Bitkern

Bitcoin-Mining

Social Impact, Energy Usage and Sustainability

Introduction

Blockchain technology has many applications, and these will continue to grow exponentially in the future. One of the applications that has been in use are decentralised payment transfer systems, such as Bitcoin. Bitcoin is not beyond reproach and faces many challenges. The market is young, and due to limited capitalisation, prices tend to fluctuate sharply. Bitcoin has generally outperformed the traditional market, and, in the long term, Bitcoin has great growth potential.

2021 has been a challenging year. The Covid-19 pandemic has caused turmoil in every country of the world and economies have subsequently been badly shaken. The impact is manifold and will continue to be felt in some expected and some still unknown areas. Investors and users of Bitcoin want a certain degree of stability, or, at a minimum, predictability that is based on facts, calculations and models that are reliable and valid. Radical changes in a short period of time have not only brought economic distress, but also opportunities and challenges that require innovation, flexibility, and quick responses to increasingly unforeseen occurrences.

Two of the major challenges facing our world are our environment and the social impact on our communities, societies, and the world at large. More than ever, local occurrences have a ripple effect and travel across the globe.

ESG, or social, environmental and governance factors are playing an ever-increasing role in business investments as sustainability and the ethical impact of investments come to the fore when measuring the value of investments.

This brochure focuses on the social impact of Bitcoin mining on local and global communities, and on the sustainable use of energy sources in crypto-currency mining.

Bitcoin – Advancing financial freedom across the globe

Bitcoin has had and will continue to have a huge impact on societies around the globe. Some see this in a negative light; others focus on the positive impact Bitcoin and the decentralised method of transfers without government or institutional control can have on people, and moreover on people in the emerging markets. Alex Gladstein, Chief Strategy Officer of the Human Rights Foundation, talked about the increasing advantages that Bitcoin can provide to oppressed people in the world at the Bitcoin 2021 conference in Miami in the discussion "Banking the Unbanked":

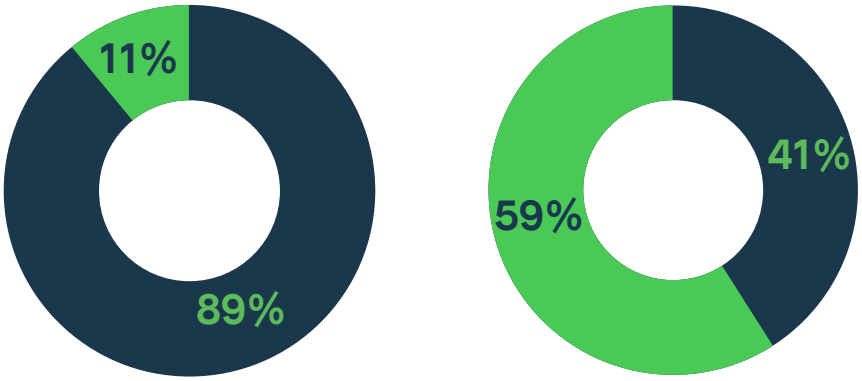
> "People need low fees, people need instant payments, people need micropayments, people need a little more privacy…"[i]

The poor of the world usually do not have access to banking, which puts them at a disadvantage. Bitcoin has it made possible for them to transfer digital money on its decentralised network. It has the potential to give financial independence to millions of people who would otherwise not be able to participate in any financial system. The many underprivileged people who live primarily in the global South and in the developing countries of the world are given access and can transact outside the centralised banking system and their governments.

Holding Bitcoins is helpful for the unbanked for a number of reasons. Creating a private wallet with a private key is free and can be accessed using a computer or mobile phone with an internet connection. Considering that in some Southern African countries, close to 90% of the people own a mobile phone with some amount of data, they can use Bitcoins to get paid and make transactions. As Bitcoins cannot be transferred if they are not there, overdraft and other credit fees can be avoided.

> "Bitcoin is easy to use, trustless and universal··· The unbanked now have a wallet, which they use as a bank account. It receives Bitcoin as a salary and sends it as payments for bills."[ii]

While in the developing world millions of people have no access to financial services, there is widespread access to mobile phones, and "growth in digital financial services, agent networks and mobile phone ownership highlight the opportunity to drive faster financial inclusion growth through digital financial services, such as mobile money."



