Dual Impact of Crypto Industry Technologies on the Energy Poverty

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Abstract

Recent years have been important for the active development of blockchain and cryptocurrency. The industry is constantly in the top news. The last half of 2021 brought us another trend: the metaverse (or metauniverse, as some prefer). To combine our real life, work, and exciting technology, the metaverse has captured the public imagination. In the work, the authors emphasize that, even though the metaverse is still at the beginning of its development, crypto is already playing a central role. The metaverse is growing at a rapid pace, projects continue to evolve to connect more aspects of our digital lives and blockchain plays a crucial role in this development. The paper states that the potential of this technology is expected to be growing in the coming years, in particular in solving the problem of free access to the energy market for small producers. This will not require a lot of computing power but instead can bring significant energy savings, considerably impacting the reduction of energy poverty.

Keywords

Blockchain, metaverse, technologies, energy poverty, crypto industry.

1. Introduction

In recent years, unprecedented changes have taken place in the world. First, the Covid-19 pandemic, then the war in Ukraine led to significant socio-economic losses in almost all major economies of the world. According to the estimates of the International Monetary Fund, the overall decline in global GDP at the end of 2020 amounted to 3.5%, and the growth of the world economy, forecasted for 2023 and 2024 (as well as the actual result of 2022), is lower than the historical average annual indicator of 3.8% for the period from 2000 to 2019 [1]. The effects of Covid-19, combined with the war in Ukraine, have made households in Europe more vulnerable to energy poverty, especially during the cold winter months. Easy and reliable access to energy is vital for households to adapt to increasingly harsh winters. However, income losses during the pandemic and rising energy prices in response to Europe's dependence on energy imports are leaving many low-income households unable to pay their electricity bills [2, 3]. The estimates of the European Commission show that about 34 million people in the European Union (EU) experience energy poverty to varying degrees, which is considered by the European Union as one of the top 10 strategic tasks on the way to ensure the sustainable development of energy and society as a whole. Consequently, humanity faced one of the most serious economic crises in the entire period of assessments of global economic dynamics [4–6].

2. Energy Poverty

The deepening crisis of the COVID-19 pandemic, rampant climate change, and the war in

CPITS 2023: Workshop on Cybersecurity Providing in Information and Telecommunication Systems, February 28, 2023, Kyiv, Ukraine
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Ukraine have caused serious negative economic, social, and environmental consequences around the world. We faced the risk of a sharp divide in the world, with rising inequalities between developed and developing countries, and within developing countries themselves, between urban and rural areas, the rich and the poor, men and women. The impact is most devastating for many people living in the least developed countries. People who are employed in the informal sector of the economy, without access to social protection, have been particularly affected by the socio-economic crisis. According to the World Bank, the number of people living in extreme poverty increased by 88–115 million people in 2020, and by the end of 2021, their total number reached 150 million. Comparing the situation with the Great Depression, UN experts concluded that the number of people living in extreme poverty will increase to 180 million in the coming months [7].

The pandemic as well as the war in Ukraine became a certain catalyst and forced almost all layers of the world community to ask deeper questions about who they are and how they work, to rethink values and how they convey them to counterparties. Achieving success at this historical moment quickly transformed into self-preservation, which practically means "reinventing yourself" by maximally mobilizing your ability to respond effectively and to adapt as soon as possible to the "new normal". Such adaptation and achievement of the NTP in the form of vaccination, which leads to the relaxation of administrative restrictions, according to the World Bank, is realized in the form of growth of the global economy by 5.6 percent in 2021—this is the highest rate of post-recession recovery in the last 80 years. At the same time, the pandemic continues to dampen economic activity in many emerging and developing economies. The recovery has an uneven character and is mainly due to the rapid revival of economic activity in some large countries.

