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Carbon Neutrality in Crypto

The Crypto Industry and Its Sustainable Efforts

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Research and Insights

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Executive Summary

The energy consumption of the proof of work (PoW) consensus mechanism has **put a spotlight on underlying environmental concerns in crypto,** particularly global warming caused by the greenhouse gas emissions (or carbon emissions). In this report, we provide an overview of carbon neutrality in crypto, including:

Background

- Global agreements, which introduce a carbon trading market (carbon credits and carbon offsetting), have been established to curb carbon emissions.
- Innovative blockchain consensus (i.e., proof of stake), renewable energy, carbon offsetting investment, and tokenised carbon credits are all well-adopted throughout the crypto industry to reduce carbon emissions.
- Some crypto organisations, such as Crypto Carbon Ratings Institute (CCRI) and Green Crypto Research (GCR), **have also come out with crypto-specific ESG Rating Frameworks to standardise the ESG assessment**.

Sustainable crypto projects

- **In this report we introduce a number of sustainable crypto projects,** including Toucan Protocol and KlimaDAO, which facilitate tokenised carbon credits trading; Moss.Earth, which issues tokens backed by actual carbon credits; and Single.Earth, a blockchain platform on which landowners and investors can protect natural lands for decarbonisation.
- **Selected crypto industry players who are committed to carbon neutrality are introduced, as well.** They are Save Planet Earth, Yieldly Finance, Crypto Climate Accord, and Crypto.com.

Future drivers in sustainable crypto

- **For true sustainable crypto industry development, support from the community is required,** such as the Crypto Impact and Sustainability Accelerator (CISA), which was co-launched by CoinDesk and the World Economic Forum (WEF).
- **Policymakers globally are questioning the carbon footprint and energy use associated with the crypto industry.** Recent initiatives, such as U.S. President Joe Biden's Executive Order in the U.S. and the EU's MiCA bill, address the energy use of crypto assets and the sustainable development of the crypto industry.

1. Introduction

As the crypto industry continues growing rapidly, environmental issues caused by the proof of work (PoW) consensus algorithm were brought to the spotlight following a tweet by Elon Musk in May 2021.

Generally, the **environmental issues refer to global warming and climate change** caused by the greenhouse gases (GHGs) in the atmosphere. **Greenhouse gases are related to energy consumption,** as a large portion of energy is generated by burning fossil fuels (e.g., coal, natural gas, and oil). The burning process releases greenhouse gases as a by-product, including carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O), among others. **These gases enter the atmosphere and subsequently result in global warming and climate change.**

The table below illustrates the estimated global annualised energy consumption of Bitcoin mining vs. other industries. Please note that Bitcoin is selected for comparison because it is the biggest cryptocurrency by market cap (39% dominance as of 12 April 2022).

A Comparison Between Annualised Energy Consumption of Industries

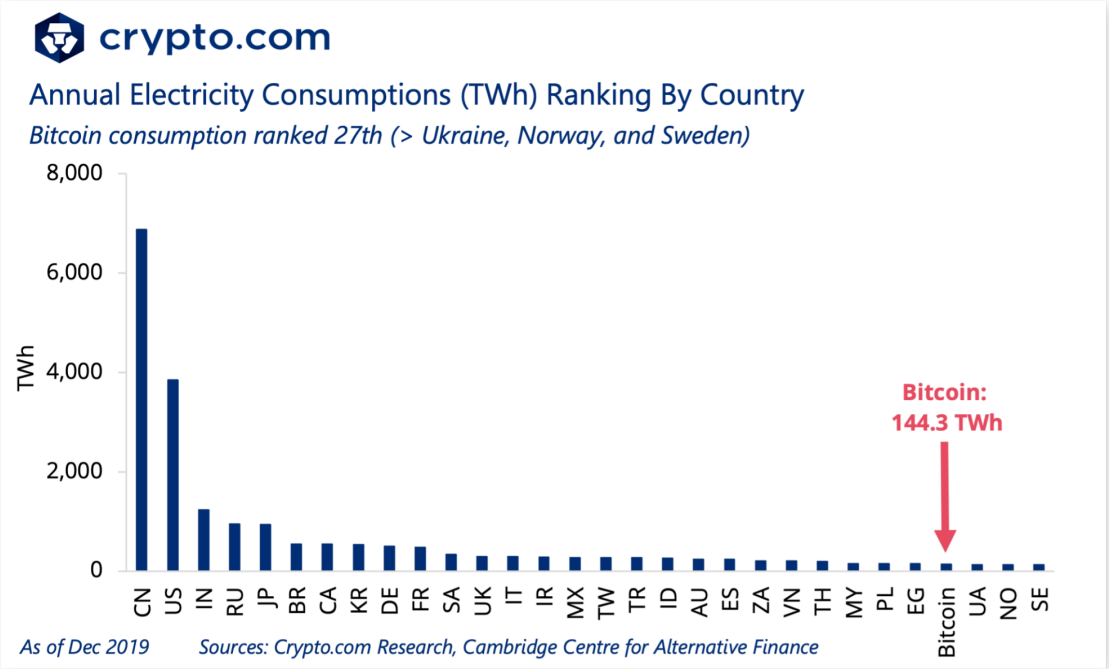
Metric	Bitcoin Mining	Gold Mining	Traditional Banking	A/C	Data Centre
Est. energy Consumption *(TWh)*	144.30	131.00	263.72	2,199.00	200.00
% Contribution to World Total Energy Consumption*	0.32%	0.29%	0.59%	4.88%	0.44%
Carbon Dioxide Equivalent (CO_2e) Emissions** *(Million metric ton, Mmt)*	65.55	62.22	113.53	1,044.53	95.00

**World total energy consumption is estimated to be 115,575 TWh; average transmission loss of 61% is considered into % contribution*

***Assuming average carbon intensity of electricity generated is 475 gCO^2/kWh (1 metric ton = 1,000 kg)*

As of 12 Apr 2022 Sources: Galaxy Digital, Cambridge Centre for Alternative Finance, Crypto.com Research

To further visualise the electricity consumed by Bitcoin mining, the following chart shows the top electricity consumption by country.



If the crypto industry continues growing, so will its energy consumption. This will lead to **more carbon emissions if energy is produced from non-renewable energy sources.** To counter this, several projects have adopted the international treaty to reduce carbon emissions, as introduced in the following chapters.