89% of adults in high-income countries have a formal bank account.[i] 41% of adults in developing countries have a formal bank account.[ii]
Source: Bitkern Technologies GmbH. Created with data from the World Bank's Mobile Money Market Sizing Study. CGAP, GSMA, and McKinsey & Company.

Women are active household financial managers and tend to reinvest up to 90% of their earnings in their families, compared to 30-40% of men, so mobile money can also be a route to female empowerment in communities. Particularly in markets where social or cultural barriers prevent women from travelling long distances or interacting with men, mobile money offers an important tool for financial independence and household security.[iii]

Why then do some governments try to curtail the use of digital currencies? In June 2021, for example, Kenyan banks started sending out warnings to clients not to trade in cryptocurrencies. As cryptocurrencies "were not properly regulated", NCBA Bank Kenya told clients "not to buy, hold, or trade in virtual currencies". However, this is exactly the point of cryptocurrencies, that there is no regulation from banks, other institutions and governments. It is truly free and unregulated transfer of money that is self-regulated and not subject to control by any institution. Anyone can access it. There are no conditions and no minimum amounts that regulate access. And this is how the unbanked can

Only 37% of women in developing countries have a bank account. Access to a Bitcoin wallet offers financial inclusion and a sense of empowerment.

get access to financial services, which constitutes a huge social impact on large population groups, especially in the developing world. Further, the majority of poor people and the majority of young people who are digital natives are more likely to use non-traditional financial services.

China has been clamping down on Bitcoin mining, and in 2021 miners had to move their mining activities elsewhere. This coincided with the People's Bank of China (PBOC) plan to launch their own coin. On the positive side, El Salvador is the first country that declared Bitcoin a legal tender, and other countries are bound to follow suit. In Japan, the Financial Services Agency (FSA) registered Coinbase as a crypto exchange service provider. In 2021, over 40 German banks declared that they were interested in offering cryptocurrency services under the new German law that allows banks to obtain a license to offer crypto services. There are also many central banks worldwide that respond to cryptocurrencies by working to launch their own central bank digital currencies (CBDCs) to drive digital transformation in the financial services sector. The European Central Bank (ECB), for example, launched an investigation into issuing a CBDC to investigate key aspects of a digital euro.

Bitcoin, the best-known cryptocurrency, has long ceased to only find acceptance in the non-mainstream population groups, and for some time now, institutional investors have also been using Bitcoin as part of their portfolio.

Inflation expectations are high around the world. The long lockdown periods

have had a huge negative impact on economies, the purchasing power of consumers has fallen, consumer debt is on the rise, and it is uncertain how quickly and to what extent economies are going to recover from recent turmoil and what is still to come. And in times of uncertainty and the risk of high inflation rates, spreading the risk with Bitcoin, which will not be affected the way other currencies will, is a sound investment strategy. Bitcoin is limited to exactly 21 million coins, which protects it against inflation, and this makes Bitcoin suitable as a hedge against inflation.

Holding Bitcoins is now seen less risky than not having crypto assets at all, cryptocurrency is uncorrelated to other asset classes, and institutional investors use it as a diversification tool[iv]. Further, blockchain technology is secure, trustless and borderless, and fees are low and transactions fast.

> "60% of institutional investors believe in investing in crypto assets as part of their portfolio and 36% are already using it."[v]

The focus on crypto assets can leverage environmentally focused funds, mutual funds, and real estate. Grayscale Investments, the world's largest crypto asset management company, filed registration to make some of its digital currency investment funds U.S. Security and Exchange Commission (SEC) reporting companies.[vi] And major US insurance companies obtained shares in crypto investment products via the Grayscale Bitcoin Trust and Grayscale Ethereum Trust.[vii] There are more and more asset management companies that add digital assets to their retirement plans. The American company Forusall, for example, manages plans for employees from companies like Target, Coca Cola and Citigroup, and include digital assets to their mainstream retirement plans.

In France, where investment in cryptocurrencies is allowed for all major retirement plans, there was a proposal by authorities to give the European Securities and Markets Authority (ESMA) in Paris the responsibility to regulate cryptocurrencies in the entire European Union (EU).[viii]

Bitcoin does not only have the potential to offer individuals unregulated financial services, but multinational companies, such as Microsoft, Amazon, Burger King, KFC, Sotheby's, Overstock, Pizza Hut, BMW, Wikipedia, Shopify, Something Geeky, Norwegian Air, PayPal and many more accept Bitcoin as payment for their goods and services. There are predictions that are backed up by surveys in different countries, that Bitcoin will eventually be transacted more than fiat currency.

