FIELDS (AUG. 29, 2019), https://perma.cc/Z9YL-B7V8.

97. *See* John Schmidt & Benjamin Curry, *Why Does Bitcoin Use So Much Energy?*, FORBES ADVISOR (May 18, 2022, 2:42 PM), https://perma.cc/L53W-7U76.

98. Information used to create this table was taken from 2021. *See Average Electricity Retail Prices*, U.S. CHAMBER OF COM. GLOB. ENERGY INST. (Mar. 11, 2022), https://perma.cc/E2T2-B4UG.

production.[99] The aluminum industry used this electricity derived from inexpensive hydroelectric power produced on the Columbia River.[100] The Grand Coulee Dam alone provided the power to make the aluminum in about one-third of the planes built during World War II.[101] In 1980, Congress passed the Northwest Power Act which guaranteed the various aluminum smelter companies long-term power supply contracts.[102] The aluminum industry's requirement for such extensive amounts of power caused some aluminum companies to cease production during the west coast energy crisis of 2000-2001, precipitated by California's poorly planned retail deregulation,[103] causing rolling black-outs across the west coast and increases in power prices.[104]

Enter cryptocurrency miners. The same attributes that made eastern Washington and the Columbia River area attractive to the aluminum industry made it ripe for cryptocurrency miners. In East Wenatchee, Washington, five hydroelectric dams straddle the Columbia River.[105] The hydroelectricity there is cheap and readily available. The commercial cost of power in Washington ranks 49th in the United States at approximately $0.077/kWh; the cost of a kWh in East Wenatchee is sold at a seventy-five percent discount at around $0.019/kWh.[106] Old, defunct, fruit warehouses that used to house the region's famous apples, old department stores, car washes with large bays with electric plugs for powerful vacuums and other cleaning equipment, and old machine shops were converted there in a trend once anticipated to transform the region into the "Silicon Valley" of cryptocurrency.[107]

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99. *See generally*, *Aluminum*, NW. POWER & CONSERVATION COUNCIL, https://perma.cc/4MQP-4QFW; *see also How Aluminum Is Produced*, ROCKS & MINERALS, https://perma.cc/SS7P-MMHC (Aluminum is produced from Bauxite through electrolysis. To make a single pound of aluminum, 6.2 kWh of electricity are consumed); *see also* Heath Tarbert et al., *Leaders of CFTC, FinCEN, and SEC Issue Joint Statement on Activities Involving Digital Assets*, SEC (Oct. 11, 2019), https://perma.cc/LD83-LE36.

100. *See* Joe Dewey, *Blockchain & Cryptocurrency Regulation 2020 | USA*, GLOB. LEGAL INSIGHTS, https://perma.cc/W8SC-NJ22 (The Bonneville Dam, the Columbia River's first hydroelectric dam, came on-line in 1938. The first aluminum smelter in the Pacific Northwest was sited in Vancouver (consuming 32.5 annual megawatts), and many more smelters and dams were constructed in the following years).

101. *See id.*

102. *See Aluminum*, *supra* note 100.

103. *See Aluminum*, *supra* note 100; *see also* CONG. BUDGET OFF., CAUSES AND LESSONS OF THE CAL. ELECTRICITY CRISIS (2001), https://perma.cc/J82M-9NJV; *see generally*, Steven Ferrey, *The Carbon Suite in the Hotel California: 'We are All Prisoners Here, of Our Own Device*,' 23 S. CAL. INTERDISC. L. J. 451 (2014); *see generally*, Steven Ferrey, *Carbonite Legal Conflict in California*, 5 SAN DIEGO J. OF CLIMATE & ENERGY L. 95 (2014).

104. *See* Dewey, *supra* note 101 (The aluminum industry in Washington decreased in economic value by $300 million from 1997 to 2003, or about fifty percent of its total worth.) *see also*, https://montana-aluminum.com/wp-content/uploads/2018/01/AL-book-Chapter-53.pdf (last accessed Dec. 13, 2023).

105. *See* Paul Roberts, *This Is What Happens When Bitcoin Miners Take Over Your Town*, POLITICO MAG. (Mar./Apr. 2018), https://perma.cc/SSN9-QREV.

106. East Wenatchee Electricity Rates, Elec. Loc., https://perma.cc/RVD6-Z2VU.

107. Roberts, *supra* note 106.

By 2014, the requests for electric power from crypto miners already surpassed the total wattage used by all 70,000 of its residents.[108] As the complexity grew to mine a single Bitcoin, so did the electricity demand for and price of a Bitcoin: gone were the days of mines with 5 megawatt hours (MWh) of power demand; the new generation demanded 50 MWh mines. Crypto miners overwhelmed the grid, using large amounts of power capacity, and causing brush fires when power transformers failed.[109] It was estimated that by 2018, between 15-30% of all Bitcoin, Ethereum, and Litecoin cryptocurrency mining in the world was in the Columbia River Basin in the Pacific Northwest.[110]

G. U.S. States' Laws and Policies Attracting Crypto Mining

Not all of the big players in the cryptocurrency mining industry are operating in the lowest electricity rate states (which include 3 Pacific-West states in Table 1). State electric regulatory policy plays a role in the location of crypto mining capacity. The four principal states that contribute to more than two-thirds of Bitcoin's hashrate in the U.S. are:

- New York (19.9%);
- Kentucky (18.7%);
- Georgia (17.3%); and
- Texas (14%).[111]

Of the four, only two are represented in Table 1 (above) showing the dozen least expensive state retail electricity rates in the country: Kentucky and Texas. While some of these states are embracing crypto mining, one estimate suggests thirty-three states have bills supporting cryptocurrency infrastructure.[112] We examine each of the four states that host the most crypto resources below. Other states are seeking to impose limitations on the industry after experiencing noticeably higher electricity rates, purportedly resulting from crypto mining, which affected consumers.[113]

Kentucky

In recent years, Kentucky's cryptocurrency mining industry has surged among the four most attractive states. The state's electricity production, fueled abundantly by coal and natural gas, has led to retail electricity costs per kWh that are lower than the national average.[114] Kentucky has incentivized cryptocurrency

108. *See id*.
109. *See id*.
110. *See id.*
111. *See* MacKenzie Sigalos, *New York and Texas Are Winning the War to Attract Bitcoin Miners*, CNBC (Oct. 18, 2021, 7:49 AM), https://perma.cc/2N8F-GK55.
112. Josh Saul & Bloomberg, *Georgia Is Becoming the New Hot Spot for Growing Crypto in the U.S.—and Bitcoin Miners Are Taking Notice*, FORTUNE CRYPTO (Feb. 7, 2022, 7:25 AM), https://perma.cc/992Z-DZZV.
113. *See* discussion *infra* Part V.A–B.
114. *See supra* Table 1.

mining through favorable tax deductions, which some estimates suggest will cost Kentucky taxpayers millions in lost tax revenue per year.[115] Kentucky Senate Bill 255 would extend Kentucky's clean energy incentives to miners who invest at least $1 million in crypto-related equipment; Kentucky House Bill 230 offers tax breaks to crypto miners, making them exempt from the state's six percent sales tax and its three percent utility gross receipts tax.[116] News reports note several cryptocurrency mining operations opening or expanding throughout Kentucky and, in many towns, repurposing abandoned fossil fuel-fired power plants.[117]

Texas

Another among these four attractive U.S. states for crypto mining, is Texas. Crypto mining has rapidly grown there since miners departed China due to changes in the nation's policies.[118] As of 2022, exiled crypto miners from countries that banned crypto mining have flooded to Texas with the hope of tapping into cheap electricity.[119] Some suggest that the magnitude of electric energy required for some of the mining sites proposed in Texas could use roughly the same amount of electricity to power a moderately sized city containing 60,000 homes.[120] Some are predicting that Texas will be the "[B]itcoin capital of the world" before 2030.[121] Over the next decade, Texas may see an additional 25 gigawatts (GW) of new electricity demand from crypto-asset mining—equivalent to a third of existing peak electricity demand in Texas.[122] The Electricity Reliability Council of Texas (ERCOT) is the grid system operator for the majority of Texas, experiencing a peak summer electricity demand of approximately 76 GW, and current crypto-asset mining activity of about 2 GW. ERCOT has approximately 17 GW of crypto-asset facilities that are in the process of connecting to the grid, with an expected 5-6 GW of new demand possible in the next 12-15 months.[123]

This migration of crypto mining to Texas is only driven in part by the lower price of power. It also is driven by the relatively large amount of power available in Texas and the state's legal/regulatory environment, which is unique in the continental United States in that it is not regulated by the Federal Energy Regulatory Commission (FERC) and does not trade any substantial amount of

115. *See* Reuters, *Coal to Crypto: The Gold Rush Bringing Miners to Kentucky*, ECON. TIMES (Mar. 15, 2022, 1:54 PM), https://perma.cc/YR6T-BVNF.

116. *See* S. 225, 2021 Leg., Reg. Sess. (Ky. 2021), https://perma.cc/35AW-4LGC; *see also* H. 230, 2021 Leg., Reg. Sess. (Ky. 2021), https://perma.cc/BV4G-KECL; s*ee also* Danny Nelson, *Kentucky Governor Signs Tax Breaks for Crypto Miners into Law*, COINDESK (Sept. 14, 2021, 5:32 AM), https://perma.cc/R57Y-F69D.

117. *See* Reuters, *supra* note 120.

118. *See supra* Table 1; and Vigna, *supra* note 95; and *infra* notes 376-378.

119. *See* Vigna, *supra* note 95.

120. *See* Naureen S. Malik & Michael Smith, *Crypto Mania in Texas Risks New Costs and Strains on Shaky Grid*, BLOOMBERG (Mar. 15, 2022, 3:15 PM), https://perma.cc/8LSX-8JAX.

121. Leigh Cuen, *How Texas is Becoming a Bitcoin Mining Hub*, TECHCRUNCH (Feb. 11, 2022, 7:15 AM), https://perma.cc/9KA3-8AA3.

122. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 5.

123. *See id.* at 17.

wholesale power with other states.[124] There is inexpensive electricity production in the deregulated market in Texas.[125] Then-governor George W. Bush supported deregulation, claiming that the electricity market would benefit from competition and offer Texans the opportunity to reduce their rates by choosing which supplier they wanted.[126]

Part of the attraction of Texas stems from its cheap energy, coupled with the fact that Texas produces the most power per state, ensuring a supposed abundance of energy for mining purposes. However, the instability of the in-state Texas grid, not substantially interconnected with other states, was made clear in February 2021 when freezing temperatures and snow caused an extended rolling power blackout in Texas.[127] There, millions were left without power for days.[128] It is possible that a substantial surge in demand for electricity generated for crypto mining could contribute to similar blackouts in the future. Crypto miners in Texas can also earn substantial amounts of money from shedding their electric demand. During July 2022 alone, a single publicly traded Bitcoin miner who operates a facility in Texas earned $9.5 million from the demand response program from the Texas grid in which this crypto miner was paid to cease its use of power at times of scarce grid supply, which was more than the value of the 318 Bitcoins the facility produced in the same month.[129]

New York

Another among the four most utilized states for crypto, upstate New York remains an attractive location for crypto miners due to its abundant hydropower resources. The supply of hydropower comes from the Niagara River.[130] The Niagara Power Project is New York's biggest electricity producer, producing up to 2.6 million kilowatts of electricity.[131] Large crypto mining companies are setting up facilities in upstate New York.[132] In New York, as well as in Montana, Pennsylvania, and Indiana, there are reports that increased power demand from crypto-asset companies have reversed closure or restarted plans for fossil-fueled power plants.[133]

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124. *See* 16 U.S.C. § 824p(k).

125. *See generally Texas State Energy Profile*, U.S. ENERGY INFO. ADMIN. (Sept. 21, 2023), https://perma.cc/2CMH-RRHM.

126. *See* Clifford Krauss et al., *How Texas' Drive for Energy Independence Set It Up for Disaster*, N.Y. TIMES (May 13, 2021), https://perma.cc/H9KA-PCU5.

127. *See* Grace Dubicki*, Texas' Privatized Power Grid Is a Disaster 20 Years in the Making*, MEGAPHONE SW. UNIV. (Mar. 23, 2021), https://perma.cc/9SWN-6HNG.

128. *See* Asher Price, *Texas Politicians Saw Electricity Deregulation as a Better Future. Years Later, Millions Lost Power*, USA TODAY (Feb. 22, 2021, 12:22 PM), https://perma.cc/P7W7-8H5R.

129. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 18.

130. *See Niagara Power Project*, N.Y. STATE NY POWER AUTH., https://perma.cc/7SEX-M6MF.

131. *Id.*

132. *See* Dan Miner, *CEO of Bitcoin Mining Operation in Niagara Falls Details Firm's Commitment to Growth*, BUFFALO INNO (Feb. 2, 2022, 6:00 AM), https://perma.cc/9JG2-4DPN.

133. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 23

Crypto-asset mining in upstate New York increased annual household electric bills by $82 and annual small business electric bills by $164, with net total losses from local consumers and businesses estimated to be $179 million from 2016-2018.[134] Recent impacts, increasing retail electric prices to serve increased demand and state programs to vigorously encourage conservation, however, have led New York legislators to consider a bill to ban in-state Bitcoin mining[135] imposing a two-year moratorium on air permit issuance or renewal for an electric generating facility that benefits crypto mining facilities.[136]

Georgia

The state of Georgia is attracting crypto miners with its cheap electricity prices, and Georgia, like Texas, has a surplus of energy generation capacity to accommodate and serve additional demand. Georgia's power is approximately twelve percent renewable power, about twenty-seven percent nuclear, and the sixty percent fossil fuel-fired.[137] Even more, regulators recently introduced a bill that would exempt crypto miners from state sales and use taxes.[138]

H. *De Minimis* Electric Competition Along the U.S. Border

U.S. states are bordered by two countries with abundant cheap power, which have managed to keep virtual currency at arms-length amongst the growing concerns over electricity system stability. One might assume that either would be attractive for crypto, yet Canada, with much cheaper renewable power than the U.S., and Mexico, with surplus oil and a nonmember of OPEC, have not encouraged crypto in the way that some U.S. states have.

For example, Mexico is one of the largest producers of petroleum in the world, qualifying as the fourth largest producer in the Americas behind the United States, Canada, and Brazil.[139] In 2019, nine percent of all U.S crude oil imports came from Mexico.[140] Mexico harbors some of the largest future oil reserves in the world, amounting to approximately 5.8 billion barrels of crude oil reserves.[141] The Mexican electric sector is dependent on a cheap fossil-fuel supply; its total primary energy consumption is forty-three percent petroleum and other liquids and

134. *Id.* at 17.

135. *See* S. S6486D, 2021-2022 Leg., Reg. Sess. (N.Y. 2021), as of October 2023, the bill passed both the New York State Assembly and Senate.

136. *See id.*

137. *See Georgia State Profile and Energy Estimates*, EIA (Dec. 2021), https://perma.cc/MH7K-7WGH; *see also Nuclear*, GA. POWER, https://perma.cc/2K86-XMZ3.

138. *See* H.B. 1342, 2021-2022 Leg., Reg. Sess. (Ga. 2022); *see generally*, Turner Wright, *Georgia Lawmakers Consider Giving Crypto Miner Tax Exemption in New Bill*, COINTELEGRAPH (Feb. 18, 2022), https://perma.cc/WS7W-HBEL (House Bill 1342 seeks to exempt sale and use tax on electricity used by commercial mining facilities larger than 75,000 square feet).

139. *See Country Analysis Brief: Mexico*, U.S. ENERGY INFO. ADMIN., https://perma.cc/P3X7-XPDJ (Mar. 31, 2023).

140. *See id.*

141. *See id.*

forty-two percent natural gas.[142] With an abundance of cheap fuel, electricity prices are lower than in many countries. The average electricity price in Mexico is $0.10/kWh, which is nearly half of the average cost per kWh in the United States.[143] However, Mexico's crypto miners currently are facing pushback surrounding the legality of crypto mining. In 2021, Mexico's Finance Minister confirmed a ban on the use of cryptocurrency for transactions, noting that Bitcoin and other virtual currency were not considered legal tender assets or currencies.[144]

By contrast, Canada has an abundance of both natural gas and cheap renewable hydroelectricity. The country generates sixty-one percent of its electricity from hydro power, making it the second largest producer of hydroelectricity in the world.[145] With an abundance of surplus renewable energy, Canada has not sought to attract crypto miners: Canada was the first nation to establish laws regulating cryptocurrency.[146] As defined in Canada's Currency Act, legal tender for virtual currency is limited to bank notes issued and coins minted by the Bank of Canada.[147]

IV. Federal and State Legal Constraints on Regulation of Crypto Electricity

"Energy is the only universal currency."[148]

A. High Demand

Cryptocurrency currently consumes 0.5% of all electricity used globally; which, for context, is seven times more than the total amount Google uses to electronically connect all global users and provide cloud storage for the world's data.[149] Estimates place consumption by crypto mining and verification in the vicinity of 91 terawatt-hours (TWh) of electricity annually.[150] Crypto usage has significantly increased since Bitcoin was first mined in 2009. At that point, mining one coin consumed a few seconds worth of household electricity; whereas today, mining one Bitcoin uses nine years' worth of a household's electricity.[151] Some scholars suggest that Bitcoin's indirect carbon emissions at the current rate, alone

142. *See id.*

143. *See* Statista Rsch. Dep't, *Household Electricity Prices Worldwide in September 2022, by Select Country*, STATISTA, https://perma.cc/N3LX-UF85.

144. *See* Andrés Engler, *Mexico's Finance Minister Confirms Cryptos Are Banned from Financial System*, COINDESK (Sept. 14, 2021, 6:17 AM), https://perma.cc/NM23-SLQ7.

145. *See Provincial and Territorial Energy Profiles – Canada*, CAN. ENERGY REGUL., (Aug. 23, 2023), https://perma.cc/AJJ4-D54Z; *see also About Electricity*, GOV'T CAN., https://perma.cc/7GZR-6RZD (last modified June 15, 2020).

146. *See Canada and Cryptocurrency*, FREEMAN L., https://perma.cc/N83L-5USY.

147. *See id.*

148. VACLAV SMIL, ENERGIES: AN ILLUSTRATED GUIDE TO THE BIOSPHERE AND CIVILIZATION x (MIT Press, 1999).

149. *See* Eugene Kim, *Bitcoin Mining Consumes 0.5% of All Electricity Used Globally and 7 Times Google's Total Usage, New Report Says,* BUS. INSIDER (Sept. 7, 2021, 5:32 AM), https://perma.cc/3KE5-ZK2Q.

150. *See id.*

151. *See* Huang et al., *supra* note 84.

with no other increases by world nations (which are still increasing) would be enough to push global warming beyond the Paris Agreement commitment to stay below an increase in temperature of two degrees Celsius.[152]

Further, Bitcoin's energy usage is vastly higher than other forms of currency. A single Bitcoin transaction requires 632.08 kWh of electricity while, or a credit card company to consume the same amount of electrical energy consumption, it would need to complete 425,269 VISA credit card transactions[153]—making crypto mining 1.5 million times more power consumptive than the electronic credit system that undergirds the U.S. economy. While electricity usage does not necessarily mean more GHG emissions for a renewable electric grid, a majority of the world, and of the United States, still rely on fossil fuels for the production of electric energy.[154]

B. Regulatory Concerns from Non-Crypto Rate-Paying Consumers

The impact on electricity costs is astronomical and will change the industry. Cryptocurrency mining is now the largest source of electricity demand for some utilities.[155] One study suggests that citizens in New York have experienced significant increases in annual electric bills, ranging from $14 for small businesses and $7 for individual households; another way to scale the overall annual cost of cryptocurrency mining is about $92 million for all New York small businesses plus $204 million for all New York individual consumers.[156] Plattsburgh, New York residents' electricity bills increased thirty percent when crypto mining arrived, and a recent study found that Plattsburgh residents and small businesses paid $189 million and $90 million, respectively, more in electricity bills due to cryptocurrency's arrival.[157]

There are numerous documented situations in which U.S. utilities made significant capital investments in additional power generation and transmission infrastructure to serve crypto miners where the costs ultimately were shifted away from the crypto mining consumers to existing ratepayers:

- The Nebraska Public Power District spent $17.6 million, or eighteen percent of its 2020 budget, on transmission improvement including a substation to serve a crypto mining operation;
- Big Rivers Electric utility was reported to plan to spend $12.7 million in upgrades to service a new crypto

152. *See* Camilo Mora et al., *Bitcoin Emissions Alone Could Push Global Warming Above 2°C*, 8 NATURE CLIMATE CHANGE 931, 931–33 (2018).

153. *See Bitcoin Energy Consumption Index*, *supra* note 74.

154. *See infra*. n. 321.

155. *See* DEROCHE ET AL., *supra* note 57, at 7.

156. *See* Matteo Benetton et al., *When Cryptomining Comes to Town: High Electricity-Use Spillovers to the Local Economy*, CEPR (Aug. 12, 2023), https://perma.cc/JV5P-4PBV.

157. *See* Solomon, *supra* note 40, at 41.

mining operation in Paducah, Kentucky;

- Entergy Arkansas had a cryptocurrency mining operation which abruptly left to find lower electric rates after the utility spent significant capital amounts to serve it; and,
- In 2018, a mining company in Washington exited with more than $700,000 in unpaid utility bills and declared bankruptcy. [158]

C. Supreme Court "Bright Line" Legal Constraints on Federal Regulation to Discourage Excessive Crypto Power Use

Incentives to use or conserve electric power are embodied in electric rate regulation. In trying to implement federal policy to supply lower-carbon energy more efficiently, the most cost-effective option in every instance is to use less energy more efficiently to do tasks. The federal government and certain states are attempting to implement electrification of vehicle transportation, the largest sector of the economy contributing to global warming, as well as electrify residential and commercial building heating, the fourth largest sector contributing to global warming.[159] In an effort to mitigate climate change impacts of this upcoming shift to greater technology electrification for conventional necessities of space conditioning and vehicle transportation, state and local governments are enacting low-carbon goals or requirements,[160] which will increase demand for electricity, irrespective of the new industry demands for non-essential energy uses for cryptocurrency.[161]

Electrification of major new and existing energy markets appears inevitable under current U.S. policy.[162] The instability of additional demand for cryptocurrency could cause reliability challenges for an evolving U.S. electrical grid. The United States has no national policy regarding cryptocurrency. The most recent attempt to establish a national policy, the Crypto-Currency Act of 2020, expired on the floor of the House of Representatives.[163]

It is unclear which agency, or agencies, of the executive branch controls which aspect of cryptocurrency. Executive agencies have taken more active roles in regulation,[164] but their focus appears limited to upholding national security.[165]

158. *See* DEROCHE ET AL., *supra* note 57, at 3 (discussing that "[i]In some of these cases, the mining operation left abruptly months later, leaving behind stranded costs that are picked up by the utility and its customers.").

159. *See Sources of Greenhouse Gas Emissions*, U.S. EPA, https://perma.cc/Y5TR-MJD9 (last updated Aug. 25, 2023).

160. *See* Dan Gearino, *Inside Clean Energy: Here Are 5 States that Took Leaps on Clean Energy Policy in 2021*, INSIDE CLIMATE NEWS (Dec. 23, 2021), https://perma.cc/FH26-HXFH.

161. *See infra* Part VI.B.

162. *See supra* Part VI.

163. *See* Crypto-Currency Act of 2020, H.R. 6154, 116th Cong. (2020).

164. *See* Dewey, *supra* note 101.

165. *See* Tarbert et al., *supra* note 100.

At least in the short-term, the United States, without improvements in the transmission system, is not fully prepared for the increased intense localized demand for power: "[t]he sheer speed and magnitude of load growth associated with cryptocurrency mining is unprecedented and threatens the ability of both generation and transmission resources to get electrons where they are needed without overheating or unbalancing the physical infrastructure."[166]

There remains a fundamental, legal "bright line" differentiating federal and state jurisdiction over power. The Federal Power Act of 1935 provides that FERC has jurisdiction over the terms of interstate and wholesale power sales; however, its authority does not extend to "any other sale of electric energy"[167] and shall "extend only to those matters which are not subject to regulation by the States."[168] This federal jurisdiction does not include state regulation of retail electric power rates.[169] The U.S. Supreme Court has held several times that Congress meant to draw a "bright line," easily ascertained and never requiring a case-by-case analysis between state and federal jurisdiction.[170]

Thus, states exercise exclusive authority over retail rates that all consumers, including crypto miners, pay to utilize centrally supplied electric power. This absolute state authority was tested and upheld in a 1982 Supreme Court case.[171] In *FERC v. Mississippi*, the Supreme Court declared that the federal government could not mandate any obligatory electric rate or service requirements for states to implement.[172] So new federal programs, orders, or regulations may not prescribe substantive electric power requirements for the states to complete or implement, pursuant to established Supreme Court law.[173] Pursuant to the Federal Power Act and the decision in *FERC v. Mississippi*, states exclusively exercise the final decision on retail rate matters and the terms of service of retail utilities, which excludes any federal intervention.

The Federal Power Act, routinely upheld by the U.S. Supreme Court, and reinforced by the Supremacy Clause of the Constitution, vests exclusive power over using electric utility rates to influence consumer behavior in state governments.[174] And those state governments, as with many things in U.S. law, are taking disparate positions on encouraging or discouraging energy-intensive

166. DEROCHE ET AL., *supra* note 57, at 19.

167. Federal Power Act of 1935, 16 U.S.C. §§ 791a–825r, 824(b)(1).

168. *Id.* § 824(a).

169. *See* Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities, 76 Fed. Reg. 49,842 (Aug. 11, 2011) (codified at 18 C.F.R. pt. 35) (requiring nondiscriminatory access by all parties to transmission infrastructure); *see also* U.S. CONST. art. IV, § 3, cl. 2 (the federal government controls all permitting for development on federal lands); *see also* Kleppe v. New Mexico, 426 U.S. 529, 539 (1976) (the Property Clause gives Congress authority over federal property generally, and the Supreme Court described Congress's power to legislate under this Clause as "without limitations").