1.1 Carbon Credit and Carbon Offset

To combat global warming and climate change, international agreements have been drafted by the United Nations Framework Convention on Climate Change (UNFCCC); namely, Kyoto Protocol (1997), Copenhagen Accord (2009), Paris Agreement (2015), and COP26 (2021). **The main objective of these agreements is to reduce and control GHG emissions, as well as to incentivise the production of low-GHG goods.**

Each GHG has different properties. For easy benchmarking, **a standardised unit, known as a carbon dioxide equivalent (CO_2e), is established to measure the global-warming potential (GWP) of various GHGs.** CO_2e is calculated by benchmarking the GWP of the GHG to that of CO_2 (i.e., GWP of CO_2 = 1). For example, methane has a GWP of 25; emitting 1 kg of methane has the same greenhouse effect as emitting 25 kg of CO_2. Hence, emission of 1 kg of methane can also be expressed as 25 kg CO_2e.

With this measure, one of the most important elements, a flexible carbon trading market, has been developed with the Kyoto Protocol, together with carbon footprint, carbon credit, and carbon offset.

- **Carbon footprint** — A measure of the total amount of GHGs released into the atmosphere as a result of the activities of an individual, an organisation, a company, or a nation; usually denoted as CO_2e.
- **Carbon credit** — An allowance given to one company or country for a certain amount of emissions in CO_2 or the equivalent in other GHGs. One carbon credit is equivalent to the permission to emit one ton (or metric ton, *mt*) of CO_2e.
- **Carbon offset** — A measurable and verifiable reduction in the emission of carbon or the equivalent in other GHGs, or an increase in carbon storage (e.g., land restoration, tree planting), which are mainly used to compensate for emissions occurring elsewhere.

1.2 Carbon Neutrality and Carbon Market

In general, we can define these terms as follows:

- **Carbon neutrality** — The amount of carbon emitted is offset entirely with other activities that either reduce GHG emissions or increase carbon storage.
- **Carbon market** — A cap-and-trade marketplace for businesses or governments to trade carbon credits.

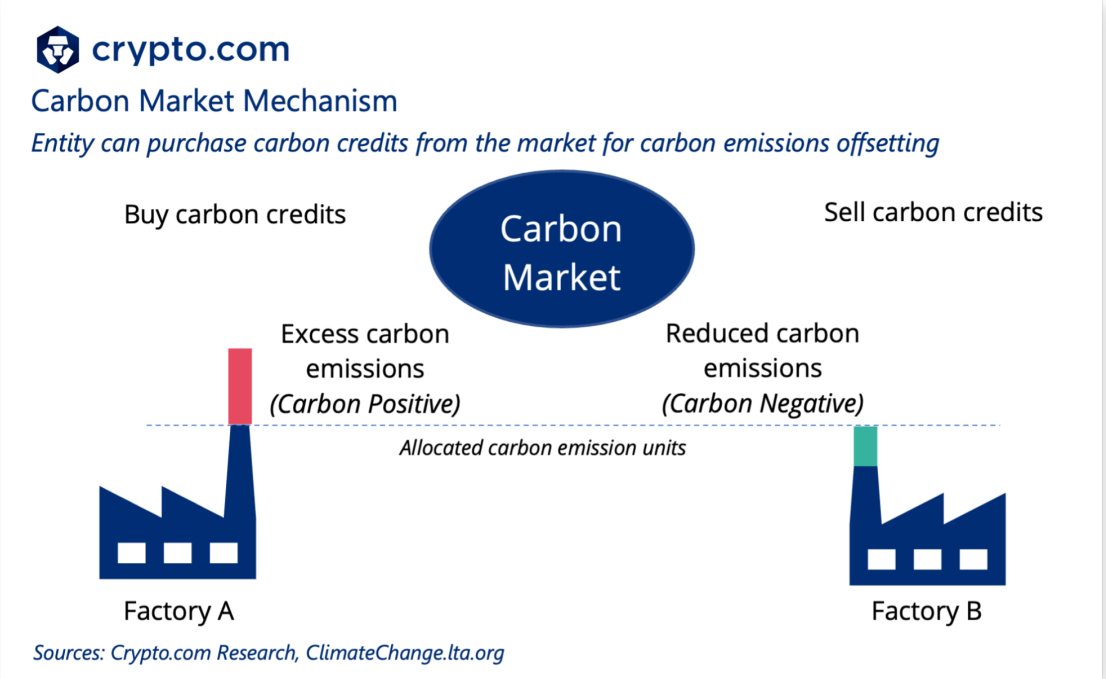
As GHGs mix in the atmosphere, **emissions and offsets of carbon do not necessarily need to take place at the same location.** For example, one entity (e.g., an organisation or a company) is allocated 100 carbon emissions units, and its current carbon footprint is 120 units. Hence, to achieve carbon neutrality, this entity can invest in carbon offset projects or carbon storage activities, or purchase carbon offset credits from the carbon market, in order to offset the excess 20 units of carbon footprint. In summary, we can calculate three different carbon footprints for one entity:

Carbon Footprint Status

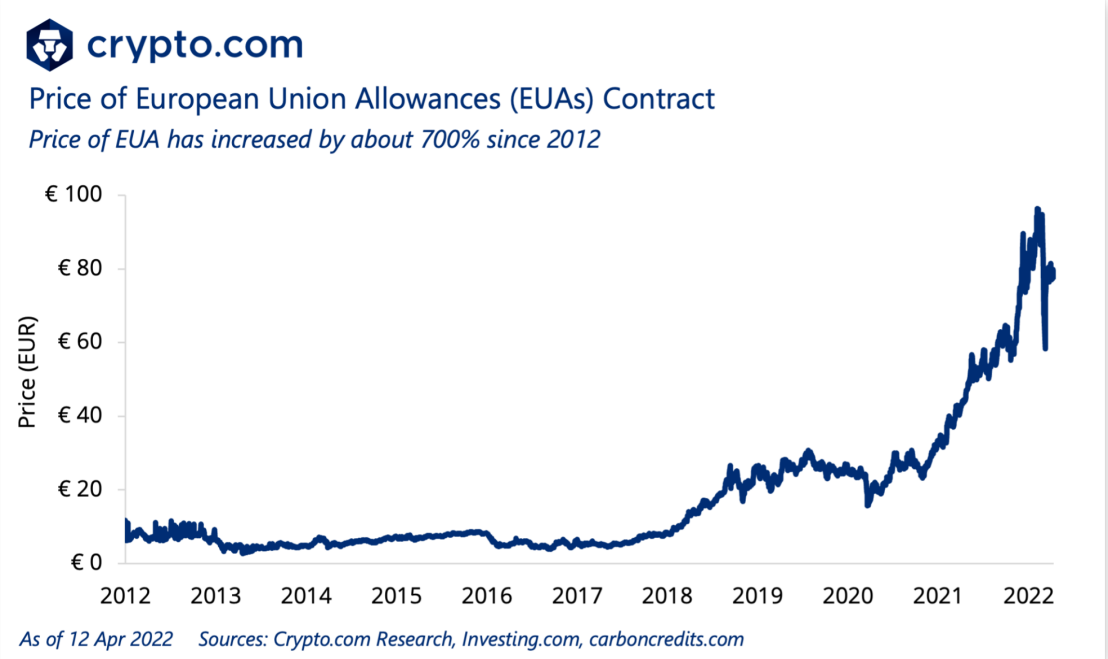
Scenario	Carbon Footprint > Allocated Carbon Emissions	Carbon Footprint = Allocated Carbon Emissions	Carbon Footprint < Allocated Carbon Emissions
Carbon Footprint Status	Carbon Positive	Carbon Neutral	Carbon Negative
Action(s) to Achieve Carbon Neutrality	• Ceases the emission-causing activity • Purchases carbon credit from carbon trading market • Invests in other emissions-reducing activity (e.g., reforestation)	–	• Entity may sell its unused carbon credits in the carbon trading market and earns extra profit

As of 23 Mar 2022 *Sources: United Nations Climate Change, Plan A Academy, Ecosystem Marketplace, Crypto.com Research*

The carbon trading mechanism is illustrated in the infographic below.