3. Metaverse

Thanks to the new reality, most social processes have changed beyond recognition, and digitalization has experienced an incredible acceleration that has resulted in an ultra-modern concept called the "metaverse" (or metauniverse), becoming a central topic of global discourse. Society, finding itself in a state of permanent stress, reacted to the latest idea quite predictably—as a natural protective reaction, it accepted and approved it in general. Thus, metaverses, virtual worlds uniting billions of people, have turned from the predictions of science fiction and futurists into specific goals written in the roadmaps of IT corporations and big business startups. Here it is impossible not to draw parallels with the times when computer technologies were just emerging and the discourse was built around the concept of cyberspace and cybernetics in general and the common inspiration associated with it. For what it's worth, an endless series of terms were generated by it: cyber security, cyber crime, cyber war, cyber socialization, cyber metrics, cyberculture, cyberpunk, cyber sports, cybertext, and so on. Now the concept of cyberspace is enshrined in legislation as an environment (virtual space) that provides opportunities for communication and/or implementation of social relations, formed as a result of the functioning of compatible (connected) communication systems and the provision of electronic communications using the Internet and/or other global data transmission networks.

But let's return to the present. The metaverse at this particular moment can be identified as nothing more than a plan, an all-encompassing mega-project, which in its significance for the future development of humanity may become similar to the breakthrough in social and business interaction as mobile phones have become. Among the planned attributes of the metaverse are permanence (absence of the concept of "available/inaccessible" for interaction), synchronicity (existence in real-time), interoperability (functional compatibility) of data, digital assets, and content. As the above concept explains the basics of the metaverse, unfortunately, it is impossible to predict exactly what it will look like. Indeed, we are still in the conceptual stage of the metaverse. If the idea of a metauniverse can be implemented, it is quite likely that it will radically change the behavior of both consumers and companies. So the metaverse does not exist—at least not yet. To date, there is nothing that can be "legitimately" identified as a metauniverse.

In the generally accepted sense, the term metauniverse means a hypothetical fusion of various forms of digital "reality" with, properly speaking, the reality that we consider to be real-world. But officially, there is no consensus on the interpretation of the term metauniverse not only in the scientific community but also does not exist among entrepreneurs, just as it does not exist even where it was generated as an innovation—among IT specialists, which is quite natural. Most often, the metaverse is understood as an amorphous mixture of virtual and augmented reality with the real world. If

we specify by narrowing down the concept to a minimum, we get the following sketch: in virtual reality, the user will be able to go to a clothing store in another corner of the world, try on a T-shirt, buy it, and then receive it by mail in the real world.

Global interest in the metaverse continues to grow as new opportunities emerge to explore its full potential. This is closely related to the emergence of cryptocurrency, and the two will be heavily dependent on each other as both concepts continue to evolve. CoinKickoff analysts analyzed 1.6 million tweets and the 19 most popular meta versions. As a result, the TOP of countries committed to virtual reality was born. The Philippines is one of the biggest enthusiasts for the development of the metaverse, hosting Asia's largest metaverse conference in Manila in May 2022. Their tech community is also becoming one of the continent's leaders, and its startup community is poised to popularize the metaverse in the already popular gaming sector.

Ukraine came in 3rd position. In our country, 54.9% received positive feedback about virtual platforms. In the segment of Ukraine, Google counted 252 search queries about the metauniverse [8].

Bloomberg Intelligence analysts have calculated that the potential of the metauniverse market for the next 10–15 years is a capitalization of 800 billion US dollars. But, we remind you, 5–10 years ago almost no one invested in this sector, moreover, the final potential is unknown. For example, according to the results of the third quarter, the combined monthly audience of Meta services (Facebook, Instagram, WhatsApp, Messenger) is 2.91 billion users. By 2030, analysts predict that at least 5 billion people will have access to metauniverse services! In the future, mobile Internet, cloud technologies, payments, education, financial transactions, property relations, and many other aspects of our lives will migrate to the digital world [9]. The term "Metauniverse" is formed from the Greek prefix. Metà—"between, after, through" and the word "universe". At the same time, its crystallization to the present state began quite a long time ago and was used in parallel with the term "multiverse" in the discourse between physicists, mathematicians, philosophers, cosmologists, science fiction writers, and religious figures. The term "multiverse", however, in a different context, was found in the distant 1895 by the American philosopher and psychologist William James in the rather famous essay "Is Life Worth Living?" In the conventional sense, the term "multiverse" is a hypothetical group of several universes. At the same time, these universes include everything that exists: the integrity of space, time, matter, energy, and information as well as the physical laws and constants that describe them. Different universes in the multiverse are called "parallel universes," "other universes," "alternate universes," or "multiple worlds."

