Module #2.2

Bitcoin uses too much energy and is bad for the environment

- **2.2** Bitcoin uses too much energy and is bad for the environment
- **2.2.0** Introduction
- 2.2.1 Gold as a non-sovereign store of value
- 2.2.2 The Fiat Banking system
- **2.2.3** How does this compare to other energy uses?
- **2.2.4** What are the benefits of this energy usage by Bitcoin?
- **2.2.5** Is there a viable alternative to POW and a distributed ledger to provide the necessary security for a decentralised money with a fixed supply?
- **2.2.6** Could the way that Bitcoin uses energy actually provide benefits to other industries?









2.2 Bitcoin uses too much energy and is bad for the environment

- → Bitcoin has often come under attack for using too much energy.
- Back in 2017, the World Economic Forum (WEF) published an article on its website claiming that 'by 2020, Bitcoin will consume more energy than the world is able to produce'.
- As recently as 2021, the BBC posted an article by Cambridge University stating that Bitcoin uses more electricity annually than the whole of Argentina. Quoting David Gerard, author of Attack of the 50 Foot Blockchain, "This means that Bitcoin's energy use, and hence its CO2 production, only spirals outwards. It's very bad that all this energy is being literally wasted in a lottery."

2.2.0 Introduction

A criticism often leveled at Bitcoin is that it uses too much energy and is therefore bad for the environment. This has been going on for years as the examples above show, so is Bitcoin really using too much energy, or could it in fact help the transition to renewable energy sources and assist companies with their commitment to ESG?.

The first question to consider is how would anyone objectively determine if something like Bitcoin uses too much energy or is 'bad for the environment'? If any central authority does not believe in the value of Bitcoin, then it will declare any energy used by it to be wasted, as it could have been put to a better use. If willing participants provide the energy to run the Bitcoin network, what central authority should be able to determine whether they should be allowed to do so.

Bltcoin's energy consumption comes primarily from the mining function. Rather than being an issue, this feature of linking real world resources to create blocks, settle transactions and secure the Bitcoin network is one of the key innovations of Bitcoin.

The Bitcoin network does use a substantial amount of energy, but this consumption is what makes the Bitcoin network robust and secure.

Module #2



So, does Bitcoin use too much energy? When considering this question, it is important to evaluate what you are comparing it to

- Gold is an alternative sound money. A reasonable comparison is therefore to consider how much energy is used to find, extract, process and store gold, usually in a vault somewhere.
- The fiat currency system comprises all of the banking infrastructure, branches, data centers, and offices.
- How does this compare to other energy uses?
- What value does Bitcoin provide to the world in return for the energy used?
- Is there a viable alternative to Proof of work (POW) to provide the necessary security of a decentralised money with a credible fixed supply.
- How could the Bitcoin network provide potential benefits to other industries, such as the adoption of renewable energy sources, mitigation of greenhouse gas emissions or reducing energy costs for some applications.

2.2.1 Gold as a non-sovereign store of value

The energy usage of the Gold mining industry is not as easy to evaluate as Bitcoin.

The Market Underestimates The Tremendous Energy Consumption By The Gold Mining Industry.

Steve St Angelo Mneymetals article (2018)

the comments are still valid today.

Although the article listed above is several years old now the comments are still valid today. The days of finding gold in large quantities and easily accessible, such as in the California gold rush, are well behind us. In a similar way to Bitcoin's proof-of-work process becoming incrementally harder to produce the same output, a gold miner will typically have to find and sift through an ever greater amount of rock to extract a few ounces of gold.

The improvements in technology to help find and extract gold have been balanced out over time by the increasing difficulty of finding it to provide a reasonably consistent increase in the gold supply, or inflation, of around 2% per annum. If we look at this process in more detail:





Exploration

1-5 years typically taken to identify potential sources and drill for samples





Extraction

Extracting tons of core and loading onto large trucks for transportation.





Transportation

These trucks use fossil fuel energy, typically managing a few miles per gallon, and require energy to produce..