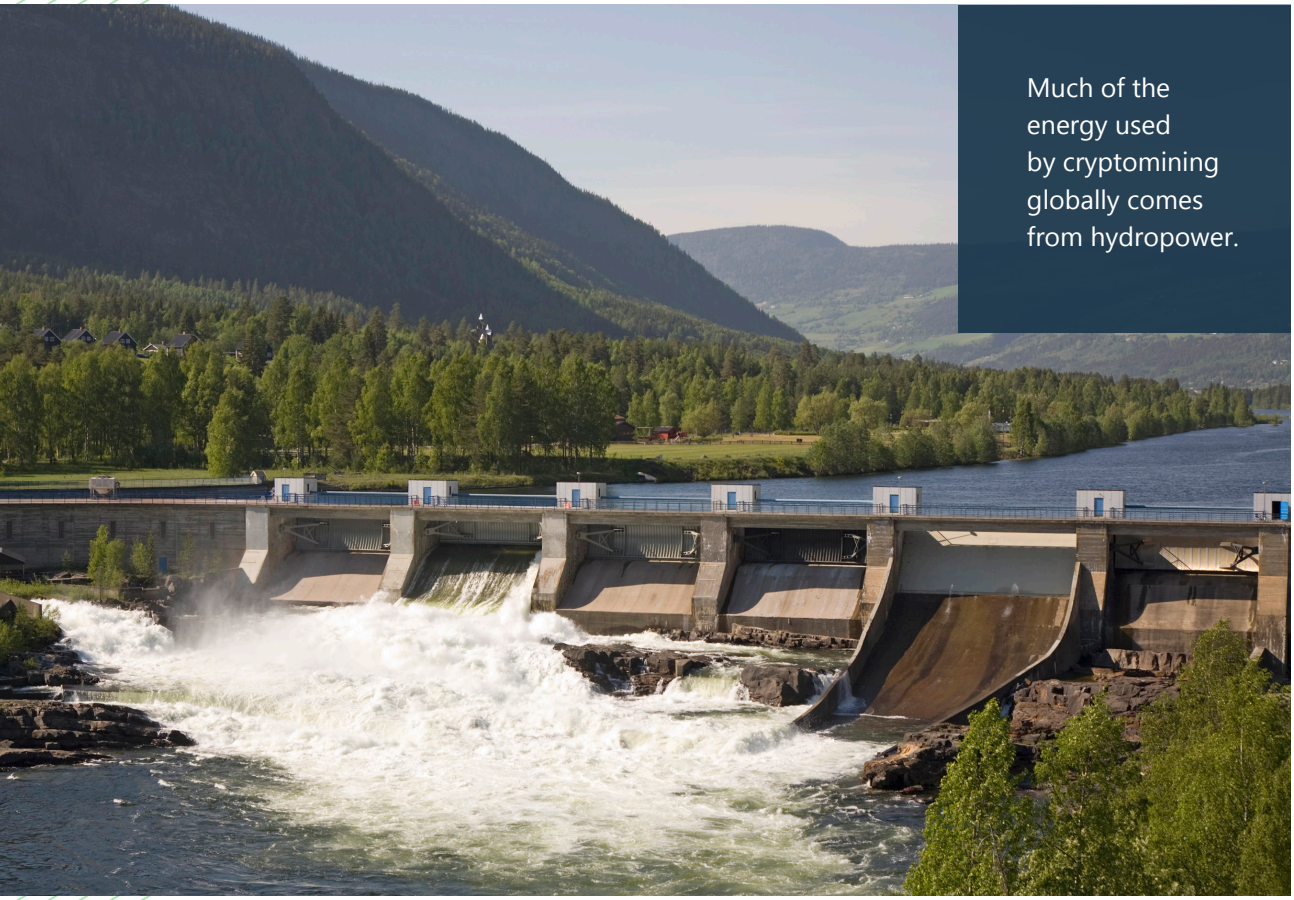
> "The transition to digital assets is inevitable due to the huge benefits that cryptocurrencies bring in terms of efficiency,

Bitcoin has become a popular asset among institutional investors.