There are multiple mandatory (compliance) carbon markets in the world, which are governed by national, regional, or provincial law, that compel emission sources to meet GHG emissions reduction targets. Since carbon offset credits are generated and traded for regulatory compliance, they act like other commodity pricing. The chart below shows the historical price of European carbon credit contracts, which is the largest carbon market, over the last 10 years. **It is a future contract for the purposes of trading and delivering European Union Allowances** (EUA — the official name for the region's emission allowance; one EUA allows the holder to emit one metric ton of CO_2e).



1.3 How Crypto Achieves Carbon Neutrality

The PoW consensus mechanism requires participants to solve complicated puzzles by a number of SHA256 computations — this is known as 'mining'. The mining process is usually kept running constantly (24/7), making it very energy-consuming.

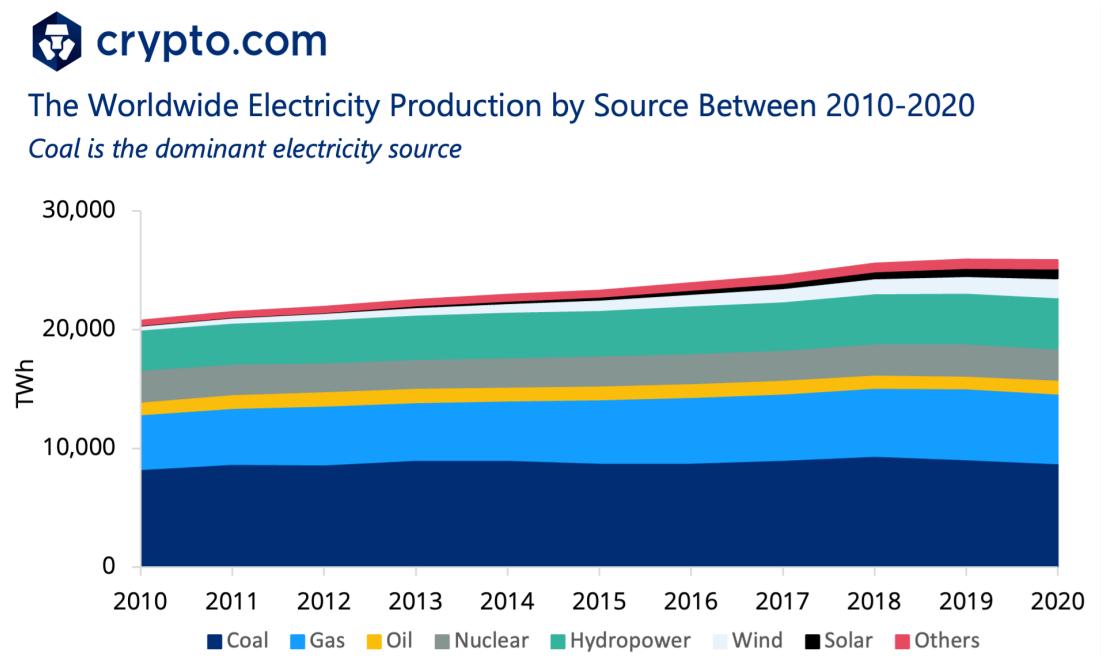
Therefore, it is generally believed that cryptocurrencies carry a heavy carbon footprint, which has been a main limitation for a wider adoption, as their environmental drawback is an ethical issue. This dilemma has fueled great interest in the community to solve the issue. Here we introduce selected approaches to achieve crypto carbon neutrality.

1.3.1 Proof of Stake (PoS)

PoS is a more energy-efficient, voting-based consensus algorithm design that, compared to PoW, requires significantly less energy. **In PoS, the validators have to lock in crypto assets as a stake to join in the consensus algorithm.** One example of a PoS network is Ethereum 2.0, which, when fully launched, is expected to reduce its total energy consumption by 99.95%, from 84,000 Wh to 35 Wh per transaction.