Milling

Once the tons of ore have arrived on site, it needs to be crushed and then ground further to release the gold





Smelting

Smelting requires heating the gold to high temperature to remove impurities and to further refine and purify the gold.





Casting

Finally, the gold is melted and formed into bars by pouring the molten gold into moulds





Transportation

The gold bars are then moved under heavy security where needed globally





Storage

The gold bars are then stored in bank vaults

All of these processes require a large amount of energy - as the report quoted states, we would not be able to extract the amount of gold as we do currently without a large usage of fossil fuel.

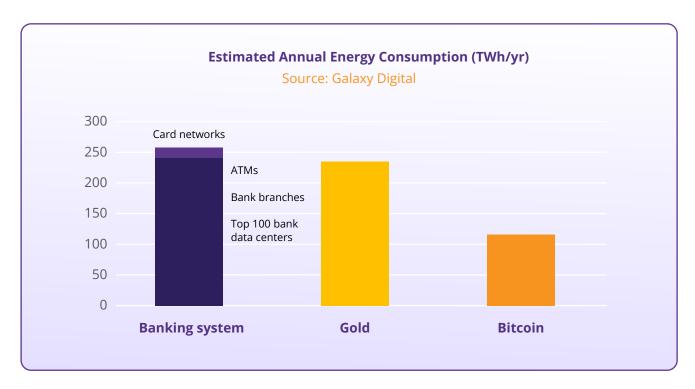


2.2.2 The Fiat Banking system

The current fiat banking system is not a direct comparison to Bitcoin. To achieve the final settlement capability that Bitcoin offers, it requires multiple settlement layers and cooperation between banks at different levels of the local, national and international system. Lightning also offers a similar settlement capability to the current card system in place. Calculating the energy usage of this system is very difficult to calculate, but would need to include:

- → The office infrastructure used by banks throughout the world
- → The data centres in place to run the current financial system
- → All of the retail branches in place to offer financial services
- → The global ATM network
- → The card provider (Visa and Mastercard primarily) infrastructure

Estimating the energy used to maintain this infrastructure is extremely difficult, but Galaxy Digital Mining attempted to do so in a report dated May 2021.



As can be seen from the chart - the estimates for Bitcoin energy usage compare favorably with these two alternatives.

The US Dollar has been the global reserve currency after taking over dominance from the UK pound early in the twentieth century. After the final disconnection from the gold standard and the creation of the petrodollar in the early 70's, the fundamental underpinning of the USD has been the military infrastructure which provides the security of the currency. The ability to project physical power underpins the value of the USD, but the financial and human cost of this approach is hard to measure.



First of all, Bitcoin and Visa are fundamentally different systems. Bitcoin is a complete, self-contained monetary settlement system; Visa transactions are non-final credit transactions that rely on external underlying settlement rails. Visa relies on ACH, Fedwire, SWIFT, the global correspondent banking system, the Federal Reserve and, of course, the military and diplomatic strength of the U.S. government to ensure all of the above are working smoothly.

Nic Carter

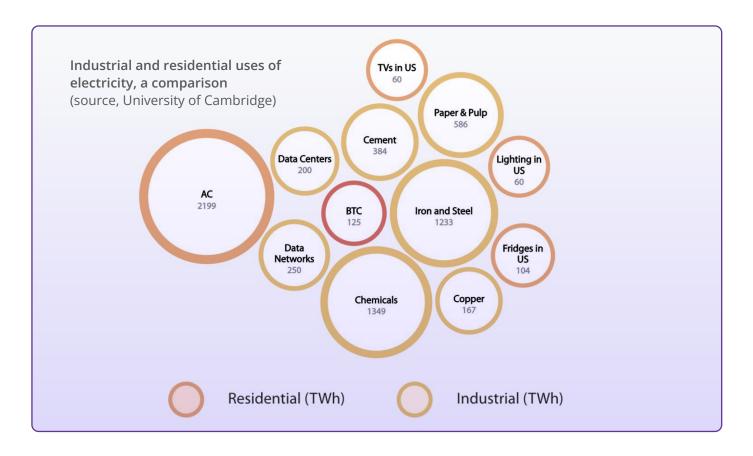


https://www.coindesk.com/markets/2021/02/08/what-bloomberggets-wrong-about-bitcoins-climate-footprint/



2.2.3 How does this compare to other energy uses?

Bitcoin does use a substantial amount of energy to protect the network, but how does this compare to other energy uses?