> security and speed."[ix]

Robert Breedlove, Founder, CEO and CIO of Parallax Digital, speaks about the implications of the digital age in a pre-conference interview to the Bitcoin conference 2021:[x] "There was this loud wakeup call to the inaptitude of governments due to the Covid response ⋯ I really think we are in a transformational time going from the industrial age into the digital age, which I think will be equally if not more transformative than our move from the agricultural age to the industrial age. And Covid was just a mass accelerant to that entire transition. I think we are seeing the analogue institutions that we used to orient ourselves for hundreds of years now are just dissolving in the digital age. They are no longer useful. And humans are finding a way to self-organise. So, that's a big change. It's so big that you can't even get your head around its application ... Bitcoin has done really well in the wake of Covid⋯ And the digital age is characterised by exponential change. I think these are just going to get faster⋯ Exploring the sovereign individual thesis – just saying that Bitcoin and related digital technologies are the ultimate migration of power to people, once and for all. We do reclaim sovereignty in a way that was never before possible before Bitcoin ... I think all socioeconomic structures ⋯ get disrupted as a result of this."

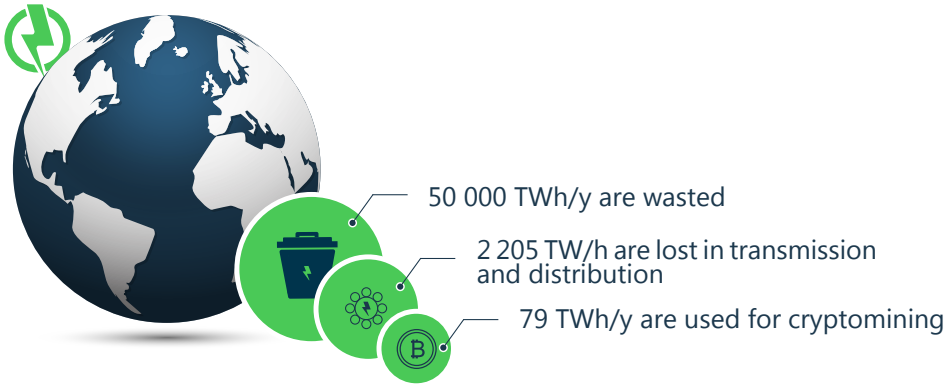
The world's energy problems and how Bitcoin mining may be part of the solution



Much of the energy used by cryptomining globally comes from hydropower.

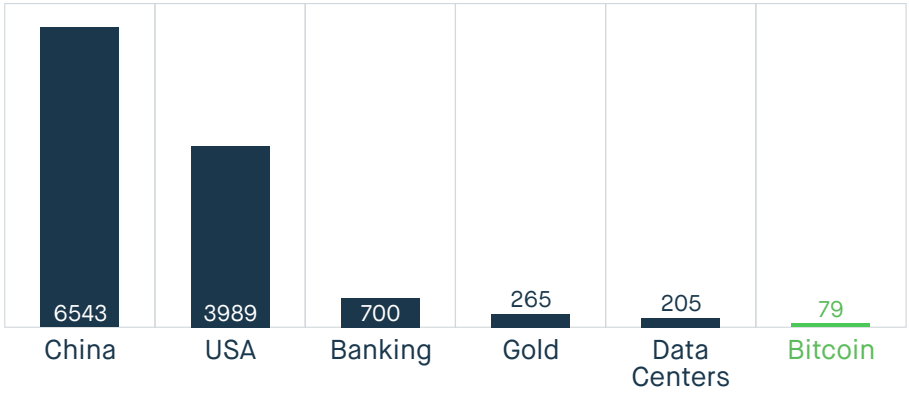
Bitcoin mining has often been criticised by media, governments and businesses for using a lot of energy, and the energy use of entire small countries is being stated as comparison to what Bitcoin mining uses. And when Elon Musk, CEO of Tesla tweeted in May 2021 that he would no longer accept Bitcoins as payment for his cars because of Bitcoin mining's increasing use of fossil fuels, the share price plummeted. This occurrence sparked yet another round of debates about the energy use of Bitcoin mining. Bitcoin can actually be beneficial in that it can position the mining hubs next to large power producers and use the energy that would otherwise be wasted during times of overproduction.

Bitcoin operations are transparent, and their energy consumption is well documented. 99.8% of Bitcoin's energy consumption comes from operating the high performance computers that validate the transactions in the Bitcoin blockchain. Looking at the world's energy generation and its wastage through oversupply of energy that cannot be stored and, to a much lesser degree through losses in transmission and distribution, Bitcoin mining uses only a tiny part of the energy that is lost annually.