Thus, the commonality of concepts on the main fundamental basis is quite close or coincides. At the same time, the concept of the multiverse is broader and therefore may well include the Metaverse as a certain cluster of technologies. However, the Metaverse cannot be identified by a product or technology—just as the term Internet cannot be identified as a product or technology. The metauniverse is an extended reality that combines augmented, virtual, and mixed reality and is a reality-virtuality continuum that includes all possible variations and compositions of real and virtual objects. Augmented reality technologies are used mainly in virtual social interaction platforms, but their characteristics can be applied in other contexts.

4. Metaverse Projects and Blockchain Technology

Central to the metauniverse concept is the idea of virtual three-dimensional environments that are accessible and interactive in real-time. The metauniverse is expected to have a strong connection with the real economy, eventually becoming an extension of it. In other words, the metauniverse will allow companies and individuals to participate in economic activity in the same way that they have done until now—to create, sell and invest in products, goods, and services. To some extent, such activity as a basis for value creation may rely on non-fungible tokens—unique digital certificates stored in the blockchain that guarantee the exclusive right to any digital good.

If non-fungible tokens become a commonly accepted tool for trading such goods, they could help accelerate the use of augmented reality ecosystems as people visit places to combine elements of the digital economy with their autonomous lives.

The metauniverse project also involves the use of Decentralized Autonomous Organizations (DAOs) as its component—an organizational form in which the coordination of participants' activities and resource management takes place by a pre-agreed and formalized set of rules, whose compliance is automatically monitored. The rules

of the DAO will be fixed and placed in smart contracts on non-fungible tokens.

At the moment, in the USA there are several working examples (Miami—MiamiCoin, New York—NYCCoin, and Austin—AustinCoin) of the implementation of this model by local administrations to the next level—the merging of DAOs into a crypto city on the Citycoins platform, which is based on the Stacks protocol. It allows the use of smart contracts in the Bitcoin network. The model is aimed at providing municipal budgets with additional income at the expense of community members participating in crypto production. The profit from such activity is distributed as follows: 70% goes to the miner, and 30% is credited to the city wallet (Fig. 1).

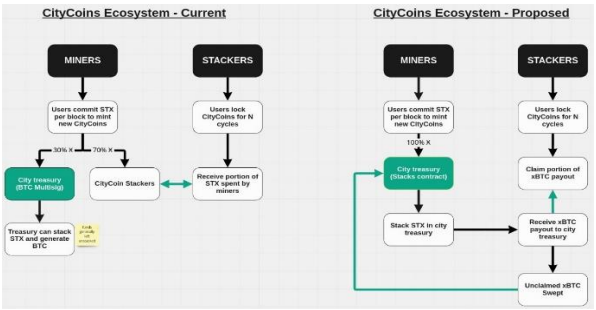

Figure 1: Citycoins Ecosystem platform [10]

For example, Miami, which started first, accumulated 21.6 million dollars in the first three months in STX. Note that participants have the option to view their mining history, including won and/or unclaimed blocks, two examples below for MIA/NYC, where ADDRESS is the participant's address (https://miamining.com/history/ADDRESS) (Fig. 2).