The University of Cambridge puts together a live update on Bitcoin's energy consumption and provides us with a current (2022) estimate;



In terms of global energy consumption they calculate Bitcoin's share as 0.28% (Total global energy consumption is 115,575 TWh)



In terms of global electricity consumption they calculate Bitcoin's share as 0.56% (Total global electricity consumption is 22,315 TWh)

As you can see, while Bitcoin does use energy, it is a rounding error in comparison to overall energy usage, and one could argue that creating and securing a global permissionless currency is of greater benefit to mankind than, for example, using energy to dry clothes or having the convenience of electronic devices such as TVs on permanent standby.

So, what value does the world obtain from the energy used by Bitcoin?

2.2.4 What are the benefits of this energy usage by Bitcoin?

We have seen how the energy usage of Bitcoin compares to other financial alternatives such as Gold and the current fiat system, but what do we get for the energy that bitcoin uses?

Bitcoin transactions are efficient in that the ability to transmit value across the world almost instantaneously, with final settlement, is unrivaled.



Cash can provide immediate and final settlement of a transaction but is only useful for people in close proximity to each other.



The use of credit cards may feel like it enables instantaneous digital settlement, but it's more akin to a short term loan enabled by a complex set of players operating behind the scenes that enable each transaction, and who all want a small cut for their troubles.

The two areas where Bitcoin is described as wasteful are in the Proof of Work consensus mechanism, and in the distributed nature of the ledger, where every node potentially has an entire copy of the ledger. These key attributes are what enables Bitcoin to be a truly decentralised form of money.

It enables every node to verify the validity of each transaction and ties real world energy costs to the process of creating the blocks. This is what enables Bitcoin to avoid any central authority that can arbitrarily change the rules, create new Bitcoin, cancel transactions or 'double spend' the Bitcoin, or be shut down.

The energy consumption requirements make a Bitcoin blockchain takeover unlikely due to the sheer cost required to produce enough blocks fast enough for such an attack to succeed. This ensures the 'unforgeable costliness' of attacking Bitcoin, thereby mimicking gold's scarcity in the digital realm.



2.2.5 Is there a viable alternative to POW and a distributed ledger to provide the necessary security for a decentralised money with a fixed supply?

If you believe that the energy used by Bitcoin is wasteful, but still see a benefit of having a global decentralised and permissionless form of money with a fixed supply, what are the alternatives?

Centralised model

One option would be to have a central server(s) controlled system that validates transactions as they arrive against the ledger. For scale and resiliency, this would probably consist of a distributed set of servers that coordinate to run the system and manage the supply of new coins.

The question is who would run these servers and ensure adherence to the protocol? As Satoshi Nakamoto stated in 2009:

Previous attempts at creating a digital currency include examples of systems using centralised servers which were shutdown by authorities. This experience influenced the development of Bitcoin to avoid these issues.

Central Bank Digital Currency

Many Central Banks around the world are developing CBDCs' - a blockchain based alternative to the current system of money. A recent report from the cross-party Lords economic Committee (January 2022) concluded that CBDC's were a 'solution in search of a problem' that could potentially enable:

The removal of any privacy for anonymous transactions

KYC requirements for all wallets and usage

Unconventional monetary policy (such as sell-by dates on stored money or restrictions on usage, for example a limit on alcohol purchases)

Security risks from cyber-attacks

Far from achieving the desired goal of a global, permissionless form of money, CBDCs would concentrate even greater power into the hands of Government and financial authorities..

The root problem with conventional currency is all the trust that's required to make it work

The central bank must be trusted not to debase the currency, but the history of fiat currencies is full of breaches of that trust.