170. FERC v. S. Cal. Edison Co., 376 U.S. 205, 215–16 (1964).

171. *See* FERC v. Mississippi, 456 U.S. 742, 759–61 (1982).

172. *See id.*

173. *See id.* at 769 ("Titles I and III do not involve the compelled exercise of Mississippi's sovereign powers. And, equally important, they do not set a mandatory agenda to be considered in all events by state legislative or administrative decisionmakers.").

174. *See* U.S. CONST. art. VI, cl. 2.

crypto mining. As a result, there will be individual retail rate decisions in each of the 50 states, 2 U.S. commonwealths, and 11 U.S. territories and the District of Columbia, all of which enjoy land-use sovereignty. It is clear that the 50 states are of various opinions about renewable energy versus traditional forms of electricity production and the related costs of electric power.[175]

When establishing rates and creating specific terms exclusively applied for crypto mining operations, there is a potential for violating prohibitions against discriminating against any consumer class, as will next be explored.

D. 'Equal Protection' Prohibiting Limits on Crypto Power Use

Both state and federal energy regulatory commissions, when enacting any rate for electric service, are legally required to fashion terms and rates that are "just and reasonable."[176] A nearly universal legal obligation imposed by federal and state laws on public utilities is to furnish service and to charge rates that will avoid undue or unjust discrimination among prices paid by different customers.[177] "'[U]ndue' or 'unjust' discrimination among customers is prohibited."[178] Policy considerations play a subsidiary role in the ultimate rate allocation among consumer retail customer classes.[179]

These principles are embedded in rate decisions of both FERC[180] and state regulatory commissions,[181] and in articulated principles when courts review the legality of application of these principles by regulatory agencies.[182] Selling at retail, the regulated electric service and commodity must be sold in a non-discriminatory manner irrespective of policy goals outside of the purchase of the service: "[t]he principles of *horizontal equity* that 'equals should be treated equally' and *vertical equity* that 'unequals should be treated unequally' . . . [is interpreted to mean] that equal . . . cost causers for the provision of a good or service should pay the same . . . prices."[183] Horizontal equity among different customer classes or types of customers is based on cost of service: it can be illegal

175. *See* Ellen Knickmeyer, *Amid Urgent Climate Warnings, EPA Gives Coal a Reprieve*, ASSOCIATED PRESS (June 19, 2019, 5:42 PM), https://perma.cc/S9ZN-AFJD.

176. 16 U.S.C. § 824d(a).

177. *See* JAMES C. BONBRIGHT ET AL., PRINCIPLES OF PUBLIC UTILITY RATES 515, 528 (2d ed. 1988) (the authors also point out that "if an electric plant is operating near its full capacity, the imposition of higher charges for on-peak than for off-peak service would actually be required to avoid discrimination.").

178. CHARLES F. PHILLIPS JR., THE REGULATION OF PUBLIC UTILITIES: THEORY AND PRACTICE 434 (3d ed. 1993).

179. *See* BONBRIGHT ET AL., *supra* note 178, at 524, 540 (noting that Ramsey pricing can lead to service and user subsidies and "regulation may be unnecessary for social optimality").

180. *See* Ala. Elec. Coop., Inc. v. FERC, 684 F.2d 20, 27 (D.C. Cir. 1982) (holding that rate schemes applying a uniform rate to two similar groups of customers may be unlawfully discriminatory if the scheme creates an undue disparity between the rates of return on sales to different groups).

181. MICH. COMP. L. § 460.557(3)–(4) (2019); *see also* TEX. UTIL. CODE ANN. § 36.003(a)–(c) (West 2019) (prohibiting rate-setters in Texas from prescribing "prejudicial . . . or discriminatory" rates).

182. *Ala. Elec. Coop., Inc.*, 684 F.2d at 27.

183. BONBRIGHT ET AL., *supra* note 178, at 568 (emphasis in original).

for a state to set rates that "grant any undue preference or advantage to any person or subject any person to any undue prejudice or disadvantage."[184] An electric power customer only needs to show substantial vertical disparity in rates between customers of the same class or size of consumption in order to raise questions of discriminatory or preferential rates.[185]

Unlawful discrimination may arise under a single rate design where a uniform rate creates an undue disparity between the rates of return on sales to different groups of customers.[186] If this rate design provides costs of service to one group that are different from costs of service to another, "the two groups are [then,] in one important respect[,] quite dissimilar."[187] It is also illegal for a public utility to "maintain any unreasonable difference in rates . . . as between localities," which is geographically-based discrimination.[188]

Moreover, decisions of electric power regulatory agencies must independently conform to the Filed-Rate Doctrine and the bar against retroactive ratemaking.[189] This also has implications for Constitutional requirements for state and federal regulation. State regulators must not violate the Dormant Commerce Clause by discriminating against out-of-state power and both the state and federal electricity regulators must carefully respect the 'bright line' distinguishing their respective jurisdictions.

A state public utility regulatory commission lacks the power to approve the collection of unjust, unreasonable, discriminatory, preferential, or prejudicial rates from any group of customers.[190] "The provision and pricing of services to any person(s) should not impose unwarranted economic costs on other person(s)."[191] The rate charged to one group should not impose a cost burden derived from a different pricing policy to another group.[192]

V. Strategic State Legal Techniques to Limit Crypto Demand for Power

As examined above, states are using three legal mechanisms to attempt to limit or ban mining's use of electricity: discriminatory higher rates which may or may not track cost of service; outright bans on utility service; and a moratorium on service. Each is analyzed below.

Several states have made attempts to discourage new crypto mining operations by imposing higher rates, or conversely to attract them by offering lower

184. 16 U.S.C. § 824d(b).

185. *See* Pub. Serv. Co. of Ind. v. FERC, 575 F.2d 1204, 1212 (7th Cir. 1978), *aff'd sub nom.* Frankfort v. Fed. Energy Regul. Comm'n, 678 F.2d 699 (7th Cir. 1982).

186. *See Ala. Elec. Coop., Inc.*, 684 F.2d at 27.

187. *Id.*

188. 16 U.S.C. § 824d(b).

189. *See* Cogentrix Energy Power Mgmt. v. FERC, 24 F.4th 677 (D.C. Cir. 2022) (concerning recovery of previously paid costs to comply with reliability standards, holding that in establishing NE-ISO tariffs for wholesale power sales and transmission, must independently conform to the Fixed-Rate Doctrine and the bar on retroactive ratemaking by FERC and state PUCs).

190. *See* 73B C.J.S. *Public Utilities* § 32 (2013).

191. BONBRIGHT ET AL., *supra* note 178, at 568.

192. *See id.*

retail power rates. Below, this Article analyzes how courts have reacted to legal challenges to special electric rates for crypto mining.

A. Crypto Consumer Classifications for Rates

New York

The New York Municipal Power Authority created a new tariff in 2018 for high-volume data processing for crypto-assets to raise the cost of mining.[193] From 2016 to 2018, crypto-asset mining in upstate New York increased annual household electric bills by $82 and annual small business electric bills by $164, with net total losses from local consumers and businesses estimated to be $179 million.[194] The Public Service Commission of New York noted on March 15, 2018, that if the new rates had been in place in January of that year, "the two cryptocurrency companies in Plattsburgh would have seen a more than 60 percent increase in their monthly electricity costs."[195]

Washington

The Public Utility District of Grant County, Washington, adopted a rate class for crypto-asset miners to recover the District's incremental costs associated with meeting electricity demand from mining.[196] In 2020, the United States District Court of Washington addressed claims relating to the rates that cryptocurrency mining companies pay for electricity in Grant County, Washington.[197] The plaintiffs claimed that the District: (1) violated the Commerce Clause of the Federal Constitution and the Due Process Clause of the Fifth and Fourteenth Amendments; (2) violated Section 20 of the Federal Power Act, 16 U.S.C. § 813, by creating an unfair and discriminatory rate schedule; and (3) violated Washington's ratemaking law, the Due Process Clause of the Washington State Constitution, and the Privileges and Immunities Clause of the Washington State Constitution.[198] The United States District Court rejected each of the miners' legal claims.[199]

The cryptocurrency mining companies were unable to identify a viable property interest protected by substantive due process.[200] Their complaint defined

193. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 17 (from 2016 to 2018, crypto-asset mining in upstate New York increased annual household electric bills by $82 and annual small business electric bills by $164, with net total losses from local consumers and businesses estimated to be $179 million).

194. *See id.*

195. Evelyn Cheng, *Bitcoin Mining Firms Getting Pushback from New York State for Trying to Profit from Cheap Electricity*, CNBC (Mar. 16, 2018, 2:12 PM), https://perma.cc/R59L-CFKK.

196. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 17.

197. *See* Blocktree Props., LLC v. Pub. Util. Dist. No. 2 of Grant Cty. Wash., 447 F. Supp. 3d 1030, 1035 (E.D. Wash. 2020) (Public Utility District No. 2 purported that requests from cryptocurrency miners in 2017 totaled 1,500 MW of new load, which amounted to more than twice the District's average load), *aff'd sub nom.* Cytline, LLC v. Pub. Util. Dist. No. 2, 849 F. App'x 656 (9th Cir. 2021).

198. *See Blocktree Props., LLC*, 447 F. Supp. at 1036.

199. *See id.* at 1030–45.

200. *See id.* at 1038.

the property as investment in land and operations; the court responded that accepting such an argument would improperly classify anything of monetary value as a property interest protected by the Due Process Clause.[201] The plaintiffs also tried defining their alleged property interest as the right to a fair, non-arbitrary utility rate, but the court refused to consider a consumer's interest in a non-arbitrary utility rate, a protected interest for the purposes of substantive due process.[202] Finally, the plaintiffs categorized their property interest as a right to be free of confiscatory rates that amount to the taking of property without due process of law, but since "confiscatory rates" applies to utility companies, the court held that this argument lacked merit.[203]

For their procedural due process complaint, the plaintiffs argued that the Washington law establishes a property interest in nondiscriminatory, non-arbitrary electricity rates.[204] The court explained that a legitimate claim of entitlement to a benefit must have more than unilateral expectation due to an independent source, such as state law establishing and defining the contours of the benefit.[205] However, entitlement to a benefit is less likely to be established where a statute gives the administering body broad authority to act with regard to the benefit and thus, the benefit is less likely to be a protected property interest.[206] The court held that plaintiffs failed to demonstrate a legitimate claim to a fair and nondiscriminatory rate under Washington law because Washington law gives broad power and discretion to public utility districts in their authority to set rates and implement a method of rate calculation and does not constrain public utility districts' discretion by providing an approved method of rate calculation.[207] Furthermore, even if the plaintiffs could have pointed to a valid property interest, their procedural due process claim failed as a matter of law because rate setting is a legislative act and procedural due process rights do not attach.[208]

Although a majority of the crypto-mining plaintiffs were in-state companies conducting mining operations in Grant County, the court addressed plaintiffs' Dormant Commerce Clause argument because two of the entities were not Washington organizations.[209] The court held that the rate schedule is not discriminatory because it treats in-state and out-of-state crypto-mining companies the same.[210] With respect to the question of whether the rate schedule places a burden on interstate commerce, the plaintiffs argued that the higher electricity rates make their business less profitable, inherently burdening interstate commerce because the companies sell interstate to consumers around the country.[211] The plaintiffs also contended that "if utilities outside Grant County adopted [similar rate schedules then] interstate and international commerce using cryptocurrency

201. *See id.*
202. *See id.*
203. *See id.*
204. *See id.* at 1039.
205. *See id.* at 1041.
206. *See id.* at 1042.
207. *See id.*
208. *See id.* at 1041.
209. *See id.* at 1042.
210. *See id.*
211. *See id.*

and blockchain technology would be destroyed."[212] The court held that the plaintiffs' argument did not support a Dormant Commerce Clause claim because the Dormant Commerce Clause protects the interstate market, not particular interstate firms or an industry's profit margin, structure, or existence.[213]

The plaintiffs argued that Section 20 of the Federal Power Act ("FPA") prevents the District from charging unreasonable, discriminatory, and unjust electric rates.[214] The court did not concede that a private right of action was created by Section 20 of the FPA, because the focus of the statute is more on FERC's jurisdiction, power, and responsibilities, rather than on the customer.[215] However, the court held that even if a private right could be found, plaintiffs have no cause of action under that statute because Section 20 does not provide plaintiffs with a private right or a private remedy.[216] The court reasoned that Congress intended for enforcement of Section 20 to be carried out by FERC, and an express method of enforcement of the statute was intended to preclude stand-alone, private actions.[217] The United States District Court for the Eastern District of Washington granted the utility body's motion for summary judgment.