World energy generation and wastage
Source: Bitcoin Technologies GmbH. Created with data from Galaxy Digital Mining, May 2021; and Bitcoin's Energy Use Compared to Other Major Industries. Hass McCook, 10 August 2021

Comparing the energy consumption of China, the US, the global banking sector, gold and data centers with Bitcoin's energy consumption, the heavy criticism that Bitcoin is often subjected to is unfounded.



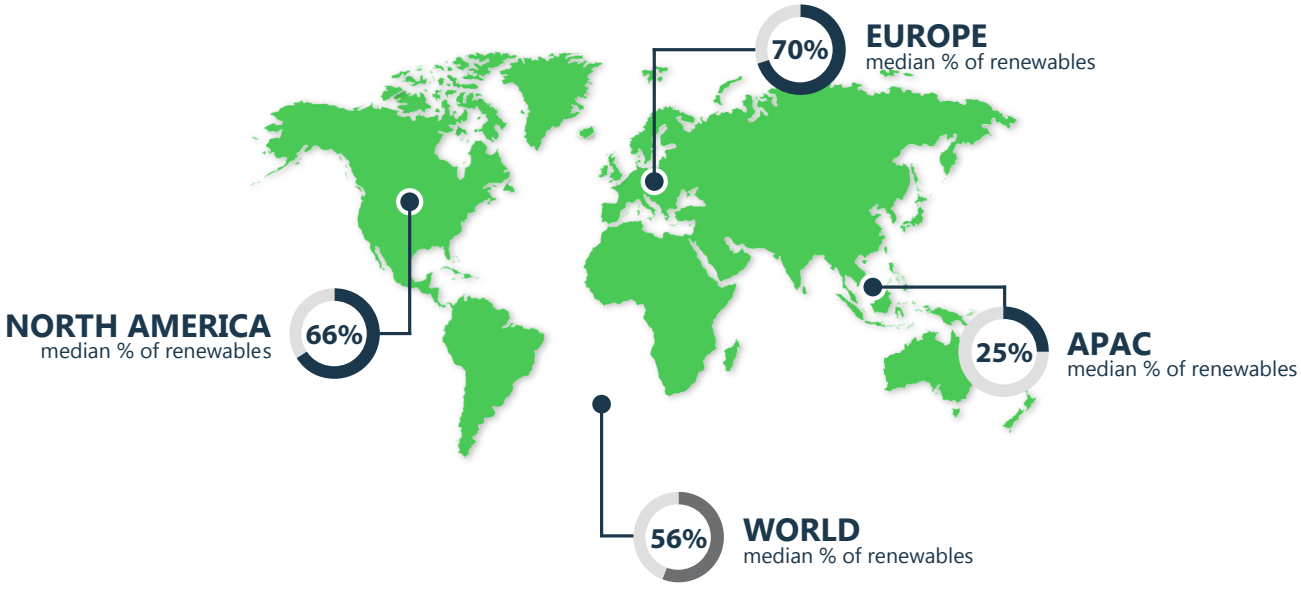
BTC mining's part in global energy consumption
Source: Bitkern Technologies GmbH. Created with data from Hass McCook. Comparing Bitcoin's Environmental Impact. 4 May, 2021; and Bitcoin Electricity Consumption Index (CBECI), University of Cambridge

The banking system's energy usage includes banking data centers, bank branches, ATMs and card network's data centers. Gold's energy consumption includes the mining, milling, concentrating and smelting, and the refining and recycling of gold. [xi]

Bitcoin miners are economically motivated and look for low-cost electricity in order to maximise profits. Because all miners on the network are in competition with each other, it is in their interest to minimise their operation costs and to look for the cheapest energy sources. As they are also location-independent, migrating from one location to another to reduce energy costs is accomplished with relative ease.