Centralised model

An alternate method for managing a blockchain based form of money whilst maintaining a level of decentralisation is to replace the POW process with Proof of Stake or POS.

Ethereum, another crypto currency, made the switch to POS fairly recently and claimed that the energy efficiency gained by doing so made it more attractive as a protocol. So how does it work?

With proof of stake, participants referred to as "validators" lock up set amounts of cryptocurrency or crypto tokens—their stake, as it were—in a smart contract on the blockchain. In exchange, they get a chance to validate new transactions and earn a reward. But if they improperly validate bad or fraudulent data, they may lose some or all of their stake as a penalty.

The blockchain algorithm selects validators to check each new block of data based on how much crypto they have staked. The more you stake, the better your chance of being chosen to do the work. When the data that has been cleared by the validator is added to the blockchain, they get newly minted crypto as a reward.

Logically, using this approach, the people who already have the largest amount of resources staked into the system will win the most opportunities to validate new blocks and claim the reward, trending towards centralization over time. They will also have an outsized influence on the direction of the protool, and this in turn opens up the network to potential bribery attacks and changes to the protocol to benefit the largest holders. The creation of money 'for free' by the stakeholders instantly and for which they derive the benefits mimics the fiat monetary system of insiders gaining value at the expense of other users. This goes against the principles of sound money and equitable distribution based on effort that Bitcoin stands for.

2.2.6 Could the way that Bitcoin uses energy actually provide benefits to other industries?

Although the complaints about the energy usage of Bitcoin have been occurring ever since it began to gain a level of scale as to be noticed by outside interests, a more interesting and recent development has been how the unique way in which Bitcoin uses energy can actually be of benefit:

Enabling Renewable Energy	Bringing Power to remote Region	Grid Deman Response
Recycling heat	BTC Proof of work	Banking the Unbanked
Tapping Energy from the oceans	Reducing Methane gas Emissions	Using sustainable energy

Module #2



Enabling renewable Energy

Bitcoin mining is a highly competitive landscape, miners are incentivised to streamline their operations and carefully manage production costs, the largest input for this is electricity. Miners are therefore constantly searching for the lowest cost sources of electricity, which is often tied to under-utilised hydro, wind or solar power. Wind and solar power have limitations, wind output is variable and the sun often doesn't shine. Renewable energy facilities are also often incentivized to deliver electricity in a manner consistent with contractual agreements. This can lead to a supply and demand mismatch which needs to be addressed.

Bitcoin miners can setup anywhere, including colocating around these renewable energy sources offering a flexible load that can work in harmony with supply and demand patterns. This ability to dynamically flex power consumption during periods of excess supply and/or low market demand can provide additional incentives to the buildout of additional capacity, This can improve the economics of renewable energy. As an example a recent report stated that 'the UK Government's recent plan to cut the average delay time projects face to connect to the grid from 5 years to just 6 months could bode well for unlocking speedier commissioning of wind farms.' Imagine if all of those wind farms could have been mining Bitcoin while waiting to be connected.

Sources: KPMG report Bitcoin's role in the ESG imperative UK offshore wind 2023 round-up and 2024 outlook google.com/url?q=https://ore.catapult.org.uk/blog/uk-offshore-wind-2023-round-up-and-2024-outlook/&sa=D&so urce=docs&ust=1749877149615028&usg=AOvVaw2yrjQoRPawFbonQRPKDQ4j

Demand response

In addition to being a buyer of last resort when demand is low, Bitcoin miners have the opportunity to serve as a flexible load through participation in demand response programs that help to balance electrical grids. This is accomplished by the interruptible nature of mining operations in that they can curtail their power usage at a moment's notice to give that power back to the grid in the event that demands exceeds available supply at peak usage times. Under normal or low usage times, the electricity producer needs a ready buyer for every Watt produced to minimise waste and maximise return on investment. An exponential increase in bitcoin mining would reward electricity producers for their investment as well as load-balancing at the peak of production at all times.