The *Blocktree* plaintiffs appealed to the Ninth Circuit,[218] which affirmed the lower court's ruling, holding that the rate schedule:

- Did not violate the Dormant Commerce Clause by demonstrating intent to discriminate because it was enacted to address a sudden influx in cryptocurrency requests for electricity;[219]
- Did not have a discriminatory effect on interstate commerce because it only affects the price of electricity for crypto-miners operating within the utility district;[220]
- Does not unduly burden commerce merely because of its effect on businesses engaged in the industry and their profitability;[221]
- With respect to due process, the company's "claimed interests in its current profitability, investments in Grant County, a non-arbitrary rate, and money generally are not constitutionally protected interests";[222] and
- Created no Federal Power Act, 16 U.S.C.A. § 813,

212. *Id.*
213. *Id.*
214. *See id.* at 1044.
215. *See id.* at 1045.
216. *See id.* at 1046.
217. *See id.*
218. *See* Cytline, LLC v. Pub. Util. Dist., 849 F. App'x 656, 656 (9th Cir. 2021).
219. *See id.* at 657–58.
220. *See id.* at 658.
221. *See id.*
222. *Id.*

> private cause of action because the statute only designates the FERC's enforcement power to ensure rates charged by federal licensees are "reasonable, nondiscriminatory and just to the customer."[223]

Idaho

Idaho Power became the first investor-owned utility to submit an application to any state regulator "to create a separate class of 'Speculative High-Density Load Customers,' since the utility received at least 17 separate inquiries totaling 1,950 MW — roughly fifty-two percent of its until-then-record peak demand."[224] This included energy priced at marginal cost, and the requirement to be fully interruptible at the Idaho Power's discretion.[225] After the Idaho Public Utilities Commission (PUC) approved Idaho Power's application in June of 2022, finding the new schedule and new rate to be "fair, just, and reasonable," a cryptocurrency company filed a Petition for Reconsideration and a late Petition for Intervention as a party the following July.[226] The cryptocurrency company argued that the new schedule "is an illegally discriminatory classification and hence in violation of law and beyond the Commission's authority to approve" because it discriminated between old and new customers without any reasonable justification and the commission failed to make a reasoned decision supported by sufficient findings of fact and substantial evidence as part of its order approving the new schedule.[227]

On October 5, 2022, the Commission issued an order denying the petition of the cryptocurrency mining company, stating that "taking proactive steps by implementing a schedule under which future HDL Customers can take service is a fair and reasonable approach that protects current customers on the company's system."[228] The Commission cited the Ninth Circuit decisions in *Blocktree* and *Cytline* as "persuasive evidence and authority that implementing an electric service schedule applicable to cryptocurrency miners in the company's service territory is a reasonable and fairly normal measure to protect customers from the potential risks of cryptocurrency operations."[229] Although the implementation of the new rate schedule was granted by the commission, with respect to establishment of an uncompensated mandatory interruptible service provision, the commission ordered

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223. *See id.* at 659.

224. DEROCHE ET AL., *supra* note 57, at 17.

225. *See* Application at 2, In the Matter of the Application of Idaho Power Company for Authority to Establish a New Schedule to Serve Speculative High-Density Load Customers, No. IPC-E-21-37 (Idaho Nov. 4, 2021).

226. Order No. 35428 at 6, In the Matter of the Application of Idaho Power Company for Authority to Establish a New Schedule to Serve Speculative High-Density Load Customers, No. IPC-E-21-37 (Idaho June 15, 2022).

227. Petition for Reconsideration of Geobitmine LLC and Petition for Intervention as a Party at 11–12, In the Matter of the Application of Idaho Power Company for Authority to Establish a New Schedule to Serve Speculative High-Density Load Customers, No. IPC-E-21-37 (Idaho July 6, 2022).

228. Order No. 35550 at 20, In the Matter of the Application of Idaho Power Company for Authority to Establish a New Schedule to Serve Speculative High-Density Load Customers, No. IPC-E-21-37 (Idaho Oct. 5, 2022), https://perma.cc/9AGF-J6XL.

229. *Id.* at 21.

subsequent determination of whether compensation for mandatory interruption is required, and if so, an amount of compensation that is fair, just, and reasonable to interrupt customers.[230]

Arkansas

In July 2022, retail utility Entergy Arkansas (Entergy), submitted a proposed tariff for "Large Power High-Load Density" customers triggered by "approximately 150 MW of 'cryptomining related interest' in its service territory."[231] Entergy described a previous incident where a new cryptocurrency mining customer that required significant facility upgrades opted to pay a monthly minimum for those upgrades under Entergy's tariff and subsequently moved "its shipping containers 'virtually overnight' shortly" thereafter, "leaving Entergy unable to even reach the customer to recoup their upfront costs, forcing existing customers to pick up the bill."[232] Entergy Arkansas's cryptocurrency mining tariff would require miners to pay a security deposit, contribute to any construction upfront, post a surety bond or letter of credit, and select between two interruptible rates, allowing:

> "Entergy or the grid operator to require the miner to cease operation on 30 minutes to an hour's notice ten to twenty times per year, ensuring the additional cryptocurrency load is available as a demand response resource and will not—at least in theory—add to Entergy's capacity obligations and require it to construct new generation resources."[233]

On December 19, 2022, the Arkansas Public Service Commission approved Entergy's new schedule, effective as of January 2, 2023.[234]

As a final example, Missoula County, Montana, enacted emergency regulations to require cryptocurrency miners to purchase or build new sources of renewable energy to offset 100% of their energy demands.[235]

B. Equal Protection Required in Retail Utility Rates

The bulk of legal challenges to policies of differentiated utility "rates [irrespective of crypto consumers] have been based on the equal protection clause of the applicable state constitution."[236] State regulatory commissions must

230. *See id.* at 22–23.

231. DEROCHE ET AL., *supra* note 57, at 17.

232. *Id.* at 18.

233. *Id.*

234. *See* Order No. 58 at 1, In the Matter of Formula Rate Plan Filings of Entergy Arkansas, Inc., Pursuant to APSC Docket No. 15-015-U (Dec. 19, 2022) (No. 16-036-FR), APSC No. 896

235. *See* David Erickson, *Missoula County Adopts Emergency "Green" Regulations for Cryptocurrency; Operators Protest*, MISSOULIAN (Apr. 4, 2019), https://perma.cc/NE9B-M9C9.

236. STEVEN FERREY, THE LAW OF INDEPENDENT POWER, § 10:17 (Jul. 2023); *see* Mountain States Legal Found. v. P.U.C., 590 P.2d 495, 496–97 (Colo. 1979) (challenging

determine whether different customers have paid variable "amounts for the same service under the same circumstances."[237] As an example, Pennsylvania's energy regulatory commission order requiring electric utility retail charges to be applied equally within the residential class and offering a special rate to low-income and fixed-income customers constituted unconstitutional discrimination.[238]

Indiana law prohibited utilities from charging different rates for customers who receive "the same services under the same conditions."[239] Targeted lifeline rates that provided a below-cost electric rate for specific customers based on their level of income or demography were found to violate state statutes prohibiting undue discrimination.[240] The court held that it was discriminatory to charge customers different rates when they were "receiving the same service under the same circumstances."[241]

The Colorado Supreme Court held that targeted lifeline rates for low-income customers were unconstitutional because they were unjustly preferential, discriminatory, and contrary to legal prohibition of preferential rates.[242] The court reasoned that the PUC is a nonelected body that cannot determine which customers could receive a special rate[243]: "To find otherwise would empower the PUC, an appointed, nonelected body, to create a special rate for any group it determined to be deserving."[244]

The Maine PUC held that a reduced rate for elderly, low-income customers was unjust and unreasonable.[245] The commission held that the reduced rate was an inappropriate "social judgment[]."[246] When Washington ordered utility

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differentiated rates on Colorado state constitutional grounds); *see also* Re Cent. Me. Power Co. Intervenors: Martin-Marietta Corp. et al., 26 P.U.R. 4th 388, 430 (Me. 1978); *see also* Pa. P.U.C. v. Phila. Elec. Co., 91 Pub. Util. Rep. 3d 321, 373 (Pa. 1971).

237. *Id.* § 10:17 (citation omitted).

238. *See Phila. Elec. Co.*, 91 Pub. Util. Rep. 3d at 373.

239. Citizens Action Coal. of Ind. Inc. v. Pub. Serv. Co. of Ind., 450 N.E.2d 98, 101 (Ind. Ct. App. 1983); *see* Section 8-1-2-103(a) of the Indiana Code which states:

> No public utility, or agent or officer . . . [thereof], or officer of any municipality constituting a public utility, as defined in this chapter, may charge, demand, collect, or receive from any person a greater or less compensation for any service rendered or to be rendered, or for any service in connection . . . [therewith], than that prescribed in the published schedules or tariffs then in force or established as provided . . . [herein], or than it charges, demands, collects, or receives from any other person for a like and contemporaneous service.

IND. CODE § 8-1-2-103(a) (2019).

240. *See Citizens Action Coal.*, 450 N.E.2d at 101.

241. *Id.*

242. *See Mountain States Legal Found.*, 590 P.2d 495 at 498.

243. *See id.*

244. *Id.*

245. *See* Re Cent. Me. Power Co. Intervenors: Martin-Marietta Corp. et al., 26 P.U.R. 4th 388, 430 (Me. 1978), *appeal sustained in part, denied in part sub nom.* Cent. Me. Power Co. v. P.U.C., 405 A.2d 153,194 (Me. 1979).

246. *Id.* The Commission stated:

companies to reduce the utility rates of distressed farmers,[247] the Washington Supreme Court held that the ability to pay could not support a rate reduction borne by other ratepayers.[248] Massachusetts is the only state in which a discounted rate for certain customers, but not for other customers, has been upheld by its highest court.[249] In Massachusetts, utility companies provide a straight percentage discount for low-income customers.[250]

Targeting a particular use of electricity, such as for crypto mining, might be challenged on equal protection grounds in many states. However, of note, reasonable classifications of use can be implemented: most states distinguish different terms and rates for commercial, industrial, residential, and municipal classes of customers.[251] In some states, those who heat with electricity, and thus consume greater amounts of electricity than other residential consumers, are offered a distinct class of typically less expensive rates, justified as large volumes are less expensive to serve. Declining block rates are implemented for policy reasons to buffer the higher costs incurred by large consumption, as well as to encourage these consumers to remain customers of the electric utility rather than switch to other forms of building space conditioning.[252] In some cases, there is a basic or "lifeline" amount of electric power provided at a discounted rate, before rates decline for larger amounts of consumption.[253]

Operating in the opposite vein, some states have imposed inclining block rates where the price for additional blocks of electricity increase in price.[254] This

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> We cannot solve the nation's economic problems and we cannot solve ratepayers' financial problems. What we can do, however, is try to insure that those who buy electricity pay what it costs to generate and deliver that electricity to them, and that no one group of customers is subsidized at the expense of another. By doing this, we believe that all customers will be treated as fairly as possible; that they will be more able [sic] to choose wisely among competing energy technologies; that use of electricity will be neither promoted nor discouraged artificially; and that rates will, ultimately, be more stable than might otherwise be the case.

Id. at 429.

247. *See* State *ex rel.* Puget Sound Power & Light Co. v. Dep't of Pub. Works, 38 P.2d 350, 351–52 (Wash. 1934).

248. *Id.* at 353; *see also* Narragansett Elec. Co. v. Harsch, 368 A.2d 1194, 1213 (R.I. 1977) (holding that the commission erred in relying upon consumers' ability to pay in setting cost of equity).

249. *See* Am. Hoechest Corp. v. Dep't of Pub. Utilities, 399 N.E.2d 1, 4 (Mass. 1980) (explaining that it was not improper for the Massachusetts Department of Public Utilities to consider the age and income of customers to offer a reduced rate); *see also* FERREY, *supra* note 237, § 10:17.

250. *See Am. Hoechest Corp.*, 399 N.E.2d at 2 (explaining that a customer qualifies for a rate reduced from the standard domestic rate if the customer is at least 65 years old, head of the household, and a recipient of supplemental social security income).

251. *See Table 5.6.A. Average Price of Electricity to Ultimate Consumers by End-Use Sector*, U.S. Energy Info. Admin., https://perma.cc/UU5A-U5PB.

252. *See generally* KEVIN A. KELLY ET AL., LIFELINE RATES FOR ELECTRICITY AND NATURAL GAS 3–4 (1976), https://perma.cc/N23N-TWML.

253. *Id.*

254. *See Chapter 7.4: Customer Rates and Data Access*, EPA Energy & Env't Guide to Action, https://perma.cc/565J-6HD7 (last updated Feb. 23, 2023).

also is justified on policy grounds rather than on economic data.In some states, inclining block rates to all large consumers should be permissible based on conservation principles to conserve resources and reduce various emissions.

C. Moratoria and Exactions Applied to Crypto Mining

Several communities, utilities, or states have created moratoria on mining.

- "The Public Utility District of Benton County, Washington, also adopted a policy for crypto-asset customers, citing concerns about the utility district's distribution system safety and reliability."[255]
- "Plattsburgh, [New York], enacted an 18-month long moratorium on mining operations after community members and businesses complained of high energy bills and noise."[256]
- On November 22, 2022, the New York State Senate passed a bill initiating a two-year moratorium on behind-the-meter (self-generated) electric energy consumed or utilized by a cryptocurrency mining operations using proof-of-work authentication methods.[257]
- The Chelan County Public Utility District in Washington state created moratoria on new mining operations and enacted a retail rate structure to discourage crypto miners.[258]

Of note, the twenty-eight public utility districts in Washington are self-regulating power supply districts where the consumer-members elect a board to run the utility as a not-for-profit, community-owned utilities.[259] However, it is questionable whether the same outcome would have transpired had this been an investor-owned utility.

