Future financial services regulatory regime for cryptoassets - GOV.UK (the "paper")

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We address a selection of the questions posed by the Treasury's consultation paper, as indicated below.

Part 1: Preamble

Bitcoin is a new form of digital money, with a hard capped supply. It is permissionless - by which we mean that anyone, no matter their social class, political views, location or status, may participate in the network, whether or not they possess ID or a fixed address. The network treats each one of its participants the same, enabling them to preserve their savings against currency debasement or inflation resulting from uncontrolled increases in the money supply[1], and to transact freely in regimes where their attempts to exchange value would otherwise be forbidden or censored. The network, and specifically the Bitcoin protocol's means of determining the order of transactions, is secured by energy, since it is impossible to mine new blocks, thereby determining the sequence of transactions and at the same time releasing new bitcoin, without the expenditure of energy by specialised machines colloquially known as miners or ASICs (application-specific integrated circuits). It is the requirement to expend energy in order to release new Bitcoin in the block reward that provides Bitcoin with its 'unforgeable costliness'. No person, no matter how much bitcoin they already hold, can alter the rules of the protocol or the capped supply; and no person can alter the record of past transactions preserved in the blockchain without repeating all the work that has been done, and expending all the energy that has been spent, in creating the original blocks.

Energy is what ties the digital Bitcoin to the physical world, and ensures that it remains impossible to forge, or to manipulate at the protocol level, and renders it no longer computationally feasible for an attacker to compromise. Despite the short term fluctuations in its price, it is for these reasons (among many others) that Bitcoin has provided a financial lifeline to citizens across the world - in Lebanon[2], in Argentina, and throughout Africa[3] and the global south[4] - and provides a means for those without access to the traditional banking system to be able to store and manage their wealth in the digital age.

In relation to the protocol's need to expend energy in extending the blockchain and securing the ledger of transactions, we draw particular attention to the UK government's statements that 'Cutting methane emissions is one of the fastest and most cost effective tools available

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1 https://www.thisismoney.co.uk/money/markets/article-11405501/Bank-England-official-concedes-printing-money-fuelled-UK-inflation.html

2 https://eng.ambcrypto.com/bitcoin-in-lebanon-mirrors-its-role-in-argentina-hong-kong/

3 https://disrupt-africa.com/2022/12/09/kenyan-bitcoin-mining-startup-gridless-raises-2m-seed-funding-for-expansion/

4 https://bitcoinekasi.com/

to limit global temperature rise to 1.5°C.'[5]. Our submission below highlights how Bitcoin mining can assist in these mitigation efforts, predominantly as a buyer of first and last resort for landfill gas emissions. The World Economic Forum has recently highlighted[6] the potential for Bitcoin mining to do exactly this, profiling the work of Crusoe Energy[7] in capturing stranded methane and using it to power Bitcoin mining data centres.

We furthermore highlight the recent statements from the White House report on Climate and Energy Implications of Crypto-assets in the United States that 'Climate policy aligned with achieving net-zero emissions would have zero methane venting and zero methane flaring. A combination of regulation and technological innovation can help realize this vision. Crypto-asset mining that installs equipment to use vented methane to generate electricity for operations is more likely to help rather than hinder U.S. climate objectives.'[8]

We elaborate on this potential benefit of Bitcoin mining and further address a selection of the questions posed by the Treasury's consultation paper below.

[5] https://www.gov.uk/government/publications/united-kingdom-methane-memorandum/united-kingdom-methane-memorandum
[6] https://www.weforum.org/videos/this-start-up-catches-waste-methane-to-power-data-centres
[7] https://www.crusoeenergy.com/
[8] https://www.whitehouse.gov/wp-content/uploads/2022/09/09-2022-Crypto-Assets-and-Climate-Report.pdf

Part 2: Specific Responses to Numbered Questions

Box 12.A Question 44. Is there merit in regulating mining and validation activities in the UK? What would be the main regulatory outcomes beyond sustainability objectives?

Box 13.A: Question 47. When making investment decisions in cryptoassets, what information regarding environmental impact and / or energy intensity would investors find most useful for their decisions?