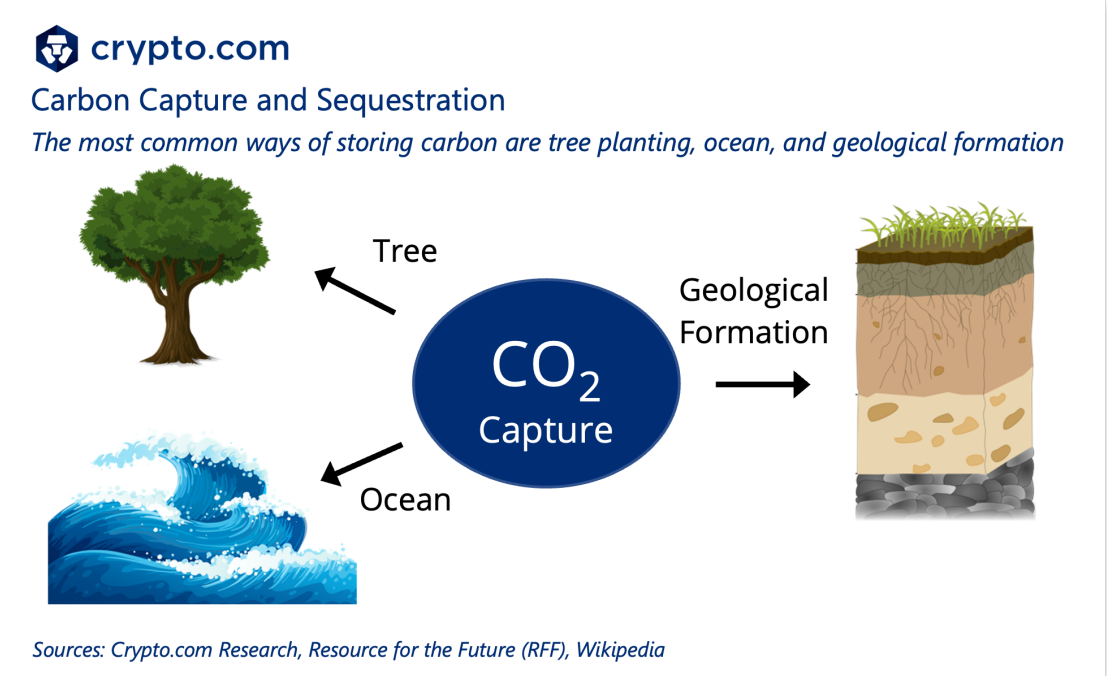
1.3.2 Renewable Energy

As shown in the chart below, **fossil fuels currently remain the dominant source of electricity.** They can be replaced by renewable energy sources, such as solar power, wind power, hydropower, bioenergy, nuclear power, and geothermal energy. By using sustainable energy for computationally intensive blockchain technology (i.e., PoW), carbon emissions can be mitigated. CoinShares estimated that about 39% of energy used in Bitcoin mining is generated from renewable sources. Also, several crypto projects, such as SolarCoin and PowerLedger, invest their funds or revenue into carbon offsetting projects (e.g., solar farms and wind parks).



1.3.3 Carbon Capture and Sequestration

Carbon sequestration is the process of capturing CO_2 before it enters the atmosphere, then transporting and storing it long term in forests, geological formations, and the ocean. Moss.Earth is one of the crypto projects that adopted this method by preserving primal forests, as well as reforestation projects. Please refer to Section 3.3 for more information.



1.3.4 Tokenised Carbon Credits

To reduce carbon emissions, governments and businesses can participate in various carbon offsetting activities and carbon credit trading in the marketplace. However, most of the traditional carbon markets are heavily regulated, and accessing the market requires tedious and opaque administrative processes. This can make the carbon market mechanism and the issuance of carbon credits look like 'greenwashing'. In blockchain-powered carbon markets, the tokenised carbon credits are more liquid, transparent, and reliable. Individuals and businesses can also purchase these verified carbon credits in a faster way compared to the traditional carbon market. Toucan Protocol is one of the tokenised carbon credit issuers in the crypto industry. It is worth noting that **tokenising carbon credits does not directly contribute to reducing carbon emissions,** but the credits provide a smoother channel to **help others achieve carbon neutrality.** More information can be found in Section 3.1.

In the next chapter, we give an overview in the Environmental, Social, and Governance (ESG) framework for crypto, focussing on the environment pillar, the sustainable crypto projects that are working on restraining global warming, as well as how they achieve carbon neutrality. We hope it will help readers better understand the sustainable efforts that the crypto industry is putting in.

2. Environmental, Social, and Governance (ESG)

ESG is widely used to identify a company's potential risks and growth opportunities in order to support investment decision-making (i.e., ESG investing). Based on Morgan Stanley Capital International (MSCI) ESG framework, the ESG pillars and 10 themes are classified as follows:

MSCI ESG Research's Key Issue Framework (3 Pillars + 10 Themes)*

'E' — Environmental	'S' — Social	'G' — Governance
Climate change	Human capital	Corporate governance
Natural resources	Product liability	Corporate behaviour
Pollution & waste	Stakeholder opposition	–
Environmental opportunities	Social opportunities	–

**For more details on the framework hierarchy, i.e., 35 ESG Key Issues, please visit MSCI ESG Ratings Key Issue Framework*

As of 11 Mar 2022 Sources: MSCI - The Evolution of ESG Investing

The above framework (i.e., 3 Pillars, 10 Themes, 35 ESG Key Issues) is applied to the MSCI ESG Rating Methodology to measure the company's ESG risks, with the rating scores ranging from leader (AAA, AA), average (A, BBB, BB) to laggard (B, CCC), based on the percentile between the best (i.e., AAA) and worst (i.e., CCC) in respective industries. Cryptocurrencies have been increasingly allocated into the portfolios of professional and institutional investors. Consequently, ESG issues associated with cryptocurrencies have become a growing concern for institutional investors.

Numerous potential ESG risks in the crypto industry have been recognised by MSCI, such as GHG emissions (i.e., Environmental), lack of investor protection (i.e., Social), as well as informal and dynamic policy actors arising from the

decentralisation of cryptocurrencies (i.e., Governance), etc. However, according to Charlie Morris, managing partner of CMCC Global, **cryptocurrencies have generally addressed 'S' and 'G' well by:**

- 'S' — Bringing banking to unbanked individuals (Social)
- 'G' — Using decentralised autonomous organisations (DAOs) to govern crypto projects instead of a particular centralised government (Governance)

In this section **we focus only on the 'E' factor for crypto**—, **given that most investors are concerned about carbon emissions and energy efficiency of cryptocurrencies**.

2.1 ESG Rating Framework, 'E' — Environment for Crypto

According to MSCI, the 'E' pillar is expanded into 13 key issues, as shown in the table below:

The 13 Environment Key Issues

'E' — Environmental		
Themes	**Key Issues**	**Impact on Crypto***
Climate Change	• Carbon emissions • Product carbon footprint • Financing environmental impact • Climate change vulnerability	• PoW algorithm uses large amount of energy, which causes carbon emissions (GHG emissions) if the energy source is non-renewable
Natural Resources (Natural Capital)	• Water stress • Biodiversity & land use • Raw material sourcing	• Mining facility might occupy a large area of land

Pollution & Waste	• Toxic emissions & waste • Packaging material & waste • Electronic waste	• As miners frequently update their hardware, outdated hardware could become 'electronic waste'
Environmental Opportunities	• Opportunities • Product carbon footprint • Financing environmental impact	• Blockchain technology via smart contract facilitates carbon trading mechanism (PDF file), as well as tracking carbon footprint production • Revenue earned from blockchain applications can be reinvested into green energy source, e.g., solar farm

**Based on discussion and study of Crypto.com Research and Insights Team*

As of 11 Mar 2022 *Sources: MSCI ESG Ratings Key Issue Framework, Crypto.com Research*

Noticeably, **the crypto industry has both positive and negative impacts on the environment.** To compare, companies with ESG ratings in the traditional finance industry (i.e., TradFi) can be found via the MSCI Ratings & Climate Search Tool. For example:

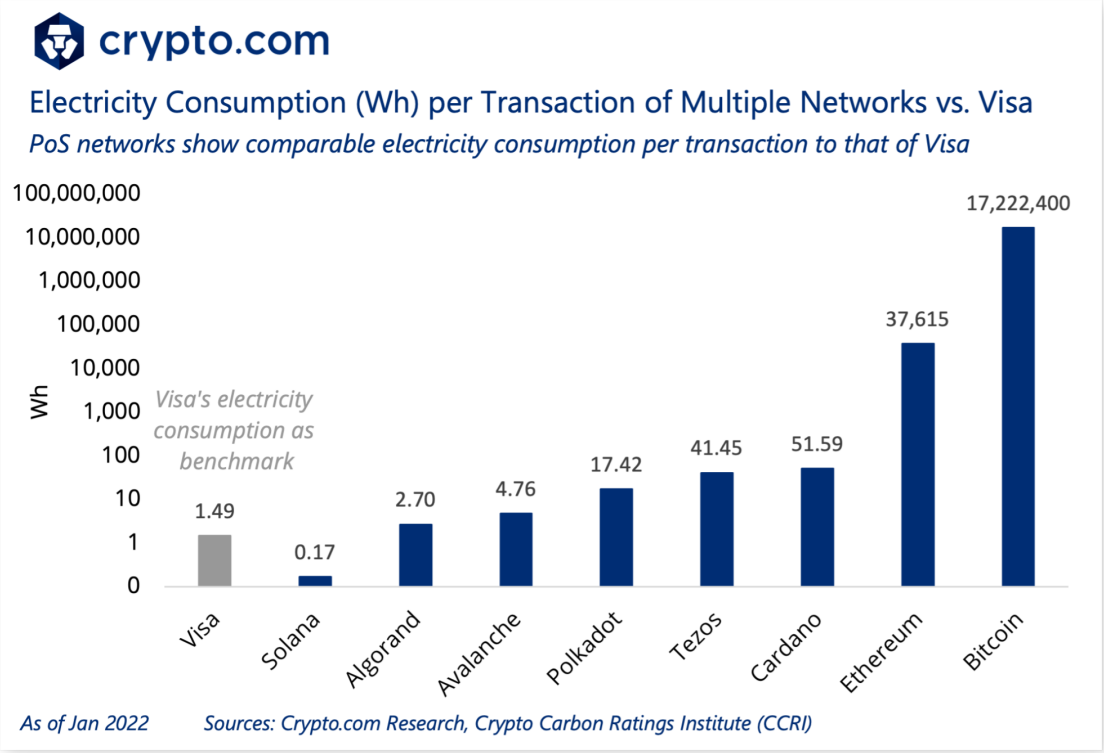
- HSBC Holdings PLC set a decarbonisation target by 2030, aiming to halt the global temperature rise at 1.87°C, and it is rated as an 'AA' leader in the banking industry. (Note: Implied temperature of ≤ 2°C is aligned with the Intergovernmental Panel on Climate Change (IPCC) goal of limiting the global temperature rise.)

- Citigroup Inc. has a decarbonisation target set for the year 2050, with a goal temperature rise of 2.6°C, which is misaligned with the IPCC goal; hence, it is rated 'A', or average, in the banking industry.

Although the MSCI ESG framework is well-established and commonly used in traditional industries, **the crypto industry itself is relatively new, and there are not enough data points yet to develop a comparison of the ESG impact between cryptocurrencies and TradFi.** Nevertheless, there are organisations specialising in a crypto-specific sustainable rating, such as the Crypto Carbon Ratings Institute (CCRI) and Green Crypto Research (GCR).

2.1.1 The Crypto Carbon Ratings Institute (CCRI)

CCRI is a research institute that **assists companies in the crypto sector in understanding and managing their environmental impact.** In a recent report published by CCRI titled, "Energy Efficiency and Carbon Footprint of proof of stake (PoS) Blockchain," (PDF file) energy consumption and carbon footprints of multiple blockchain networks were compared, including Avalanche (AVAX), Algorand (ALGO), Cardano (ADA), Polkadot (DOT), Tezos (XTZ), and Solana (SOL). The chart below presents the comparison of the electricity consumption per transaction between Bitcoin, Ethereum, multiple PoS networks, and Visa. It should be noted that this may not be a perfect comparison (e.g., Bitcoin's energy consumption is not determined by transaction volume, unlike Visa); however, we include it here nonetheless for completeness. **From the chart, electricity consumption per transaction of a PoS network is nearer to that of Visa, whereas Bitcoin and Ethereum have much higher electricity consumptions.** Additionally, CCRI develops a paid API for access to cryptocurrency sustainability metrics.



2.1.2 Green Crypto Research (GCR)

GCR is a nonprofit organisation with the goal to empower crypto enthusiasts and investors to make responsible investment decisions by evaluating the

sustainability of cryptocurrencies in a tangible framework. Similar to the ESG framework of MSCI, **GCR has developed the first crypto-specific sustainability rating system — the GCR Sustainability Rating.** This rating framework assesses the ESG aspects of a cryptocurrency and **provides a relative ranking that ranges from A+ to D- in the cryptocurrency-respective category.**

- **Environmental —** The environmental score illustrates a cryptocurrency's impact on the planet, which involves actual energy consumption (e.g., from the mining activities), awareness, and management of reducing carbon emissions; for example, the management of electronic waste, the actual energy consumption per transaction, and the outlook to reduce the carbon footprint.
- **Social —** The social score indicates how a cryptocurrency takes the community into account, and how responsibly it engages with its community; for example, equality in the distribution of digital assets among the community, social intention, transaction fees, and the vision of the cryptocurrency are considered.
- **Governance —** Governance score denotes a cryptocurrency's governance concerns and efforts in terms of behavioural guidelines and principles. This includes the security of the network (e.g., 51% attack), conflict of interest between the cryptocurrency organisation and individuals, as well as the distribution of miners/validators.

Scores of A+ to D- will be given for each ESG of an individual cryptocurrency. For instance, Bitcoin scored 'D', 'B-', and 'B+' for its ESG, respectively. As of 12 April 2022, the GCR scores of selected blockchain and protocol tokens are shown on the next page according to the GCR scores website:

Green Crypto Research Ratings

Coins	GCR Rating*	Environmental	Social	Governance
Bitcoin (BTC)	D	D-	B	B+
Ethereum (ETH)	C	C	B-	A-
Solana (SOL)	A	A+	A-	A+
Polkadot (DOT)	B	A+	B	A+
Terra (LUNA)	C	A-	C+	B-
Tezos (XTZ)	B	A+	A-	B+
Fantom (FTM)	B	A+	B+	B+
Algorand (ALGO)	A	A+	A-	A-
Polygon (MATIC)	B	A+	A+	B+
Avalanche (AVAX)	A	A+	A-	A-
Aave (AAVE)	B	A-	B	B-
Uniswap (UNI)	B	B+	B+	B+
Curve Finance (CRV)	B	B-	B	B-

**Overall rating corresponds to the worst ESG score, i.e., worst ESG has the largest weightage, so that failures in a single category cannot be compensated for by good scores from the other two*

As of 12 Apr 2022 *Sources: GCR Coins Ratings, Crypto.com Research*

Even though the crypto-specific ESG framework is relatively new, **we believe that ESG will be one of the top priorities in the crypto industry in the future.** Moreover, a number of sustainable crypto projects have kickstarted their development to address the most discussed 'E' issues, which are introduced in the next chapter.