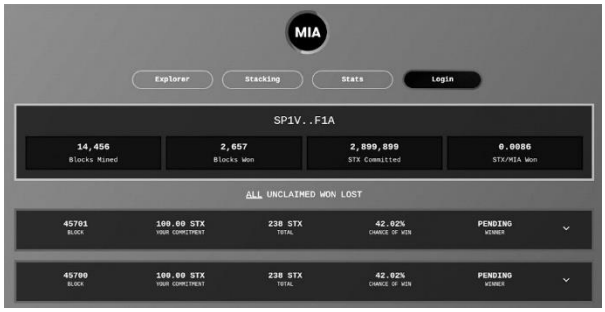

Figure 2: An example of mining history [10]

Therefore, the use of the technologies of the crypto industry allows the identification of the metaverse as a technological megaproject, which, from the point of view of cryptology, is the next big computing platform after the Internet. Blockchain technology is at the heart of the crypto industry. The growth dynamics of the blockchain market are presented in Table 1.

Table 1

Blockchain market growth dynamics [11]

Report Attributes	Details
Market Size Value in 2021	US$ 4.9 billion
Revenue Forecast Size Value in 2026	US$ 67.4 billion
Growth Rate	68.4% CAGR
Key Market Opportunities	Integration Amalgamation of blockchain, Lot, and Al
Key Market Growth Drivers	Increasing Venture Capital funding and Investments in blockchain technology
Market size available for years	2018-2026
Base year considered	2020
Forecast period	2021-2026
Forecast units	Value (USD)
Blockchain Market Segmentation	Component, Services, Provider, Type, Organization Size, Application Area, Regions
Geographies covered	North America, Europe, APAC, Middle East and Africa (MEA), and Latin America
Top Players Covered	IBM (US), AWS (US), SAP (Germany), Intel (US), Oracle (US), Huawei (China), Accenture (Ireland), Wipro (India), Bitfury (Amsterdam), Chain (US), Blockcypher (US), Guardtime (Estonia), Cegeka (Netherlands), Symbiont (US), BigchainDB (Germany), Applied Blockchain (UK), Auxesis Group (India), Spinsys (US), Infosys (India), NTT Data (Japan), Factom (US), R3 (US), Consensys (US), RecordsKeeper (Spain), Stratis (UK), Blockchain Foundry (Canada), Blockpoint (US), Leeway hertz (US), and Dragonchain (US)

As of January 2023, there are between 291,015 and 205,314 Bitcoin transactions per day. 10% of the world's population owns cryptocurrencies. 16% of Americans have invested in cryptocurrency. Using blockchain, financial institutions could save up to $12 billion every year. From 2022 to 2030, the global blockchain technology industry is projected to grow at a CAGR of 85.9 percent. By 2026, the global blockchain market will cost $67.4 billion, and the industrial blockchain market will grow to $85.64 billion.

Table 2 shows the highest distribution of blockchain market value by sector.

Table 2
Distribution of blockchain market value by sector [12]

Sector	Market Share
Banking	29.7%
Process manufacturing	11.4%
Discrete manufacturing	10.9%
Professional services	6.6%
Retail	6%
Others	35.3%

Table 3 shows the global spending on blockchain solutions from 2017 to 2024**.**

Table 3
Global spending on blockchain solutions from 2017 to 2024 [12]

Year	Spending on Blockchain Solutions
2017	0.95 billion
2018	1.5 billion
2019	2.7 billion
2020	4.5 billion
2021	6.6 billion
2024	19 billion

The report of the World Economic Forum gives the following definition of blockchain technology or distributed ledger technology: it is a technological protocol that allows the exchange of data directly between different parties within the network without the need for intermediaries. As we can see, these two terms are used interchangeably, since they both refer to a system of recording and storing information in a transparent decentralized network that does not have a central node that controls it.

However, in reality, blockchain is only one of the options for implementing a network of distributed ledgers, in which data about transactions made is structured in the form of a sequence of linked transaction blocks. Not all distributed ledger networks operate based on blockchain technology. So, for example, the Ripple protocol uses post-transaction processing without the formation of blocks. Due to this, it is less energy-consuming and faster: the confirmation time of a transaction in Ripple in the form of a cryptocurrency is four seconds, while for Ethereum this figure exceeds two minutes, and for Bitcoin, it is usually more than one hour. In addition, the open source allows banks, payment systems, and financial companies to embed Ripple protocols into their systems, which in general explains its success in the current financial system.