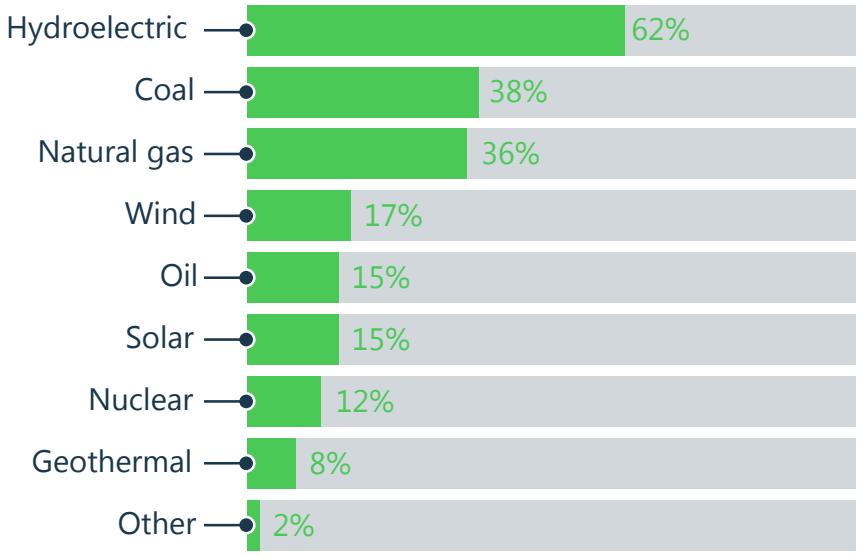
On average, 55% of costs globally are operational expenditure, such as electricity costs, maintenance and paying the workforce. The majority of these costs are the payment of utilities. The remaining 45% of costs consist of capital expenditure, such as purchasing mining equipment and developing infrastructure.[xii]

Based on a German study in July 2021 in which 32% of Bitcoin miners were questioned about their use of renewables, it is estimated that a total of 56% of the energy consumption comes from renewable energy.[xiii] In Europe, this percentage is much higher at 70%, and in the US at 66%.[xiv] The global average before the Chinese crackdown was as low as 39% because in the APAC region the share of renewable energy in cryptomining lies at 25%. However this has risen to an estimated 56% since a majority of Chinese mines have since moved to the West.



Cryptomining's renewable energy consumption
Source: Bitkern Technologies GmbH. Created with data from University of Cambridge. 3rd Global Cryptoasset Benchmarking Study. September 2020; and krypto-nachrichten 2. July 2021

Hydroelectricity is the most stable and most commonly used renewable energy source globally. In the APAC region, coal is also still widely used. In fact, Chinese miners used as much coal for mining as they did hydro. This is due to the fact that the Chinese government drove public investment in the construction of large-scale coal mines as well as hydropower plants in a bid to achieve energy self-sufficiency. With Chinese miners now having to find locations outside China, the heavy reliance on coal power stations will be reduced. In all other regions, hydro by far surpasses all other energy sources that are being used by miners, with North America, Europe and APAC also relying to an extent on natural gas and the Americas also on oil.



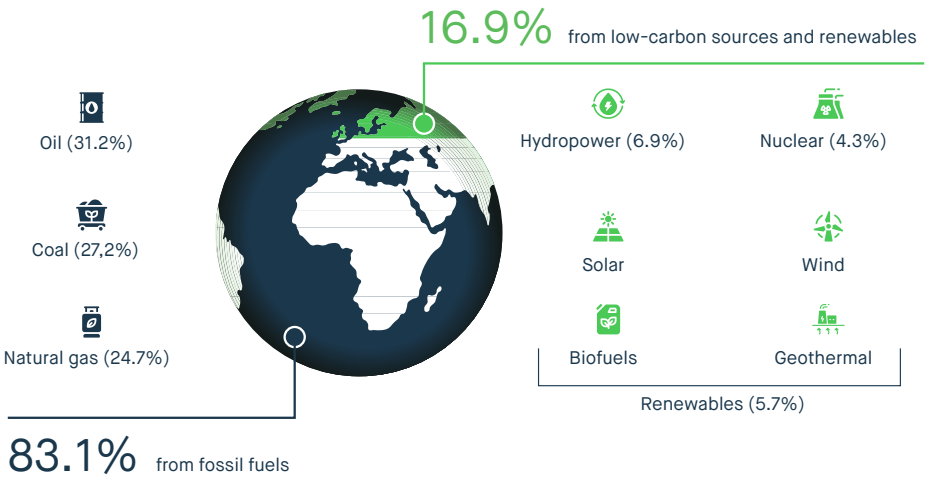
The share of hydroelectricity in cryptomining
Source: Bitkern Technologies GmbH. Created with data from University of Cambridge. 3rd Global Cryptoasset Benchmarking Study. September 2020

According to CNBC,[xv] 65% - 75% of Bitcoin mining used to take place in China, where cryptomining's renewable energy usage was as low as 25%. Chinese miners are looking for alternatives, and most of them have moved or are going to move to the US or Europe, where the renewable energy usage lies between 66% and 70%. After the migration of Chinese miners to the US and Europe, cryptomining's overall share of renewable energy, which now averages at 56% worldwide, is estimated to increase to around 70%. These estimates have not yet taken into account that the world's renewable energy usage is continuously going up, while the use of fossil fuels, especially coal-powered energy, is on the decline.