3. Sustainable Crypto Projects

In this chapter, we introduce a few crypto projects that are turning towards being sustainable. A high-level comparison of sustainable crypto projects is presented below:

Overview of Sustainable Crypto Projects

Project	Debut	Blockchain	Token	Market Cap	Highlights
Toucan	Oct 2021	Polygon	BCT	$50M	Tokenised carbon credit; brings carbon credit on-chain
KlimaDAO	Oct 2021	Polygon	KLIMA	$30M	Brings carbon credits on-chain, accelerating the price appreciation of carbon credits to promote decarbonisation
Moss.Earth	2020	Ethereum	MCO2	–	Partnered with Amazon forest conservation project
Single.Earth	Q4 2022	Solana	MERIT	–	Tokenises nature for its ecological value, promotes nature land reservation through token sale

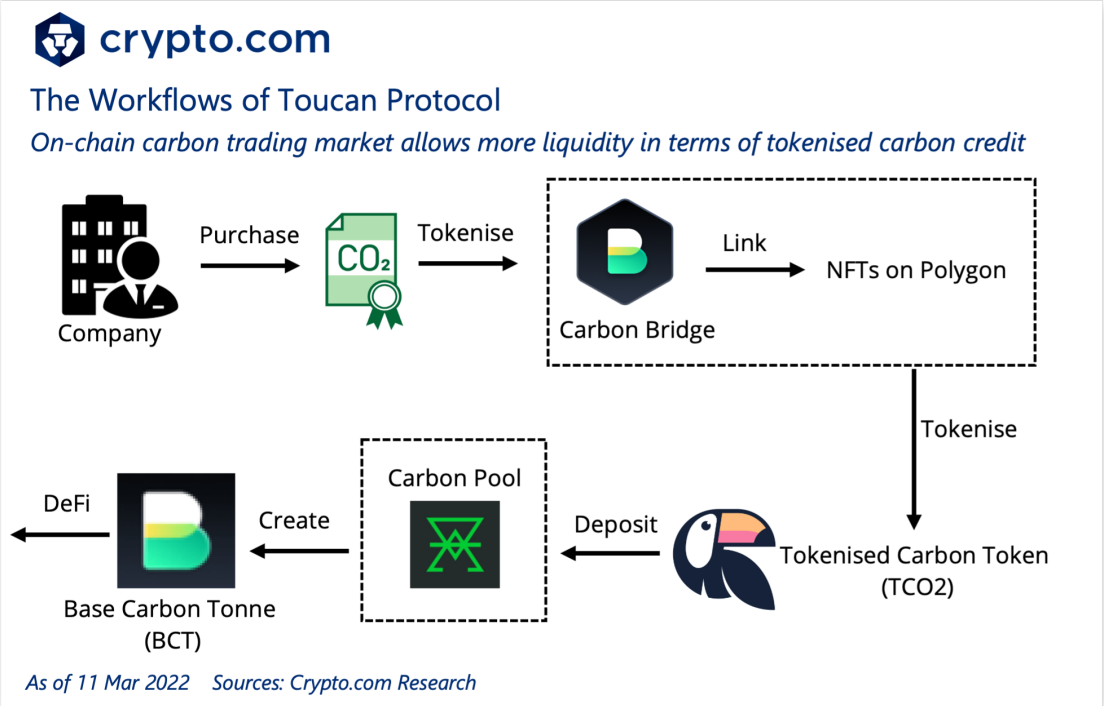
As of 11 Mar 2022 *Source: CoinGecko, Crypto.com Research*

3.1 Toucan

By bringing carbon trading markets to DeFi**, Toucan empowers both individuals and businesses to contribute towards a cleaner planet.** Toucan was launched in October 2021 on the Polygon network, an energy-efficient and eco-friendly PoS layer-2 solution for Ethereum.

Technically, Toucan involves three significant mechanisms for on-chain carbon markets:

1. **Toucan carbon bridge** — Enables users to bring their registered carbon credits onto the blockchain. Toucan is in partnership with the Verra registry (a popular verified carbon standard registry system).
2. **Carbon tokens** — Two types of carbon tokens, which are Tokenised Carbon Tokens (TCO2) and Base Carbon Tonne (BCT).
3. **Carbon pool** — Turns carbon offsets into more liquid carbon tokens (i.e., BCT), enabling price discovery for different classes of carbon assets to DeFi.



As depicted above, the working principle of Toucan protocol is as follows:

1. The protocol starts with any carbon credit owners; e.g., an organisation producing carbon credits or a company purchasing carbon credits to offset their carbon emissions, with the carbon credits meeting the minimum quality criteria of Verra's standard. Then, these credits are retired from the respective registries before 'carbon bridging'.
2. The 'carbon bridge' brings these carbon credits on-chain from the legacies registries onto Polygon (by linking these credits to newly created NFTs on Polygon). These NFTs contain the details of the carbon sequestration or reduction project.

3. **Once bridged, Toucan uses the NFTs to mint tokenised carbon offsets ERC20 tokens (i.e., TCO2), which carry the attributes and metadata of the NFTs.**

4. **By depositing TCO2 in the carbon pool (designed together with KlimaDAO), users receive Base Carbon Tonne (BCT) tokens on a 1:1 basis. This is a fungible pool token that is backed by one carbon credit held in the smart contract.**

Toucan enables the creation of liquid carbon tokens (e.g., BCT), which can be easily integrated into other DeFis. As of 11 March 2022, BCT is available for trading on KlimaDAO, QiDAO, and Market.xyz.

3.2 KlimaDAO

KlimaDAO is a fork of OlympusDAO. As introduced in the previous section, the real-world carbon credit is a 'currency' that companies can buy to offset their excess carbon emissions. **KlimaDAO drives climate action by accelerating the price appreciation of carbon credits** with its KLIMA token and bringing these credits on-chain. Each KLIMA token is backed by at least one BCT token. To better understand the current carbon market, here is a more detailed explanation.