Using costs imposed instead of regulatory prohibitions to discourage wasteful crypto mining, exactions can be applied to cover legitimate system costs. Courts hold that exactions related to public safety and welfare are a valid exercise of local police power so long as the exactions do not go beyond the scope and

255. WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56, at 17.
256. *Id.*
257. *See* Assemb. A7389C, 2021-2022 Leg., Reg. Sess. (N.Y. 2021).
258. *See* DEROCHE ET AL., *supra* note 57, at 17.
259. *See Frequently Asked Questions*, WASH. PUB. UTIL. DISTS. ASS'N, https://perma.cc/SZ86-S59S; *see also About Washington PUD Association*, WASH. PUB. UTIL. DISTS. ASS'N, https://perma.cc/9BS3-VBK2.

purpose of existing administrative regulations.[260] On private land to which the public does not have access, the case for exactions is less straightforward.

Twenty-six states have state level exaction-enabling legislation, most of which provide that exactions can only be used to address pre-specified public service purposes, facilities, or capital improvements that are related to the specific development burdens.[261] A series of Supreme Court decisions—*Nollan v. California Coastal Commission*,[262] *Dolan v. City of Tigard*,[263] and *Koontz v. St. Johns River Water Management District*[264]—require that exactions must be structured to be proportional to and related to the purpose of the exaction. The Supreme Court articulated that a "taking" will occur when the owner has been deprived of *all* economic use of the property or if there is a *physical* invasion of the property.[265] While moratoria could be contested as a temporary taking, it has been challenging to prove that a taking has transpired.[266] An ordinance must be shown to be irrational for a successful challenge: "[p]laintiff thus has the heavy burden 'to negative every conceivable basis which might support' the Moratorium."[267]

260. *Cf.* Nollan v. Cal. Coastal Comm'n, 483 U.S. 825, 97 L.E.D.2d 677, 841–42 (striking down an exaction requiring an easement across beachfront property in exchange for building permit); *see id.* at 828–29 (In Nollan, the exaction was made pursuant to an administrative regulation that protected the public's view of the beachfront); *see id.* at 840–41 (The Court invalidated the exaction, reasoning that the grant of "physical" access to the beachfront went beyond the purpose and scope of the regulation, which protected only the public's right to "see" the beachfront).

261. *See* Jim Rossi & Christopher Serkin, *Energy Exactions*, 104 CORNELL LAW REV. 643, 691 (2019), https://scholarship.law.cornell.edu/clr/vol104/iss3/3 (noting that Arizona provides for "the imposition of fees to offset costs . . . associated with providing necessary public services to a development . . . limited to roads, water systems, sewer systems, storm water systems, parks, fire and police facilities, and libraries").

262. *See Nollan*, 483 U.S. at 836-37.

263. *See* Dolan v. City of Tigard, 512 U.S. 374, 390–91(1994) (there must be an essential nexus between "the legitimate interests and the permit conditions exacted by the City" resulting in a "rough proportionality" between the exactions and the development).

264. *See* Koontz v. St. Johns River Water Mgmt. Dist., 570 U.S. 595, 619 (2013) (holding that the *Nollan*/*Dolan* exaction protocol applies to both monetary exactions as well as to demands imposed on the land developed).

265. *See* Lucas v. South Carolina Coastal Council, 505 U.S. 1003, 1019 (1992).

266. *See* Tahoe-Sierra Pres. Council v. Tahoe Reg'l Plan. Agency, 535 U.S. 302 (2002); *see also* First English Evangelical Lutheran Church of Glendale v. Los Angeles Cnty. Cal., 482 U.S. 304 (1987) (holding moratorium was not a "taking'" because it was a regulation required to protect public health and safety).

267. Ecogen, LLC v. Town of Italy, 438 F. Supp. 2d 149, 158 (W.D.N.Y 2006) (citing Heller v. Doe, 509 U.S. 312, 320 (1993)).

VI. Why Crypto Has Not Used Sustainable Power Despite Federal Law

A. The Biden Adminstration Inflation Reduction Act Subsidizing Renewable Power

Objectives

The Biden Administration's IRA and the Infrastructure Investment and Jobs Act are new federal laws aiming to aggressively shift towards renewable energy as a primary source of power. These laws are historic investments in the nation's energy system, totaling more than $430 billion.[268] The large 2021 Infrastructure Investment and Jobs Act funds what President Biden calls a "once-in-a-generation investment" to modernize the U.S. electric sector with renewable power generation; the 2022 IRA added an unprecedented $369 billion for renewable energy tax credits and related investments.[269]

The Department of Energy (DOE) estimates that approximately two-thirds of the carbon sector reductions incentivized by the 2022 IRA[270] and the Infrastructure Investment Law will be in the electric power sector, dwarfing all of the other transportation, building space heating, and industry sectors of the U.S. economy combined,.[271] Notable is that, while the power sector is responsible for approximately one-quarter of GHG emissions, federal policy is targeting the power sector to shoulder a disproportionate two-thirds of the reductions in carbon emissions.

The Biden Administration has goals for a low-carbon economy. These major pieces of legislation, the 2021 Infrastructure Investment and 2022 IRA, are designed to reduce U.S. emissions by about fifty percent below 2005 levels by 2030, plan to achieve one hundred percent carbon-free electric power nationwide by 2035, and achieve net-zero emissions by 2050.[272] The Infrastructure Investment and Jobs Act will replace transit vehicles with "zero emission and low emission transit buses" and school buses with electric vehicles, as well as investing in a substantial network of electric vehicle charging stations throughout the United States.[273]

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268. U.S. DEP'T OF ENERGY OFF. OF POL'Y, THE INFLATION REDUCTION ACT DRIVES SIGNIFICANT EMISSIONS REDUCTIONS AND POSITIONS AMERICA TO REACH OUR CLIMATE GOALS 1 (2022), https://perma.cc/GAH2-MHL8 [hereinafter Significant Emissions Reductions]

269. *Id.*

270. *See* Inflation Reduction Act of 2022, *supra* note 8.

271. *See* Significant Emissions Reductions, *supra* note 269.

272. *See FACT SHEET: The Bipartisan Infrastructure Deal Boosts Clean Energy Jobs, Strengthens Resilience, and Advances Environmental Justice*, THE WHITE HOUSE (Nov. 8, 2021), https://perma.cc/8Q8R-396S.

273. *FACT SHEET: Vice President Harris Announces Actions to Accelerate Clean Transit Buses, School Buses, and Truck*, THE WHITE HOUSE (Mar. 7, 2022), https://perma.cc/XC4J-TQFC.

Extensions of Renewable Power Tax Credits

The cornerstone of the IRA provides extensions over ten years of the two federal renewable energy tax credits at their then-current 2022 levels.

- A Production Tax Credit (PTC) credit equal to either $0.005/kWh as a base amount or a credit for certain technologies of half that amount ($0.003/kWh), each applicable for renewable electric power sold to a third party during the first ten years of operation.[274]
- An Investment Tax Credit (ITC) of twenty-six percent of eligible capital costs to build renewable power generation.[275]
- Extension of other renewable energy tax credits.[276]
- Meeting prevailing wage amounts[277] and apprenticeship[278] provisions increase the PTC credit by up to five-fold and the increase the ITC substantially.[279]
- Implement a five-fold potential increase in credit amount for operation of new eligible renewable energy facilities with a net output capacity of less than 1 megawatt (Mw).[280]

In the short term, the IRA provides through 2024 a new renewable energy project developer's election to receive a direct payment of certain clean and renewable energy tax incentives which will no longer require that the developer have project tax revenue to offset the credit or alternatively to structure tax-equity financing to immediately realize the credits.[281] The IRA in its current form would have the ITC reinstated at a rate that can be up to thirty percent of project capital costs, dependent on using local content of materials, hiring apprentices, and paying prevailing wages in the project. The alternative PTC can be increased to $0.015/kWh of electric power produced and sold, as well as, for the first time in fifteen years, make the PTC available for solar facilities. These two key electric power credits would phase-down once annual GHG emissions by at least seventy-five percent from 2022 levels.[282] Thereafter, facilities will be able to claim a credit

274. *See* Inflation Reduction Act of 2022, *supra* note 8, §§ 45Y(a)–(b)(1)(B).
275. *See id.* § 48E(a).
276. *See id.* § 45D(a).
277. *See id.* § 45(b)(7).
278. *See id.* § 45(b)(8); *see also* CONG. RSCH. SERV., REGISTERED APPRENTICESHIP: FEDERAL ROLE AND RECENT FEDERAL EFFORTS (Mar. 17, 2021), https://perma.cc/9GRJ-BUTX.
279. *See* Inflation Reduction Act of 2022, *supra* note 8, § 45(b)(6) – (b)(8).
280. *See id.* § 45(b)(6)(B).
281. *See id.* § 45(b)(7)–(8).
282. *See id.* §§ 45Y(d)(3), 48E(e)(3).

at 100% value in the first year, then seventy-five percent in the second year, then fifty percent in the third year, and then zero percent in the fourth year.[283]

Significant "bonus" credits are available to raise the value of each credit, depending on where, or with which workers, wages, and materials the projects are constructed.[284] These also escalate the value of storage tax credits as well as solar and wind generation credits.[285] The new post-2025 credit with bonus credits can have the federal government provide tax credits or cash of up to sixty percent of the project cost from day one.[286] Potential credits include:

- Ten percent credit bonus for projects located in energy communities (defined as brownfield sites or fossil fuel-host communities).[287]
- Ten percent credit bonus for meeting domestic manufacturing requirements for steel, iron, or manufactured components.[288]
- Ten percent bonus for projects located in low-income communities or on Tribal land.[289]
- Twenty percent bonus for projects of less than 5 Mw capacity located in low-income residential buildings or part of low-income economic benefit projects—with a cap on total dollar amount of gigawatt-hours of capacity that will benefit from this credit.[290]

Any facility qualifying for either the Clean Energy, PTC, or ITC would be entitled to a five-year modified accelerated cost recovery system (MACRS) with depreciation afterwards for solar and wind generation projects.[291]

For any zero or negative GHG emissions facility after 2024, the Section 45Y credit assigns a PTC value of $0.015/kWh of electricity produced and either sold to others or stored at energy storage facilities where the facility is placed into service after 2024.[292] After 2024, with a technology-neutral credit system for which energy storage is eligible, storage facilities will not need to store solar and wind electric energy but can store any energy form.

B. State Law Reinforcing the Federal Inflation Reduction Act

Augmenting federal law, several states have adopted more ambitious renewable energy goals for the future:

283. *See id.* § 45Y(d)(2).
284. *See id.* § 48(a).
285. *Id.*
286. *See id.* § 48E(a).
287. *See id.* §§ 48E(a)(3)(A), 48(a)(12).
288. *See id.* §§ 48E(a)(3)(B), 45(b)(9)(A).
289. *See id.* § 48(e).
290. *See id.* § 48(e)(1)(A)(ii).
291. *See id.* § 168(e)(3)(B).
292. *See id.* § 168(e)(3)(B)(viii).

- Massachusetts: eighty percent by 2050;
- New York: seventy percent by 2030;
- Washington D.C.: one-hundred percent by 2032;
- Vermont: seventy-five percent by 2032;
- Rhode Island, Hawaii, and Puerto Rico: one-hundred percent targets between 2030-2050.[293]

As one example, Massachusetts, the most assertive state target, is implementing plans to reduce its GHG emissions by at least eighty-five percent by 2050 and ultimately achieve net-zero emissions.[294] As outlined in its 2050 Decarbonization Roadmap (MA Roadmap), Massachusetts seeks to reach net-zero emissions by regulating GHG emissions in several ways.[295] One primary issue is the combustion of fossil fuels. In residential and commercial building subsectors, fossil fuels accounted for twenty-seven percent of state GHG emissions in 2017, with space heating being the key contributor of emissions.[296] In response to this issue, the MA Roadmap features a plan to transition all existing home heating from natural gas and oil heating to electric heating. Massachusetts' goal is to convert 100,000 homes to electric heating per year starting in 2020 by replacing traditional fossil fuel use for heating with electric air source heat pumps.[297] By 2030, the state hopes to have converted one million buildings; however, in 2021, less than 500 homes were converted to use of an electric heat pump.[298]

In addition to building space conditioning requirements, the other major sector responsible for GHG emissions is transportation. The MA Roadmap plans to electrify public transit within the next few decades.[299] Prior to 2040, the plan will require the greater Boston subway and bus authority, the Mass Bay Transit Authority, to electrify all buses.[300] To further support the state's efforts, Massachusetts is considering imposing a carbon fee extended to transportation and

293. *See MA Decarbonization Roadmap*, MASS.GOV, https://perma.cc/JZ3D-TS2M; *Climate Act*, N.Y. STATE, https://climate.ny.gov/ (last visited Nov. 25, 2023) (stating Climate Leadership and Community Protection Act goal); CleanEnergy DC Omnibus Amendment Act of 2018, D.C. Code § 34-1431; 30 V.S.A. §§ 8002-8005; *Table of 100% Clean Energy States*, CLEANENERGY STATES ALLIANCE, https://www.cesa.org/projects/100-clean-energy-collaborative/guide/table-of-100-clean-energy-states/ (last visited Nov. 25, 2023).