Box 13 A: Question 48. What reliable indicators are useful and / or available to estimate the environmental impact of cryptoassets or the consensus mechanism which they rely on (e.g. energy usage and / or associated emission metrics, or other disclosures)?

Initial abstract: In considering whether there is merit in regulating and supporting mining and validation activities in the UK, it is crucial to understand the potential benefits which these activities can bring, whether to the economy in general, to the environment, or to the flexibility and viability of a national electricity grid.

We note that the Treasury paper claims "the Proof of Work (PoW) consensus mechanisms can have a high environmental impact. This is mainly due to the energy usage of the computing task, **which [***the paper claims***] becomes more intensive as time progresses**.(our emphasis). **It is important for the record to show this highlighted statement above is incorrect**. Every 2016 blocks (roughly every two weeks) the Bitcoin algorithm adjusts its difficulty, depending on the amount of hash power running on the network during the previous period[9]. The network's power requirement can therefore decrease over time, as well as increase. It is dependent entirely on the amount of hashpower competing to find valid blocks.

When considering Bitcoin's power usage, we recommend the Cambridge University Bitcoin Electricity Consumption Index as the authoritative source (other, frequently cited sources can normally be traced back to an individual working for the Dutch Central Bank, who regrettably is not a scientist and whose writings tend to alarmism and pseudoscience). The Cambridge data may be viewed here: https://ccaf.io/cbeci/index/comparisons.

When considering validation, it is important to understand the two principal methods that exist for securing public blockchains and removing the need for a trusted third party intermediary to confirm and validate transactions, namely Proof of Work (POW) and Proof of Stake (POS). POS systems reward the holders of the most tokens (the highest stake) with additional tokens in return for their role in validation and security, while POW requires network participants to expend energy and incur cost in order to validate and secure the network. Participants are only rewarded after having successfully done this work, thus ensuring that no new tokens in a POW system are ever awarded for free. The cost of securing the network is decoupled from the number of transactions on that network (i.e. it

[9] https://www.coindesk.com/learn/bitcoin-mining-difficulty-everything-you-need-to-know/

costs as much to mine an empty block as it does to mine a block containing two thousand transactions). The oft-cited ‘energy cost per transaction’ metric is therefore misleading and erroneous.

It is a widely-held view in the cryptocurrency space that virtually all cryptocurrencies other than Bitcoin could transition to POS, but that Bitcoin should remain a POW currency[10], since the expenditure of time costs and resources in order to create and receive new bitcoin go to the heart of its monetary policy - namely that it is substantially different from easily-created ‘fiat’ or ‘liability’ money, and is akin to a commodity money, like gold, that requires the expenditure of resources to obtain and secure. Most importantly, with a view to Bitcoin’s potential as a neutral global monetary system, only Bitcoin’s POW system has been fully market-tested as secure, trustless, and censorship-resistant for more than a decade at the date of writing.

Bitcoin is currently the cleanest of all global industries in terms of its mix of sustainable energy sources[11]. The use of sustainable energy by miners has been increasing year on year and stands at close to 60% sustainable according to the latest available data[12]. In terms of overall power usage, as at April 2023 the network uses roughly 140.43 TWH per annum[13], which is circa 0.21% of global energy consumption[14]. To put this in context, the Bitcoin network uses less electricity than lighting and refrigerators in the US alone on an annual basis. The chart below provides a helpful visual guide to overall consumption (*Source: Cambridge Bitcoin Electricity Consumption Index*).