Methane reduction

Methane is a greenhouse gas emitted from a range of sources such as coal mines, landfills and industrial processes such as oil and gas extraction. There is a big focus on how methane emissions can be reduced, as it is about 80 times more potent as a greenhouse gas than carbon dioxide according to the United Nations Environment Program. So how can Bitcoin mining help? Companies who specialise in building modular data centres powered by stranded natural gas are now partnering with oil and gas companies to convert flared gas into electricity for Bitcoin mining, This reduces emissions and creates an additional revenue stream to monetise otherwise wasted energy.

Landfills are also a significant source of methane emissions, and other startup companies are focusing on mining Bitcoin at municipal landfills in the USA, which enables the landfill operators to convert methane emissions into useful electricity, reducing the environmental impact of their facilities

Bringing power to remote regions

It is estimated that approximately 770 million people around the world do not have access to electricity, the majority of which live in sub-saharan Africa. A lack of infrastructure is one of the driving forces behind this, creating the need for micro grids that rely on local renewable energy sources. Many of these microgrids are initially funded by charities and struggle to maintain financial viability. Bitcoin miners are able to co-locate within these microgrids and allow the operators to monetize what would otherwise have been wasted energy due to supply and demand mismatch. This in turn provides more consistent and cheaper electricity to residents by increasing the useful load factor on the local grid and decreasing the costs. The Bitcoin mining company can also have a better chance of obtaining loans for development as they represent an immediate revenue stream for the project.

Banking the unbanked

The ability to provide financial services to the nearly 1.4 bullion people who do not have access to financial services is enabled by the expansion of reach of the Bitcoin and Lightning network, mining can provide access to non-KYC Bitcoin. Although not a direct result of the usage of energy by the Bitcoin network, it's adoption in remote areas as described above can help to bring financial services to those who would otherwise not be ankle to have access.

Recycling heat

Bitcoin mining is embracing a wave of innovation by repurposing the heat from the mining to power state-of-the-art cooling, thermal insulation, and heating of homes, swimming pools, and greenhouses. Bitcoin mining produces significant heat. This heat can be harnessed to heat homes, buildings, greenhouses, and swimming pools.

Tapping the energy from the oceans

Ocean Thermal energy conversion (OTEC) has been an idea for decades, with prototypes that harness the temperature differences between the warm tropical surface water and the deep cold sweater to create usable energy. Bitcoin has the potential due to its unique properties to enable the progression from prototype to operational plant.

Using sustainable energy sources

Another complaint of Bitcoin has been the use of energy and hence the climate impact of the network. Bitcoin can lead the way by using the methods described above to obtain the majority of its energy needs from renewable sources. In fact a 2021 study found that capturing just the potential flared gas in the United States and Canada would be sufficient to power the entire Bitcoin network.

Daniel Batten, managing director of Bitcoin ecosystem investment firm CH4 Capital and author of The Bitcoin ESG Forecast wrote in a January 2024 note that the Bitcoin mining industry is the only major global industry to be powered mostly by sustainable energy. According to Batten, the Bitcoin mining industry is using more sustainable energy than ever before, with the share of "sustainable mining" hitting an all-time high of 54.5% in 2023

Sources:

60+ Bitcoin energy and mining statistics https://www.techopedia.com/bitcoin-mining-and-energy-statistics

Bitcoin's role in the ESG imperative KPMG https://kpmg.com/kpmg-us/content/dam/kpmg/pdf/2023/bitcoins-role-esg-imperative.pdf

How Bitcoin can unlock the energy of the Ocean for 1 billion people: Bitcoin Magazine https://bitcoinmagazine.com/business/bitcoin-unlocks-ocean-energy

Bitcoin meets ESG: Bitcoin's emerging role in sustainable investing: Alpha Point https://alphapoint.com/blog/bitcoin-esg/

UK Offshore wind 2023 round-u and 2024 outlook: Catapult https://ore.catapult.org.uk/blog/uk-offshore-wind-2023-round-up-and-2024-outlook/