294. *See MA Decarbonization Roadmap*, MASS.GOV, https://perma.cc/JZ3D-TS2M.

295. *See* MASS. 2050 DECARBONIZATION ROADMAP, MASS. EXEC. OFF. OF ENERGY & ENV'T AFFAIRS (Dec. 2020), https://perma.cc/G2Q7-VDCC.

296. *See* THE CADMUS GROUP ET AL., BUILDING SECTOR REP.: A TECH. REP. OF THE MASS. DECARBONIZATION ROADMAP STUDY, EXEC. OFF. OF ENERGY & ENV'T AFFAIRS 7 (Dec. 2020), https://perma.cc/6ENM-VN57.

297. MASS. 2050 DECARBONIZATION ROADMAP, *supra* note 296.

298. *Id.*

299. *See* THE CADMUS GROUP ET AL., *supra* note 297, at 40.

300. *See* Matt Stout, *Senate Climate Bills Would Push State to Adopt Carbon Pricing*, BOSTON GLOBE (Jan. 23, 2020, 6:31 PM), https://perma.cc/FM87-LT95.

heating fossil fuel prices.[301] While electrification of heating and transportation has proceeded slowly, carbon-neutral laws will likely create less favorable conditions for cryptocurrency miners, as prices to support a larger supply of electricity under existing ISO-New England dispatch protocols to call into operation the less efficient and more expensive to operate power generation units to meet increased demand.[302]

California has similar plans. Implementing 2006 Assembly Bill 32, California adopted a plan to reduce GHG emissions by forty percent below 1990 levels by 2030.[303] A 2020 executive order announced a plan that all new cars and passenger trucks sold must be zero-emission vehicles by 2035.[304] In 2018, California adopted Senate Bill 100 which established a goal to achieve 100% carbon-free electricity by 2045.[305] California also is banning sale of gas-fired furnaces after 2030.[306] California and New York have also banned light-duty (LD)[307] internal combustion new vehicles sales after 2035 in favor of electrified new vehicles; Massachusetts and Washington have "trigger law" statutory mandates which follow California tailpipe standards.[308]

C. Why These New Federal and State Laws Have Not Redirected Crypto Mining

> "There are few mining facilities that are building renewables to even power their own operations, let alone send to the grid."[309]

There are three impediments causing the recent federal acts to be less successful than anticipated at reducing the exorbitant consumption of U.S. power by cryptocurrency mining:

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301. *See* H.R. 3292, 192nd Gen. Ct., (Mass. 2021) (House Bill Number 3292 seeks to extend a current carbon fee on power plants to these additional sectors.); *see also* Sarah Shemkus, *Massachusetts Groups Back Expanded Carbon Tax with Focus on Equity*, ENERGY NEWS NETWORK (Mar. 2, 2021), https://perma.cc/XKR8-GXRB.

302. *See How Resources Are Selected and Prices Are Set in the Wholesale Energy Markets*, ISO NEW ENGLAND, https://perma.cc/2U5L-4XQQ.

303. *See California Climate Policy Dashboard*, BERKELEY L., https://perma.cc/KW4U-9FPF.

304. *See Governor Newsom Announces California Will Phase Out Gasoline-Powered Cars & Drastically Reduce Demand for Fossil Fuel in California's Fight Against Climate Change*, OFF. OF GOVERNOR (Sept. 23, 2020), https://perma.cc/DG5A-SNHV.

305. *See* Cal. Exec. Order No. B-55-18 (Sept. 10, 2018), https://perma.cc/QG8W-RF8L.

306. *See* Caleigh Wells, *California Plans to Phase Out New Gas Heaters by 2030*, NPR (Sept. 23, 2022, 10:52 AM), https://perma.cc/2TX5-W3SR.

307. These are vehicles of no more than a gross vehicle weight of 8,500 pounds. *See Vehicle Weight Classes and Categories*, U.S. Dept. of Energy, U.S. DEPT. OF ENERGY, https://perma.cc/2K7K-P4W2 (last updated June 2012).

308. *See* Sean Tucker, *More States Join Sales Ban of New Gas-Powered Cars by 2035*, KELLEY BLUE BOOK (Aug. 29, 2022, 7:58 AM), https://perma.cc/J47Q-R38X (In addition to Massachusetts and Washington having trigger laws to follow California, "seventeen states, representing about a third of car sales, have adopted some version of California's stricter pollution regulations in the past.").

309. Solomon, *supra* note 40.

- Despite the enactment of the IRA, miners have typically preferred using fossil-fuel-fired power, often prolonging the life of fossil plants that otherwise had or would close, and the majority of U.S. power in the intermediate term is not yet sustainable;[310]
- States and many cities are blocking deployment of sustainable renewable energy supply options and infrastructure; and
- There are significant supply chain issues that threaten to delay the transition to renewable power in the United States.

Each is analyzed below.

Asymmetry of Sustainable Renewable Power Supply and Power Demand

In this era of supply chain uncertainty, any technology is only as reliable as its inputs. The economic question arises: if there are such generous monetary returns to crypto mining, is switching to renewable energy the solution or do the technology's inefficiencies make it unsustainable regardless of the energy source? At one level, the answer is "yes." At a more nuanced holistic analysis, such a proposed solution encounters different constraints in the United States as a factor of time and necessary sustainable power inputs.

The current, although evolving, reality is that renewable energy today generates only about twenty percent of U.S. electric power. In 2021the sources of the U.S.'s primary current total energy consumption (including electric energy) had only twelve percent from renewable energy in the primary energy mix.[311]

Unless an on-site distributed renewable power facility is dedicated to a crypto mining facility, or similar high-use new power-demanding operations (which a Senate bill pending in New York would make illegal)[312] the majority of the power consumed will come from fossil-fuel-generated electricity. As analyzed above, crypto mining has not only gravitated to certain low-cost power regions of the country, but to states that have embedded conventional fossil fuel generation in the future plans. In some instances, crypto mining operations are causing the continuation or resuscitation of marginal fossil fuel generation.[313] Crypto mining customers have chosen to pay above-market prices for electricity from coal, natural gas, or inefficient plants across the nation.[314]

Crypto-asset mining is increasing electricity demand significantly, resulting in the operation of more natural gas and coal power plants by electricity system

310. *See* DEROCHE ET AL., *supra* note 57, at 8.
311. *See* Mauldin, *supra* note 32.
312. *See* S. S6486D, 2021-2022 Leg., Reg. Sess. (N.Y. 2021), *supra* note 136.
313. *See* Solomon, *supra* note 40; *see also* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56.
314. *See* Solomon, *supra* note 40.

operators,[315] which generally cost more and pollute more than the plants otherwise operated for grid electricity.[316]

State and Local Blockage of Additional Renewable Energy

The drafters of the 2021 and 2022 Infrastructure Act[317] and the IRA[318] likely did not anticipate the amount of pushback from local and state responses to renewable energy.[319]

- A 2022 study identified 121 local policies restricting new sustainable wind and solar projects in thirty-one states;[320]
- An article in Forbes documents more than 300 recent local decisions from California to Vermont blocking wind projects;[321]
- All local cities and towns have constitutionally reserved power unilaterally to block the siting of new renewable energy projects addressing climate warming;[322] and
- "States exercise exclusive power to block, and several are blocking, needed new transmission lines necessary to transmit and carry this renewable electricity for use by consumers."[323]

The U.S. Constitution's separation of powers reserves absolute discretion of 35,000 separate cities and towns[324] to control whether sustainable infrastructure can or cannot be sited on their land.[325] The Supreme Court has held that states retain "traditional and primary power over land and water use."[326] Land-use control in the American legal system is predominately a local, rather than federal

315. *See* WHITE HOUSE OFF. SCI. & TECH. POL'Y, *supra* note 56.
316. *See id.*
317. *See* Infrastructure Investment and Jobs Act, *supra* note 7.
318. *See* Inflation Reduction Act, *supra* note 8.
319. *See* Steven Ferrey, *Flipped Constitutional Supremacy: Inferior Local Law Blocking Federal Policy*, 2023 UTAH L.R. 65 (2023).
320. *See* Hillary Aidun et al., *Opposition to Renewable Energy Facilities in the United States*, COLUM. L. SCH. (Sabin Ctr. for Climate Change L. ed., 2022), https://perma.cc/WZ7F-UT8D.
321. Robert Bryce, *Wind Projects Rejected in Nebraska and Ohio, Wind Rejections Across U.S. Now Total 328 Since 2015*, FORBES (Apr. 29, 2022, 9:48 AM), https://perma.cc/7RBP-QGMV.
322. *See* Ferrey, *supra* note 320.
323. Steven Ferrey, *Dislocating the Separation of Powers State "Thumb" on the Biden Sustainability Initiatives & Law*, 54 ARIZ. ST. L.J. 755, 758 (2023).
324. *See Cities 101 – Number of Local Governments*, NAT'L LEAGUE OF CITIES, https://perma.cc/P6QT-DHZG.
325. *See* Ferrey, *supra* note 320; *see also* Ferrey, *supra* note 324.
326. Solid Waste Agency v. U.S. Army Corps of Eng'rs, 531 U.S. 159, 174 (2001) (noting that "the States' traditional and primary power over land and water use" raises "federalism questions").

or state, exercise of legal jurisdiction.[327] Local land-use regulation enjoys broad court deference and is overturned by the judiciary only if there is no rational purpose supporting enactment of the local ordinance.[328] Local boards' land-use determinations and judgments are respected because case law holds that "[a] local board of appeals brings to the matter an intimate understanding of the immediate circumstances, of local conditions, and of the background and purposes of the entire by-law."[329] The Supreme Court in *Murr v. Wisconsin*, the Court's most recent decision regarding the interpretation of local zoning laws, deferred to local judgment on the enforcement and interpretation of local zoning regulation of new construction on land.[330]

Siting of all electric power transmission and distribution lines is a matter of exclusive state power, which federal regulators have been unable to supersede.[331] Siting of the new renewable energy technologies attached to land—wind and solar power in particular—is a matter within local and state land-use police power regulation,[332] numerous cities and towns now already are deploying 'aesthetic' local zoning to block renewable electric power on their land.[333]

The most recent Supreme Court opinion regarding zoning, *Virginia Uranium, Inc. v. Warren*, defers to local zoning by-laws controlling construction permits on land and immunity to preemption by federal legislation.[334] At the close of its 2022 session, the Supreme Court took a major new step fundamentally blocking federal agency discretion to intrude into constitutionally reserved state authority regarding the electric power sector and climate change decisions reserved to the states.[335]

Rare Earth Restraints on Renewable Power for Crypto Mining

Large new inefficient users of large amounts of additional power could self-generate their own power and assert in doing so that they are not stressing the

327. *See Ecogen, LLC*, *supra* note 268, at 157 (quoting Greene v. Town of Blooming Grove, 879 F.2d 1061, 1063 (2d Cir. 1989)); *see also* John R. Nolon, *Historical Overview of the American Land Use System: A Diagnostic Approach to Evaluating Governmental Land Use Control*, 23 PACE ENV'T L. REV. 821, 821–22 (2006).

328. *See, e.g.*, *Ecogen, LLC*, *supra* note 268, at 156 ("In order to prevail on its substantive due process claim, Ecogen must establish that the Moratorium, at least insofar as it prohibits Ecogen's construction of a substation, bears no rational relationship to any legitimate governmental purpose." (citing Richardson v. Twp. of Brady, 218 F.3d 508, 513 (6th Cir. 2000))).

329. Fitzsimonds v. Bd. of Appeals of Chatham, 484 N.E.2d 113, 116 (Mass. App. Ct. 1985); *see* Manning v. Bos. Redevelopment Auth., 509 N.E.2d 1173, 1179 (Mass. 1987) (granting "substantial deference" to local administrative agency's interpretation of local zoning law); *see also* Euclid v. Ambler Realty Co., 272 U.S. 365, 397 (1922).

330. *See* Murr v. Wisconsin, 582 U.S. 383, 396–402 (2017).

331. *See* Transmission Planning and Cost Allocation by Transmission Owning and Operating Public Utilities (Order 1000), 76 Fed. Reg. 49,842 (Aug. 11, 2011) **(**requiring nondiscriminatory access by all parties to transmission infrastructure).

332. *See* discussion *supra* Part IV.B.

333. *See* discussion *supra* Part III.A.

334. *See* Virginia Uranium, Inc. v. Warren, 139 S. Ct. 1894 (2019); *accord* Pac. Gas & Elec. Co. v. State Energy Res. Conservation & Dev. Comm'n, 461 U.S. 190 (1983).