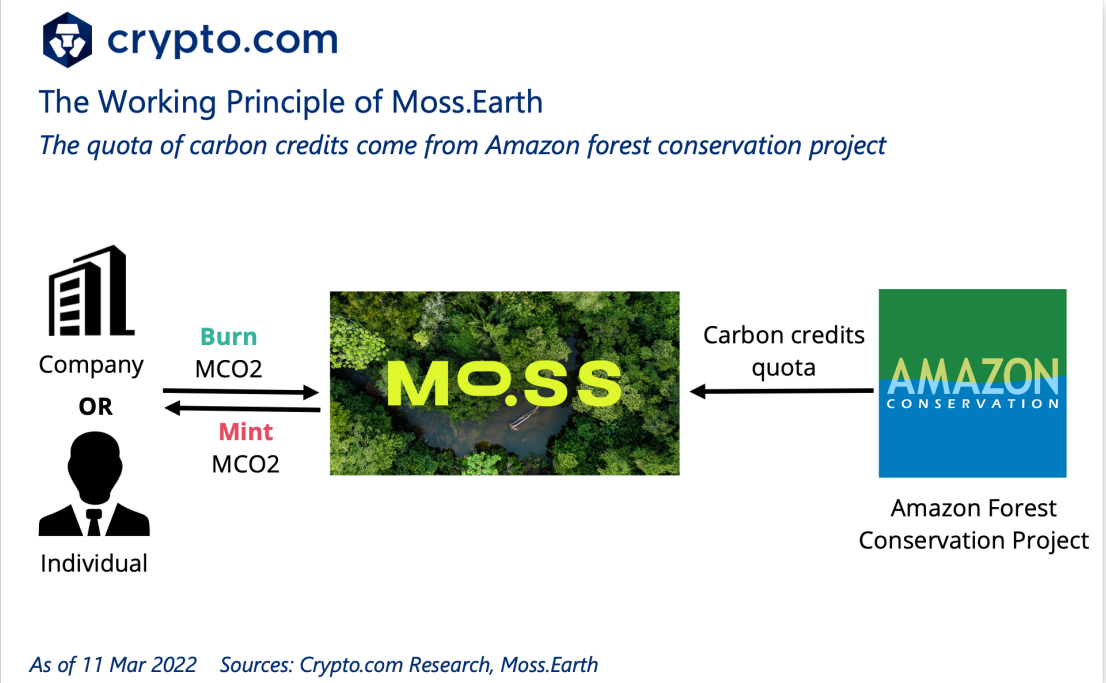
KlimaDAO has a strong relationship with the Toucan protocol, specifically its carbon pool. To participate in KlimaDAO, users need to purchase BCT or KLIMA directly from SushiSwap on the Polygon network. In order to benefit the most from using KlimaDAO, users are encouraged to obtain KLIMA via its bonding mechanism by either depositing BCT or the SushiSwap liquidity pool tokens (BCT/USDC LP or BCT/KLIMA LP) into KlimaDAO's treasury in exchange for discounted KLIMA. Each bonding has its own discount rate depending on the treasury's demand for such assets. Users benefit when they stake their KLIMA with KlimaDAO to generate returns up to 1,090% APY as of 11 March 2022.

In short, **KlimaDAO incentivises users to buy carbon credits and lock them in its platform.** Predictably, this could lead to a **price increase of carbon credits due to the 'deflationary' property** (i.e., locking the tokens in the platform to reduce circulating supply). Therefore, polluters try to reduce carbon emissions instead of buying carbon credits.

3.3 Moss.Earth

Founded in Brazil, Moss.Earth is a global climatech company focused on environmental service that issues carbon credit-backed tokens (MCO2) used to offset GHG emissions.

- **Burn** — Every time the MCO2 holders burn one token on Moss.Earth's carbon credit market, they receive a **certificate proving they have offset one ton of forest carbon emissions per token.**
- **Mint** — Each MCO2 token is minted with a neutral carbon footprint. Moss.Earth monitors the transactions and accordingly burns the necessary amount of carbon offset credits to neutralise the GHG emissions from its tokenisation activities.

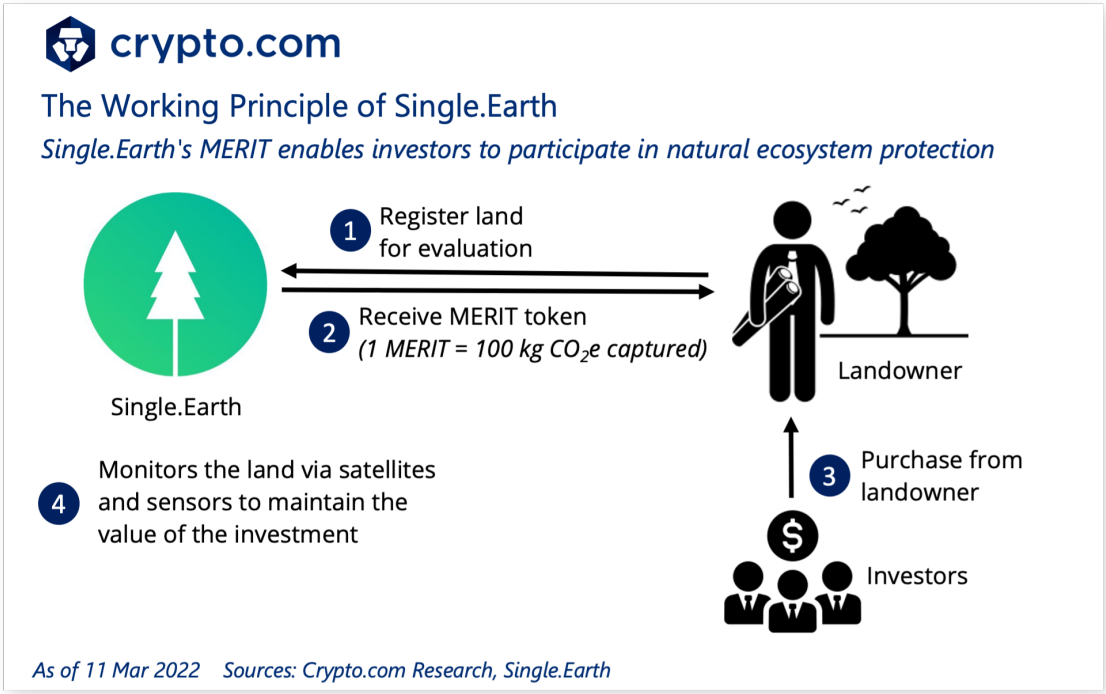


The carbon credits come from the Amazon Forest Conservation Project, which are issued to Moss.Earth accordingly. These issued credits can be sold to its participants as MCO2 tokens. The **sales proceeds have been invested in forest preservation projects,** which have prevented more than 735 million trees from being cut down (as of 11 April 2022). As a result, deforestation is being avoided and the carbon dioxide emitted to the atmosphere is reducing, as well. Moss.Earth engaged Armanino for its environmental assessment, and as of 11 April 2022, **there were a total of 2.84 million circulating units of MCO2; each MCO2 token is fully backed by one certified carbon credit** in Verra's registry.

3.4 Single.Earth

Single.Earth is a platform that tokenises land for its ecological value with the aim to make carbon removal tradable. By leveraging the technology of satellite imagery and artificial intelligence to model the cartographic data, Single.Earth

reveals how much any area of ecological significance in the world absorbs carbon and retains biodiversity.