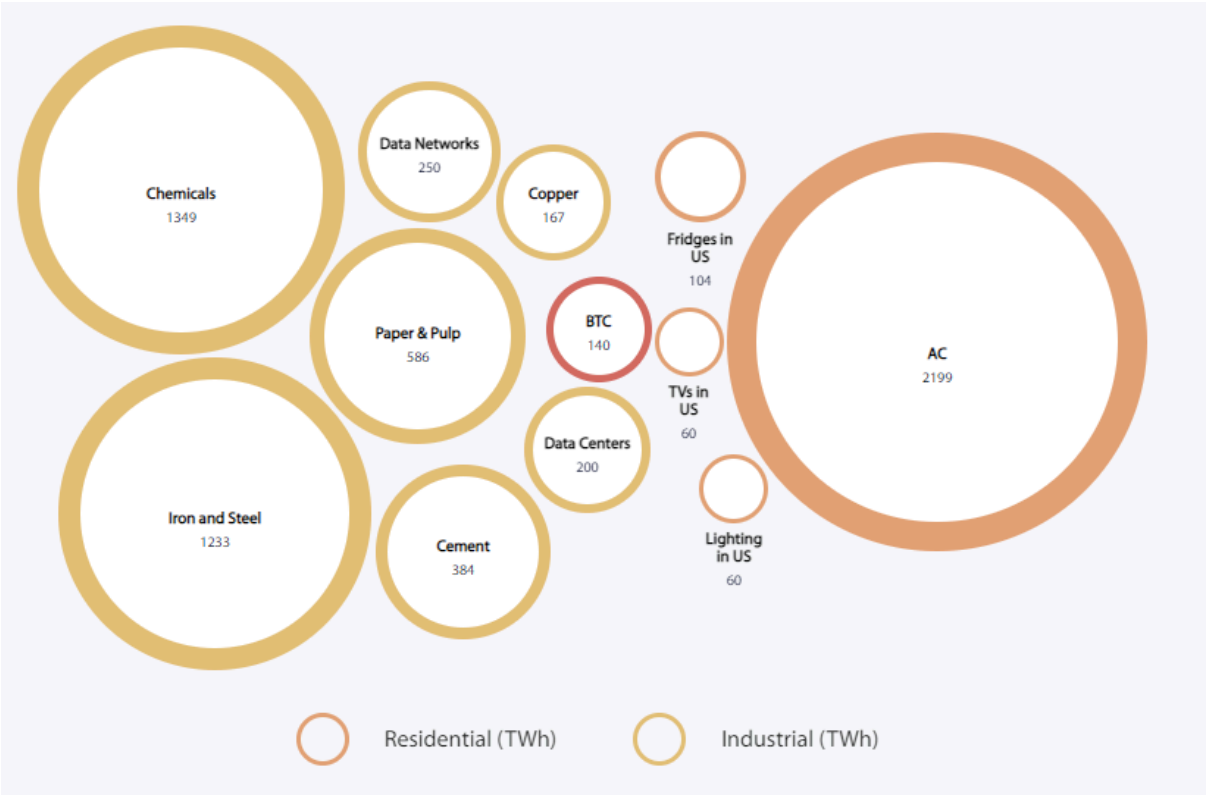
[10] https://bitcoinmagazine.com/technical/proof-of-work-superior-for-bitcoin

[11] https://www.forbes.com/sites/greatspeculations/2021/07/06/bitcoin-mining-uses-a-higher-mix-of-sustainable-energy-than-any-major-country-or-industry/?sh=753415f04cc9

[12] https://bitcoinminingcouncil.com/bitcoin-mining-electricity-mix-increased-to-59-5-sustainable-in-q2-2022/

[13] https://ccaf.io/cbeci/index/comparisons

[14] https://ccaf.io/cbeci/index/comparisons



Having said this, Bitcoin miners (i) are heavily incentivised to find the cheapest sources of electricity available, which in many cases will include stranded, wasted and/or excess sources from a sustainable source where such power would otherwise not be used by the grid, and (ii) are able to function as a buyer of first and last resort in conjunction with sustainable energy plants, making sustainable power generation immediately profitable, and stabilising the grid by purchasing excess power when demand is low, and simply turning off, in minutes, when demand is high.

We briefly examine below two promising instances of the applicability of Bitcoin mining both to greenhouse gas reduction and to the stability of the UK's grid as we move towards net zero. Each of these areas is worthy of further study and could eventually be supported by government incentives as we move towards net zero.