335. *See West Virginia*, *supra* note 13.

electric grid substantially more than before their operations arrived. Using the Biden IRA incentives for renewable energy,[336] cryptocurrency mining could utilize renewable electricity produced and self-supplied on-site behind-the-meter. Should this provide cryptocurrency mining a 'free pass?' In a perfect world, yes. In actuality, perhaps not, given that critical minerals and rare earth are limited in terms of recent U.S. supply.[337]

Even for those who want to use renewable electric energy, there is a challenge to rapidly implement renewable power. Key critical minerals are required in greater amounts for renewable energy technologies and for power storage than for conventional power generation. In terms of weight (Kg) of minerals per unit of electric capacity generation (Mw), wind power and solar power generation require more expensive copper, zinc, manganese, cobalt, and rare earth minerals than do conventional fossil fuel and nuclear power generation facilities.[338]

In the United States, it is becoming more challenging to locally source significant deposits of critical minerals for renewable energy such as copper, nickel, cobalt, or other rare earths and, if identified, it is difficult to get a mine permitted by the various government authorities.[339] These issues can create a significant supply-chain 'bottleneck' on the United States' planned rapid transition to renewable energy. Production and control of key minerals for a sustainable renewable future are concentrated outside of the United States and often in countries with whom the United States has strained international relations with.[340] Notably, China controls processing of more than eighty percent of rare earth minerals and approximately sixty percent of lithium essential for battery storage.

Over the next two decades, innovative renewable technologies will drive an increased demand for these critical minerals.[341] A study by the International Energy Agency determined that the demand for critical minerals, necessary for both expanded renewable power generation technologies and for expansion of transmission line capacity to handle the increased volume of power, will require nearly 3000% more critical minerals by 2040, with supplies of lithium and nickel increased in the next two decades by 4000%.[342]

Recalling that both the Biden Administration[343] and certain states[344] are seeking to soon electrify transportation, EVs require almost ten times the amount of key minerals and metals as do conventional gasoline-powered and diesel-powered vehicles.Moreover, the IRA requires that at least forty percent of the battery materials for EVs in 2023, rising to at least eighty percent in 2027 and after, must be extracted from or processed in the U.S. or free Trade Agreement countries,

336. *See supra* Part IV.A.

337. INT'L ENERGY AGENCY, THE ROLE OF CRITICAL MINERALS IN CLEAN ENERGY TRANSITIONS 6 (2022), https://perma.cc/7SX5-XY3M.

338. *Id.*

339. *See* Mauldin, *supra* note 32.

340. *See* INT'L ENERGY AGENCY, *supra* note 338, at 13.

341. *Id.* at 48; *see* Ker Than, *Critical Minerals Scarcity Could Threaten Renewable Energy Future*, STAN. UNIV. (Jan. 17, 2018), https://perma.cc/5SBW-72YQ.

342. *See* INT'L ENERGY AGENCY, *supra* note 338, at 198.

343. *See* Significant Emissions Reductions, *supra* note 269.

344. *See MA Decarbonization Roadmap*, *supra* note 294.

which China is not.[345] These same key minerals are used in battery storage for electricity.

VII. Innovative Legal Alternatives to Strategically Manage Crypto Power

A. State Incentives and Regulatory Options

There are strategic options for states to dis-incentivize inefficient cryptocurrency technology. A majority of states provide significant state subsidies for certain renewable power generation that could subsidize the cost of self-generation for power mining companies. These subsidies, for net metering in more than three dozen states[346] and state renewable portfolio standard Renewable Energy Credits in twenty-nine states[347]—both relatively recent regulatory creations in the last three decades—are discretionary and subject to permissibly tailored eligibility that are not possible for discriminatory state utility power tariffs.

- These subsidy mechanisms for power do not confront a century of common law court precedents requiring non-discriminatory equal protection of all consumer classes.[348]
- They do not implicate the Federal Power Act restriction of state authority because they do not involve any covered 'sales' of electric power that is governed by federal law.[349]
- Some states qualify them as akin to expenditure of state funds,[350] although this is controversial and not consistently held to be permissible by other federal courts.[351]

345. *See* Inflation Reduction Act, *supra* note 8.

346. *See* Steven Ferrey, *Tightening the Legal 'Net': The Constitution's Supremacy Clause Straddle of the Power Divide*, 10 MICH. J. ENV'T & ADMIN. L. 415 (2021); *see also* Steven Ferrey, *Virtual "Nets" and Law: Power Navigates the Supremacy Clause*, 24 GEO. INT'L ENV'T L. REV. 267 (2013).

347. *See* Steven Ferrey, *Legal History Repeats Itself on Climate Change*, 33 GEO. INT'L ENV'T L. REV. 489 (2022).

348. *See supra* Part IV.D.

349. *See* Federal Power Act of 1935, *supra* note 168.

350. *See* Old Mill Creek v. Star, Nos. 17-CV-1163 & 17-CV-1164, 2017 WL 3008289, at *7 (N.D. Ill. July 14, 2017); *see also* Coal. for Competitive Elec., Dynergy Inc. v. Zibelman, 906 F.3d 41, 58 (2d Cir. 2018).

351. *See* Ill. Com. Comm'n v. Fed. Regul. Comm'n, 721 F.3d 764, 776 (7th Cir. 2013) (citing Ferrey, *Threading the Constitutional Needle with Care: The Commerce Clause Threat to the New Infrastructure of Renewable Power*, 7 TEX. J. OIL, GAS & ENERGY L. 59, 69, 106-07 (2012) as authority by Judge Posner speaking for a unanimous federal Circuit Court of Appeals); *see also* North Dakota v. Heydinger, 825 F.3d 912, 914 (8th Cir. 2016); *see also* Entergy Nuclear Vermont Yankee, LLC v. Shumlin, 733 F.3d 393, 416 (2d Cir. 2013).

States can change who is eligible for state incentive subsidies. To discourage crypto mining location in a certain state, the twenty-nine states that offer Renewable Energy Credits352 and the more than three dozen states that offer net metering[353] could change their laws to not provide such subsidies to crypto technology customers unless they followed specified regulatory requirements for efficient use and not burdening grid resiliency set by state public utility commissions. The ability to change and adapt such state energy subsidy programs was recently demonstrated in California when the California PUC substantially changed its net metering policies and subsidies for certain state-designated renewable power usages. When the amount of electricity produced by a consumer using renewable energy on its own site exceeds the amount of electricity it uses, the excess generation is sent back to the utility with the consumer's retail electricity meter registering this exported amount with the consumer earning future credits for free electricity equivalent to this excess generation earlier exported to the grid.[354] California's generous 2016 NEM 2.0 tariff[355] included net metering tariff subsidies at near the retail rate for net metered 'wholesale' power transfers. The most recent NEM 3.0 adopted in December 2022, updates NEM 2.0 with much lower wholesale "avoided cost" compensation for net exported energy, representing a seventy-five to eighty percent reduction in that net metering consumer's subsidy for certain customers.[356] Until this point, retail customers in California were subsidizing through their higher rates this prior NEM 2.0 more generous retail rate.[357]

Approximately forty states subsidize the construction and deployment of renewable power for self-use,[358] and states could eliminate such provisions for remarkably inefficient technology large power users. It remains to be determined whether state options to limit use of electric power for crypto technology,[359] establishing categories of higher retail power rates for crypto technology[360] or requiring crypto technology to overcome rare earth supply constraints as a condition to employ renewable power,[361] are legally permissible state tools to discourage energy-intensive crypto mining technologies. Inclining block rates to encourage electricity conservation and efficient use, if a proper administrative

352. *See* Ferrey, *Legal History Repeats Itself on Climate Change*, *supra* note 360.

353. *See* Ferrey, *Tightening the Legal 'Net': The Constitution's Supremacy Clause Straddle of the Power Divide*, *supra* note 359.

354. *See* Steven Ferrey, *Torquing the Levers of International Power*, 15 WASH. U. GLOBAL STUD. L. REV. 255, 287–88 (2016) (excess electricity produced on-site by consumers flows to the grid and credits are passed through to customers). *See also* Glossary, DATABASE ST. INCENTIVES FOR RENEWABLE & EFFICIENCY, https://perma.cc/E32X-8GX6 (offsetting electricity credits at or near the utility's full retail rate for power.).

355. California PUC, Decision (D.) 16-01-044 (2016) (enacted).

356. California PUC, *Order Instituting Rulemaking to Revisit Net Energy Metering Tariffs Pursuant to Decision 16-01-044, and to Address Other Issues Related to Net Energy Metering*, Rulemaking 20-08-020 (2022).

357. *See* Ferrey, *Torquing the Levers of International Power. supra* note 355.

358. *See* Ferrey, *Tightening the Legal 'Net': The Constitution's Supremacy Clause Straddle of the Power Divide*, *supra* note 359.

359. *See* Rossi, *e.g. supra* note 257.

360. *See* discussion *supra* Part V.A and notes 191–193.

361. *See generally*, *supra* Part VI.C.3.

record is established, are permissible. Some utilities have established prohibitions on certain large quantities of power use, although few have been legally tested.[362]

As detailed in this Article, cryptocurrency mining in the U.S. has *not* been drawn to states or regions of the U.S. which have large amounts of renewable electric power.[363] Instead, it has settled in regions of the country with fossil-fuel-fired electric power, often extending the life or restarting older fossil-fuel-fired power plants.[364] This article has developed and suggests several legal 'back door' mechanisms for states and cities to exercise more effective control of energy-intensive uses of power stressing world climate in order to maintain reliable power for traditional consumers, including:

- Sustainable state retail rate design;
- States setting inclining block rates to discourage inefficient climate-warming power use;
- Local or state moratoria or exactions regarding crypto mining power demand;
- Establishing long-term, large, customer revenue assurance mechanisms with bonding requirements or letters of credit to protect all consumers from price escalation due to stranded costs in the event that a high-density-load crypto customer exits before paying; and
- Ineligibility for certain state net metering and renewable energy credit subsidies when using electricity for crypto mining technologies.

States can justify higher electricity rates for cryptocurrency mining if those costs are based on legitimate documented cost-of-service. Experience to-date suggests that higher rates and high deposits in the form of a commercial letter of credit could be objectively justified for large-capacity, new commercial users in an industry where there is a history of quick exodus from a utility's service territory, thus leaving stranded costs for the system that become the responsibility to repay by remaining general non-crypto mining consumers.

B. The Way Forward

Notwithstanding that climate policy is federal law and that electric power is a key sector of the economy affecting climate, the federal government has no authority over crypto mining and its excessive retail power use. The federal government lacks authority under the Federal Power Act, the Tenth Amendment of the Constitution, as well as Supreme Court precedent. The power that the federal government can exercise on retail power use is largely in the form of providing tax

362. *See supra,* Section V.A (describing categories of higher rates in certain states applied to crypto mining uses of large amounts of electric power).

363. *See* discussion *supra* Part III.C.3.

364. *Id.*

incentives and other subsidies through the Infrastructure Act, the IRA, and the U.S. Tax Code—all of which operate as incentives, not regulatory prohibitions.

Electric power cannot be analyzed as if it is an ordinary commodity; it fundamentally supports every other sector of the entire post-industrial U.S. economy. The critical regulated commodity—power—can and must be managed correctly by agencies of government, particularly during this time of transition away from the fossil fuels that have supported the U.S. economy for most of the last two centuries. Unless electric power, its applications, and its use are strategically controlled, climate targets will not be met.

This is no longer a technical engineering challenge: the challenge now becomes legal and regulatory intelligent management of our critical electric power system during a significant shift from fossil to renewable resources. States have discretion to reconstruct certain incentives and moratoria to shape the use of power resources that will sustain a fragile climate. States need to undertake effective regulation implementing the above legal and regulatory 'work-around' retail power controls to avoid accelerating the U.S. power system onto the highway to climate hell.

The Appendix that follows provides greater detail about international aspects of cryptocurrency mining and, for context, provides examples of other energy-intensive duplicative new demands for massive amounts of additional U.S. power not as expansive as cryptocurrency demand, although also increasing the threat to sustainable climate.

Appendix:
Comparable Energy-Intensive Power Uses in Context

A. International Crypto Becomes U.S. Dominated

The United States is witnessing the beginning of a forced end of crypto mining operations in other international locations. China was a crypto mining powerhouse. As a country with a huge amount of cheap, coal-fired electric generation plants without advanced environmental controls, China was, until recently, the crypto preference for investors in Bitcoin mining. In fact, up until early 2020, approximately sixty-five to seventy-five percent of global cryptocurrency mining activity had taken place in China.[365] The regions producing the majority of cryptocurrency mines in China were home to the country's coal plants that generate more than half of China's energy.[366] By 2021, China told banks and payment platforms to stop accepting cryptocurrency and placed a halt on cryptocurrency mining.[367] Regulators explained their decision as coming from an environmental concern—finding that regulating the industry was necessary due to Bitcoin's energy-intensive demand.[368] Similarly, South Korea's Financial Services Commission prohibited all forms of tokens or virtual security as of September 29, 2017.[369]

Kazakhstan's Bitcoin mining industry soared because of the halt of crypto mining in China.[370] There, a number of Bitcoin mining powerhouses, such as BIT Mining, moved operations on the promise of low-energy costs.[371] By August 2021, the country's share of Bitcoin mining was second to the United States, amounting to eighteen percent of the global Bitcoin mining market.[372] However, Kazakhstan's citizens are facing rising energy costs due to the increased demand in energy usage caused by crypto miners, and likely responsible for a number of black-outs, as the demand for electricity rose eight percent in 2021, compared to less than two percent in 2020.[373]

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365. *See id.*; *see also* Karen Ho, *Energy Consumption Is a Constant Concern in Crypto Mining, but More Sustainable Practices Are Emerging*, INSIDER (July 15, 2021), https://perma.cc/DGZ9-FDS8 (discussing the main provinces producing mining sites are in the provinces of Xinjiang, Inner Mongolia, Sichuan, and Yunnan).