According to Chase Lochmiller, CEO and cofounder of Crusoe Energy systems, who was in a panel discussion with Sergii Gerasymovych, founder and CEO of EZ Blockchain, Marty Bent, Director of Business Development at Great America Mining, and Steve Barbour, CEO at Upstream Data, on how "Bitcoin Mining Fixes Our Energy Problems" at the Bitcoin 2021 Conference in Miami, "oil companies have no economically or logistically feasible way to transport the associated gas that gets produced to a downstream market where it can be consumed. And so they are left with this situation where they need to actually just burn the gas on site ⋯ Methane has a much higher global warming potential than CO2. It actually heats the environment at an 83 multiple."[xvi]

> "By fitting together Bitcoin mining with this midstream oilfield problem, it actually creates a really unique solution that can be a huge win for the oil company by reducing the net emissions from each marginal barrel oil they are producing. It creates a win for the environment by reducing the emissions associated with producing oil. And it creates a win for the Bitcoin miner because we are able to generate power in a completely offgrid robust manner at globally competitive power prices."[xvii]

The Covid-19 pandemic also had a huge impact on world energy markets, and primary energy consumption as well as carbon emissions showed a large decline. Primary energy consumption fell by 4.5% in 2020. Before Covid-19, the global primary energy consumption from fossil fuels was at 84.3%, that of renewable energy at 15.7%. By 2021, consumption from fossil fuels had fallen to 83.1%. The share of low-carbon sources and renewables had increased to 16.9%. [xviii] This energy mix is being used by all industries, including the chemical industry, the metal industry, the cement industry, the paper and pulp industry, and also the battery production for electric cars.



Global primary energy consumption by source
Source: Bitkern Technologies GmbH. Created with data from BP's Statistical Review of World Energy 2021

By 2021, primary energy consumption decreased by 4.5%. Oil consumption decreased to 31.2%, coal is at 27.2% and natural gas rose to 24.7%. Renewable energy now represents 5.7% of the total primary energy consumption. Despite the largest fall in energy consumption since World War II, renewable energy continued to grow, with solar energy providing the largest contribution to the growth of renewable energy consumption. The world is moving towards net-zero emissions across all industries and with the support of the major industrial nations.

The UN Sustainable Development Goals (SDGs) include climate action, and cryptomining can play its own part in both decreasing the energy wastage of power plants and moving towards a greater percentage in the use of renewables for mining. Hydropower is already a preferred energy source in cryptomining. Solar and wind are low-cost renewable energy sources. However, they still pose a number of challenges in terms of consistency in energy supply and transmission capacity. Both solar and wind are intermittent energy sources, meaning that their supply is not consistent, and there is often either too little or too much energy. Transmission lines often reach maximum capacity and grid congestions occur. As countries build more solar and wind plants, more and better storage facilities will become available. Where Bitcoin mining is integrated into solar and wind power plants, the wastage at these plants is reduced.

Bitcoin mining presents an opportunity to accelerate the global energy transition to renewable energy. Clustering cryptomining facilities near renewable energy projects can mitigate the issue of oversupply of electricity. Solar and wind are less stable than hydropower, but overall

flexibility of cryptomining facilities, such as mobile container solutions, and relative ease of switching on and off, provides options for the use of excess energy from these sources.[xix]

According to the International Energy Agency's (IEA) World Energy Outlook 2020 report,[xx] renewable sources of electricity will rise by two thirds until 2030, and renewable energy sources will overtake coal by 2025 as the primary means of producing electricity. By 2030, hydropower, wind, solar PV, bioenergy and geothermal power will provide nearly 40% of the global electricity supply. With all these developments, Bitcoin mining, which already uses a high percentage of renewable energy for its mining operations, will rapidly move towards zero emissions and 100% usage of renewable energy.

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