(i) **Cutting methane emissions**: Methane has more than 80 times the warming power of carbon dioxide over the first 20 years after it reaches the atmosphere. Cutting methane emissions represents the most efficient means available to us of immediately slowing the rate of global warming, as we decarbonize our economy[15]. The oil and gas industry has already recognized this opportunity, and 'flared' methane is now in some pilot programs in

[15] https://www.edf.org/climate/methane-crucial-opportunity-climate-fight

the United States already being utilised to mine bitcoin and to reduce emissions[16]. Prior to these projects, more than a billion dollars in natural gas was flared in the US alone (therefore both wasted and acting as a pollutant greenhouse gas), whereas captured methane can now be monetised and consumed in Bitcoin mining rather than being either flared or released.

Additionally, an alternative and largely untapped source of methane is in the process of being cleaned up in conjunction with Bitcoin mining - that is, the methane released from landfill sites throughout the world. Landfill gas is a natural byproduct of the decomposition of organic material in landfills, and according to the United States EPA this is approximately 50% methane.[17] Again in the United States, landfill waste sites are the third largest source of human-related methane emissions. In the UK, although methane emissions have dropped over the past 20 years, landfill gas still represents nearly 36% of our domestic emissions[18]. **As noted above, methane has over 80x the warming power of CO2 in the atmosphere and reducing methane emissions represent the fastest opportunity we have to slow global warming**. At present, only a minority of landfill sites have infrastructure in place to mitigate methane emissions, and building out this infrastructure comes at a cost (likely both to the landfill and to the taxpayer). Many sites will simply need to build and maintain flaring capabilities, which have a high set up and maintenance cost with no financial upside.

Certain Bitcoin pilot projects are currently under construction and will partner with landfills and install modules to mine bitcoin on-site, using methane produced by the landfill, and make such mitigation projects financially viable and even profitable both for the landfill and the relevant local authorities.[19] **As a matter of priority, we recommend that the UK also explores such potential means of mitigating our domestic methane emissions as we transition to net zero.**

(ii) **Bootstrapping and stabilising the renewable grid**: Bitcoin miners are the most flexible customers available for an electricity grid and can make new renewable plants economically viable from day one[20]. Bitcoin miners buy up spare capacity when it is not needed and turn off quickly when demand is high. We recommend a review of recent statements made by the CEO of the Electric Reliability Council of Texas, where Bitcoin miners are already collaborating with renewable energy providers to stabilise the grid, in order to understand further detail on this topic[21]. A Bitcoin miner, unlike any other customer, will give a renewable grid enough excess power margin in order to keep the grid running at times of high demand; miners will buy up the excess power margin when not required by the grid and can power down in minutes when demand increases[22]. No other buyer of electricity is able to do this, and thus enable a renewable grid both to maintain consistently high power output capability,

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[16] https://www.cnbc.com/2022/03/26/exxon-mining-bitcoin-with-crusoe-energy-in-north-dakota-bakken-region.html

[17] https://www.epa.gov/lmop/basic-information-about-landfill-gas

[18] https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/48424/5556-methane-factsheet.pdf

[19] https://vespene.energy/

[20] https://www.coindesk.com/policy/2021/10/11/bitcoin-mining-is-reshaping-the-energy-sector-and-no-one-is-talking-about-it/

[21] https://twitter.com/ShaunEnergy/status/1505920632705327106?s=20&t=RPjAEy_1xE3u1M3q3ft5lA

[22] https://www.cnbc.com/2022/02/03/winter-storm-descends-on-texas-bitcoin-miners-shut-off-to-protect-ercot.html

and to stay economically viable throughout. This is a developing area of power generation but is very promising as regards our capability to create a viable renewable grid in the near term[23]. Furthermore, a large number of miners are in fact located 'behind the meter' at power generation facilities themselves, and able to use stranded or excess energy that the grid cannot accommodate (which would otherwise be wasted or curtailed). Mining containers are highly mobile and can be moved quickly to a location as and when needed.

Looking at the development of the Bitcoin mining industry together with building out the UK's renewable grid would be a highly-innovative and likely profitable enterprise, given the extensive potential synergies with wind, solar and ocean thermal energy power generation[24].

Box 13.A.

Question 48. (cont.) What reliable indicators are useful and / or available to estimate the environmental impact of cryptoassets or the consensus mechanism which they rely on (e.g. energy usage and / or associated emission metrics, or other disclosures)?