366. *See id*.

367. *See* Andrey Sergeenkov, *China Crypto Ban Complete History*, COINDESK (Mar. 9, 2022), https://perma.cc/EVG7-4UZT.

368. *See id*.

369. *Id.*

370. *See* Theo Wayt, *China Cracking Down on Crypto Mines Disguised as Research, Data Centers: Report*, N.Y. POST (Sept. 16, 2021, 1:12 PM), https://perma.cc/ZT2Z-JH9D.

371. *See* Paolo Sorbello, *Kazakhstan's Cryptocurrency Mining Grows Despite Emissions Worries*, THE DIPLOMAT (Sept. 15, 2021), https://perma.cc/ZT2Z-JH9D.

372. *See* MacKenzie Sigalos*, Kazakhstan's Deadly Protests Hit Bitcoin, as the World's Second-Biggest Mining Hubs Shuts Down*, CNBC (Jan. 7, 2022, 2:14 PM), https://perma.cc/4ZGV-BSKV.

373. *See* Rob Thubron, *Crypto Miners Blamed for Kazakhstan Energy Crisis*, TECHSPOT (Nov. 29, 2021, 6:55 AM), https://perma.cc/657R-RPH4.

Halfway around the world in the country of Georgia, crypto thrives. Georgia, behind only China and the United States in the amount of crypto mining, is home to the third most Bitcoin miners in the world.[374] Georgia was also an early adapter in broader cryptocurrency technology applications including decentralizing real estate transactions.[375] Georgian real estate deeds are now fully executed on the blockchain.[376]

Though Georgia has recently seen an increase in electricity usage in certain regions where crypto mining is prevalent, national policy in favor of crypto persists.[377] Georgia was the energy corridor of the former Soviet Union[378] creating eighty-one percent of its power from hydroelectricity.[379] In addition to friendly regulations, Georgia's electricity prices are 0.066/kWh, which is less than half of the average price in the United States.[380]

Cryptocurrency is not the only new demand for large additional amounts of electricity. For context, the next section briefly examines two other new energy-intensive duplicative demands for electric power.

B. NFTs: Electricity-Intensive New Art Form

Non-fungible tokens (NFTs) pose a similar inefficient demand for electricity. NFTs are digital assets, like cryptocurrency, but are designed to represent real-world objects rather than serve as virtual currency. NFTs often represent digital artwork but can range from music, videos, to real-life representations. Often, they are marketed as one-of-a-kind electronic pieces and, like physical art, they are usually limited to small batches.[381]

Like cryptocurrency, NFTs must have an owner, which a public record accounts for and documents.[382] As a result of this record, NFTs increase in value because their unique and limited quantity, even though virtual, possess collector-like qualities. Also, like cryptocurrency, NFTs require a significant amount of electricity because they rely on proof of work to validate transactions. Most commonly, NFTs rely on technology like Ethereum for validating transactions on a blockchain. Once an artist uploads a potential NFT and proceeds to "mint" his or her piece through Ethereum, miners race to solve the equation and add to the

374. *See Three Countries with the Largest Number of Bitcoin Miners*, FORBES (Dec. 15, 2017, 12:59 PM), https://perma.cc/AR7G-VX6Q.

375. *Cryptocurrency in Georgia*, GEORGIA WEALTH (Mar. 17, 2021), https://perma.cc/VT5B-T3S4.

376. *Id.*

377. Lubomir Tassev, *Georgia Goes After Crypto Miners Using Subsidized Electricity in Historic Town*, BITCOIN.COM (Jan. 13, 2022), https://perma.cc/2M6S-Q2JG.

378. Evangelos Panos et al., *Access to Electricity in the World Energy Council's Global Energy Scenarios: An Outlook for Developing Regions Until 2030*, 9 Energy Strategy Revs. 28–49 (Mar. 2016), https://perma.cc/WX8U-39P5.

379. *See* Georgia, IEA, https://perma.cc/294K-DPUZ.

380. *See* ELECTRICITY PRICE STATISTICS, EUROSTAT (Sept. 2023), https://perma.cc/74EF-JLR2.

381. *See Robyn Conti & Benjamin Curry, What Is an NFT? Non-Fungible Tokens Explained*, FORBES (Mar. 17, 2023, 12:57 AM), https://perma.cc/W8Wr-8P2Z.

382. *See Non-Fungible Tokens (NFT)*, ETHEREUM, https://perma.cc/RC82-LZVH.

blockchain.[383] Ethereum transactions use roughly 48 kWh, which is approximately the total amount of electric energy used by a typical U.S. household for 1.5 days.[384] The New York Times projects that the creation of a single NFT produces the equivalent to driving a gasoline-powered car 500 miles.[385]

C. The Cannabis Cultivation Industry

Electrified Cannabis

There is a new industry that instantaneously has become the largest electricity consuming industry in the United States, exceeding that position previously held by the federal government, which owns and supplies electricity to 300,000 federal buildings.[386] This industry is cannabis. Ironically, cannabis is not legally recognized by the federal government and federal law does classify cannabis as a legal product.

Cannabis production uses significantly more electricity per square foot compared to other industries. Indoor cannabis cultivation is estimated to spend $6 billion on energy annually.[387]

The electricity consumed to grow a gram of marijuana, or enough for a single cannabis cigarette, is equivalent to the electricity consumed from driving a fuel-efficient car twenty miles,[388] although one is not advised to do both at once. The emissions to the atmosphere associated with growing one ounce of cannabis is equivalent to burning seven to sixteen gallons of gasoline,[389] which would take some cars a distance of up to 500 miles. Early estimates of cannabis industry electricity usage were one percent of the total electricity consumed in the United States.[390]

Cannabis growers now operate indoors and rely on constant electricity-driven ventilation, exhaust fans, cooling/heating, and water systems. Generally, indoor operations require about 360 kWh per twenty-five square feet of space,[391] or 14 kWh/square foot. A majority of the energy demand from cannabis facilities comes from HVAC equipment and lighting which collectively contribute to eighty-

383. *See* Hiroko Tabuchi, *NFTs Are Shaking Up the Art World. They May Be Warming the Planet, Too.*, N.Y. TIMES (Apr. 16, 2021), https://perma.cc/B83A-WDSH.

384. *See Exploring NFT Energy Consumption*, NFT EXPLAINED. INFO, https://perma.cc/DY3Q-CGVF.

385. *See* Hiroko Tabuchi, *NFTs Have Climate Problem*, N.Y. TIMES (Apr. 14, 2021), https://perma.cc/3KMM-33G7.

386. FED. ENERGY MGMT. PROGRAM, ANNUAL REPORT ON FEDERAL GOVERNMENT ENERGY MANAGEMENT (2016), https://perma.cc/X5FA-UYNX.

387. *See* Jason Reott, *Legal Cannabis Presents Challenges for Utilities, Opportunities for Energy Efficiency*, ALL. TO SAVE ENERGY (Sept. 8, 2020), https://perma.cc/38HJ-K7BT.

388. *See* Natalie Fertig & Gavin Bade, *An Inconvenient Truth (About Weed)*, POLITICO (Aug. 10, 2021), https://perma.cc/KH2K-LZX6.

389. *See* Alex Fox, *Growing an Ounce of Pot Indoors Can Emit as Much Carbon as Burning a Full Tank of Gas*, SMITHSONIAN (Mar. 15, 2021), https://perma.cc/A6PT-X664.

390. *See* Rebecca Bridges, *Power Consumption for Cannabis Growers*, ELEC. PLANS, https://perma.cc/HXN3-62HS.

391. *See Cannabis Energy Overview and Recommendations*, MASS. DEP'T ENERGY RESOURCES (Feb. 2018), https://perma.cc/WF2P-C9LU.

nine percent of the entire operation's electricity consumption.[392] The energy consumed by lighting varies greatly, as some growers opt for low-efficiency but high-intensity sodium lights (grow lights) instead of much more efficient modern LED bulbs.[393] Grow lights are estimated to use eighty times more energy than a regular light bulb.[394] These function as a substitute for otherwise free outside sunlight.

Legalization

Although most states have legalized and regulated cannabis production for some purposes, the federal government still has not legalized the industry. As of April 24, 2023, thirty-eight states, three territories, and Washington D.C., have legalized medical marijuana.[395] As of November 8, 2023, twenty-four states, two territories, and Washington, D.C. legalized marijuana for recreational purposes.[396] While the percentage of consumers is still fairly modest, estimates in some areas of the country where recreational usage is supported by regulation, show notable increases year-over-year. For example, the Colorado Energy Office study showed overall marijuana participation in the state had increased from 1.4% in 2012 to 8.18% in 2016.[397]

Cannabis Laws by State – As of November, 2023

The increase in demand has significantly impacted the electricity stability in a growing number of states.[398] For example, soon after legalization of marijuana in Oregon, Pacific Power in Portland estimated that seven of their black-outs were caused by demand from cannabis production facilities.[399] Similarly, forty-five percent of Denver, Colorado's, increase in energy demand is attributed to cannabis production.[400] In 2015, Denver's cannabis cultivation consumed over 200 million kWh.[401] A study in 2018 noted that of the 54,418 MWh of electricity used in 2016, 1,115 MWh, or two percent, were consumed by the cannabis cultivation industry.[402]

Some states have tightened regulations to increase reliance on renewable energy and to control the impact of cannabis facilities' on-grid electricity usage.

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392. *See Cannabis Environmental Best Management Practices Guide*, CANNABIS CERTIFICATION COUNCIL 4 (Oct. 2020), https://perma.cc/LS6U-CUWX.

393. *See* Reott, *supra* note 388.

394. *See Cannabis Energy Overview and Recommendations*, *supra* note 392.

395. *See* Jeremy Berke et al., *Delaware Just Became the Latest State to Legalize Recreational Marijuana. See a List of Every State Where Cannabis is Legal.*, INSIDER (last updated Apr. 27, 2023, 12:44 PM), https://perma.cc/T4A5-JKCM.

396. *State Medical Cannabis Law*, NAT'L CONF. OF STATE LEGIS., https://www.ncsl.org/health/state-medical-cannabis-laws (last visited Nov. 25, 2023).

397. *See* CANNABIS CONSERVANCY, ENERGY USE IN THE COLORADO CANNABIS INDUSTRY (2018), https://perma.cc/G6DC-6P2T.

398. *Id.*

399. *See* Jocelyn Durkay & Duranya Freeman, *Electricity Use in Marijuana Production*, NCSL (Aug. 1, 2016), https://perma.cc/7ZRK-XYNG.

400. *See id.*

401. *See Cannabis Energy Overview and Recommendations*, *supra* note 395.

402. *See* CANNABIS CONSERVANCY, *supra* note 398.

Colorado—where marijuana growers constitute two percent of the electricity usage—has enacted several different measures to protect the electric grid. In 2020, the Colorado Energy Office launched the Colorado Cultivators Energy Management pilot.[403] At the local level, counties in Colorado have enacted local ordinances that prohibit new cultivation facility licenses in their districts.[404]

Recent studies have shown indoor cannabis production has caused a substantial increase in GHG emissions[405] of between 2,283 and 5,184 kilograms of carbon dioxide per kilogram of dried cannabis flower.[406] By comparison, outdoor cultivation estimates are between 22.7–326.6 kilograms of carbon dioxide per flower cultivated.[407] Indoor cultivation consumes 100 times more electric power than does natural outside cultivation. The consumption of electricity equates to roughly fifteen million tons of GHG emissions annually, or the equivalent to that of three million cars being added to the roads.[408]

403. *See* Colorado Cultivators Energy Management Pilot Program, COLO. ENERGY OFF., https://perma.cc/59KG-QN9R (last visited Oct. 8, 2023) (the program provided several businesses with free assessment of their current energy uses and ways to mitigate cost).

404. *See* 16-0291 (Colo. 2016) (enacted); *see also Marijuana Laws, Rules, and Regulations*, DENVER, https://perma.cc/MMG2-L7TZ (city of Denver's ordinance placed a limit on the number of cultivations to 311 distinct locations already in existence).

405. Hailey M. Summerset al., *The greenhouse gas emissions of indoor cannabis production in the United States*, 4 Nature Sustainability 644–50 (Mar. 2021), https://perma.cc/R83K-KKQN.

406. *See Governor Newsom Announces California Will Phase Out Gasoline-Powered Cars & Drastically Reduce Demand for Fossil Fuel in California's Fight Against Climate Change*, *supra* note 305.

407. *See* Anne Manning, *Insatiable Demand for Cannabis Has Created a Giant Carbon Footprint*, COLO. STATE UNIV. (Mar. 8, 2021), https://perma.cc/A25S-A5HE.

408. *See* Melanie Sevcenko, *Pot is Power Hungry: Why the Marijuana Industry's Energy Footprint Is Growing*, THE GUARDIAN (Feb. 27, 2016, 8:58 AM), https://perma.cc/YX3E-VV2U.