As shown above, the platform works as follows:

1. **Landowners register their land in the Single.Earth marketplace, and the registration is then sent to biologists for assessment of the ecological value of the land.**
2. **After evaluation, the land is given a value, which is represented by Single.Earth native tokens (MERIT). These one-off tokens are emitted to the landowner, with each representing 100 kg of CO_2e captured in a biodiverse nature on their land.**
3. **Investors can buy MERITs directly from landowners, who in return protect the 'nature'.**
4. **Single.Earth monitors the land via satellites and air-quality sensors to ensure that the land value is maintained.**

Additionally, Single.Earth is built on the Solana blockchain, which **uses only 0.00051 kWh per transaction.** In short, Single.Earth enables a platform for users to invest into carbon sequestration by protecting the natural land.

3.5 Other Projects and Players

Other than the above renowned projects, there are a number of players who are currently working towards a more sustainable crypto, as well.

3.5.1 Save Planet Earth

Save Planet Earth is developing a project to combat climate change. According to its official website and latest white paper, this project has developed the first-ever standard-certified carbon credit NFTs (CCNFTs). The sustainable blockchain (named SPE Green Blockchain, SPEC) powered by renewable energy sources and a carbon credit exchange (SPEX), which will use SPE tokens as the exclusive currency, are still in production.

3.5.2 Yieldly Finance

Yieldly announced that it would go carbon neutral by purchasing carbon offset credits. In addition, Yieldly actively supports conservation efforts across the ecosystem, including rewilding animal habitats.

Given that Yieldly is based on the carbon-neutral Algorand blockchain, it has taken a sustainable approach to building its disruptive DeFi technology. Yieldly has incorporated sustainability practices into its business model and recently increased purchasing of carbon offset credits from Greenfleet, a leading Australian nonprofit organisation focussing on large-scale native reforestation to capture carbon. Yieldly claims that carbon neutrality is just one of the many benefits it brings to the DeFi ecosystem, and it will continue to keep sustainability in its project roadmap.

3.5.3 Crypto Climate Accord (CCA)

Inspired by the Paris Climate Agreement and led by private-sector players, the Crypto Climate Accord (CCA) consortium wants to transition all blockchains to renewable energy by 2030.

In April 2021, the initiative was led by three nonprofit companies — the Rocky Mountain Institute, the Energy Web Foundation, and the Alliance for Innovative Regulation — and the original objective focused on sustainability and transition to net-zero carbon emissions in the crypto industry by 2030. As of 20 April 2022, more than 200 companies and individuals have been CCA Signatories, including global crypto mining firm Argo Blockchain and blockchain consulting company DMG. We expect to see more projects to participate in this sustainable accord in the near future.

3.5.4 Crypto.com

In May 2021, **Crypto.com, one of the fastest-growing platforms in the crypto industry, announced the goal to be carbon negative within 18 months by offsetting more carbon produced from all activities across the organisation.**

The phases of Crypto.com's decarbonisation process are:

1. **Assess carbon generated from cryptocurrency trading, depositing, and withdrawal activities across all Crypto.com platforms.**
2. **Identify the most effective ways to offset the carbon emissions with the support of accredited organisations specialising in carbon offsetting and sequestration.**
3. **Evaluate and offset the carbon generated from business activities outside of trading (e.g., marketing activities, work-place services, and business travel) across the organisation.**

Last but not least, there are more players in the crypto industry that have started creating more sustainable projects for the crypto community. Examples of this include Carbon Utilisation Token (CUT), Islands of Cool, STEPN (GMT), and carb0n.fi (ZRO).

We expect to see even more players in the industry soon take action on building a sustainable crypto world, together.

4. Outlook and Concluding Remarks

We introduced and analysed the various sustainable efforts that selected players have made. In this chapter, we present some general insights on the future of sustainable crypto efforts.

4.1 What Is the Stakeholder Reaction to Becoming Sustainable?

Crypto projects require support from different stakeholder groups in order to be sustainable. Understanding stakeholder sentiment is therefore the key to success. We share our findings in this section.

4.1.1 The World's Largest Economies

U.S. President Joe Biden signed an Executive Order regarding digital assets, including crypto, in March 2022. The stated objective of the order is to ensure the responsible development of digital assets and refers specifically to the need to manage associated climate risk. President Biden has called on agencies to **consider more responsible crypto innovation and reduce environmental impacts.** Besides, the EU's proposal for a regulation in crypto assets sought to **ban energy-intensive crypto mining** (i.e., proof of work), but the proposal did not pass.

4.1.2 Crypto Community

Crypto's CO_2 pollution has been occasionally discussed by the community. Fortunately, driven by the clear deficit of effective global efforts to shape the conversation on environmental, social, and governance impact in practical and actionable terms, the World Economic Forum (WEF), in collaboration with CoinDesk, launched the Crypto Impact and Sustainability Accelerator (CISA). This initiative focuses on development towards more sustainable blockchains.

Apart from the selected representatives in Chapter 3, more protocols seeking eco-friendly innovations are springing up. For instance, SolarCoin creates one solar coin for every Megawatt hour generated from solar technology. As a well-known L1 blockchain, Cardano adopted a dedicated PoS consensus protocol, claiming its networks only consumed 6 GWh of power per year. We believe that the crypto community views mining's carbon footprint and efforts towards preventing climate change to be moving in the right direction.

4.2 What Does a 'Best Practice' Look Like?

Theoretically, there is no fully perfect sustainable-effort solution that a blockchain protocol can adopt. Yet, more advanced technologies are evolving, which can motivate the platform operators to sustain their systems. In this section, we outline several key factors that a possible 'best practice' must have.

First and foremost, **the ideal design consists of both renewable energy usage and energy-efficient fundamental technologies** (e.g., in mining consensus and data storage). Specifically, two factors need to be taken into consideration. One is adopting more fine-grained methodologies to evaluate carbon footprints. This comes as a crucial prerequisite for devising a good carbon-neutral platform, as a better understanding of what the main emission source is and how to make it sustainable is required. The other consideration is using waste and renewable energy. For best practice, electricity should be supplied wholly by renewable energies in order to achieve carbon neutrality.

Additionally, **a desired solution should provide a way to incentivise more participants and investors.** For example, Single.Earth has put forth a smart incentive program to attract landowners and investors to participate in its ecosystem. An intuitive approach is launching their in-platform tokens, which can not simply guarantee the operation of a protocol but allows for more investors to earn while contributing.

Lastly, as long-term goals, a sustainable platform should invest part of its revenue **in environmental projects, including planting trees, rainforest reserves, and solar farms.** Such long-term investment is regarded as a form of giving back to society, especially addressing concerns of environmental issues like global warming and climate change raised by the community. Eventually, this might lead to more funding moving towards sustainable initiatives in crypto.

In conclusion, we see more projects and crypto organisations joining the sustainability race with their innovative and inclusive ideas. We anticipate a more sustainable crypto space with the efforts of all stakeholders in the near future.

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