Question 49. What methodologies could be used to calculate these indicators (on a unit-by-unit or holdings basis)? Are any reliable proxies available?
Question 50. How interoperable would such indicators be with other recognised sustainability disclosure standards?

We address each of the three questions above in the round, by reference to the following data sources and researchers.

Daniel Batten is a prominent ClimateTech VC (founder of CH4 Capital) and Bitcoin ESG analyst. His work is published and freely available at https://batcoinz.com/. His specialism is in quantifying the environmental impact of methane mitigation and sustainable energy usage in Bitcoin mining[25].

The data used in his study were obtained from various sources, including Batcoinz, the Cambridge Bitcoin Electricity Consumption Index (https://ccaf.io/cbeci/index), the Crypto Climate Accord Framework (CCAF - https://cryptoclimate.org), and Luxor's energy consumption index (https://hashrateindex.com/). The study estimated the environmental impact of methane mitigation and sustainable energy usage in Bitcoin mining, including the amount of carbon emissions mitigated and the proportion of sustainable energy used.

According to the data obtained from Batcoinz, 168 MW of methane was mitigated annually in flared and vented gas mining, resulting in the mitigation of 1.9Mt CO2e/year. In terms of sustainable energy usage, the off-grid portion of the Bitcoin mining network, which accounts

[23] https://twitter.com/level39/status/1548550264218583040
[24] https://bitcoinmagazine.com/business/discussing-how-bitcoin-can-unlock-ocean-energy
[25] https://batcoinz.com/quantifying-the-impact-of-using-stranded-methane-on-the-bitcoin-network/

for 29.49% of the network, uses on average 84.4% sustainable energy, much higher than the on-grid portion. The on-grid portion of the network uses a sustainable energy mix of 41.24%, of which the non-ERCOT portion of on-grid mining, as per the Cambridge model, is 38.01% sustainable. Overall, the sustainable energy mix of the Bitcoin network is currently 53.98%.

The study also found that the CCAF's model overestimates energy consumption by approximately 25%. The Luxor energy consumption index was found to be more accurate, underestimating energy consumption by around 10%.

The study shows that methane mitigation and sustainable energy usage have a significant impact on the environmental sustainability of Bitcoin mining. The mitigation of 168 MW of methane in flared and vented gas mining annually reduces carbon emissions by 1.9Mt CO2e/year. The use of sustainable energy sources in off-grid and on-grid Bitcoin mining also contributes to reducing carbon emissions.

Accurate measurement of energy consumption is crucial for assessing the impact of sustainable energy usage on environmental sustainability. The findings of this study suggest that the use of stranded methane and sustainable energy sources can significantly contribute to mitigating the environmental impact of Bitcoin mining.

Secondly, we refer to a recent academic paper relating to Bitcoin's potentially positive role in reducing the harmful effects of climate change (*Can Bitcoin Stop Climate Change? Proof of Work, Energy Consumption and Carbon Footprint*[26]).

Assuming that Bitcoin already has a more environmentally friendly impact than the global average, utilising it as a de-risking mechanism for investing in renewable infrastructure by serving as a dynamic buyer of last resort should not be a concern, regardless of the indicator.

However, if Bitcoin has a worse environmental impact than the global average and cannot be stopped due to its decentralised nature and resistance to attacks, it would be preferable to use it in a controlled and regulated manner as a dynamic buyer of last resort in an environmentally friendly context, providing green competition to all global players and pricing out those who use more expensive energy sources, such as fossil fuels.

In both scenarios, using Bitcoin as a risk-reducing factor for investing in renewables will not worsen any existing problems because it will only use green energy. Such utilisation will mitigate risks for renewable energy investments and have a net positive effect on the local and global energy mix of Bitcoin mining. We refer to the work undertaken by the academics Troy Cross and Andrew M Bailey, "Greening Bitcoin with Incentive Offsets"[27]. **We suggest that an opportunity exists for the UK government to explore government incentives for the**

[26] https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4347220
[27] https://www.resistance.money/green/

benefits that Bitcoin mining offers for each of (i) renewable grid construction and stabilisation, and (ii) methane mitigation, as a priority in our collective shift to net zero.