5. The Potential of Blockchain for the Global Electricity Industry

Thus, the further development of the Metauniverse concept involves both the development of computing power and the crypto industry, the central problem of which has become energy consumption. Indeed, if Bitcoin were a country, it would be among the top 30 energy consumers in the world, sandwiched between Norway and Argentina. At the same time, together with other cryptocurrencies, electricity costs are estimated to range from 1 to 1.5% of global consumption. Another 1% of global data center energy consumption doubles this figure. If you add another 3% of global consumption of computers, routers, modems, and other digital devices that are in the hands of the population, the figure will exceed 5%. And together with supercomputers—6%, which in general, according to the International Energy Agency, exceeded the forecast global value (5%) of growth in electricity demand in 2021.

If in February 2012, the size of the Bitcoin blockchain was 1.02 gigabytes, then as of January 2023, its size is 448.57 gigabytes, and the price of Bitcoin was $20,889.90 [13].

Figure 3: Image credit

21 million Bitcoins can exist at any one time. As of 2023, almost 90% of bitcoins have already been mined. It is predicted that the last Bitcoin will be mined in 2140. One Bitcoin transaction consumes 2,188 kWh of energy. Comparing this to VISA transactions, 100,000 VISA transactions consume 148.63 kWh of energy.

Distributed energy and the development of digital technologies are among the seven technological directions identified by the world community that forms the basis of the Energy Transition. Distributed ledger technologies, on which distributed energy is based, became the main trend of the digital revolution in the global energy sector very recently, (2016) when the works of several international experts were published, in which the potential of blockchain for global electric energy was made public.

Unlike most financial blockchain solutions, classic solutions to provide a decentralized alternative to traditional products and services in the electric power industry (democratization of the electric power industry) most often occur to expand the range of market participants and connect new players to it in the following way. The middleman is removed from the energy value chain, and communities, consumers, and producers are empowered to transact and negotiate with each other independently and directly.

Most of the energy blockchain projects that have been implemented or are in the process of being implemented are related to the Energy Transition and renewable energy sources and, accordingly, are located in developed countries or are identified by their authorship, which is directly related to the long-term promotion of the importance of "green" electric energy at the level of civil society, and active subsidization by the state.

Thus, according to the results of 2019, the International Agency for Renewable Energy Sources managed to count 234 similar projects: in the USA—21.4%, Germany—9.4%, Great Britain—6.4%, Australia—5.6%, Japan—5, 6% to which a total of $598 million was directed [9]. The projects were classified by direction as follows: peer-to-peer trading of electricity, management of the electric network and provision of system services, financing of "green" projects, management of environmental certificates, and charging infrastructure for electric vehicles.

Projects with the most pronounced social direction were implemented in the sector of electric network management and the provision of system services. The Spanish project CONFIA can be called the most typical here. In 2019, the Municipality of Málaga, the company Endesa, and the University of Málaga launched a project to protect the vulnerable population from energy poverty by indirectly subsidizing electricity tariffs in the form of a 25–40% discount on the consumption bill. Normally, this is a slow, inefficient, and time-consuming process for all parties involved. Within the framework of the project, all communication related to the arrays of information on accounting of outages, debts, and payment terms between all parties participating in the process (social services of city councils, regional communities, electric power companies, citizens) was automated.

Technically, the blockchain system was built on a distributed network platform where all interested parties exchange encrypted information in real-time. In July 2021, the IBM CONFIA blockchain platform was launched. Territorially, 7 municipalities and 35,000 recipients are covered, from which 2,100 vulnerable households have started receiving assistance.

€400,000 were spent on the development of the software, of which 61,000 were grant funds, and 115,000 were a long-term loan from the public-private partnership Corporación Tecnológica de Andalucía [14].

In the sector of peer-to-peer electricity trading, the large-scale Enerchain project deserves special attention—a decentralized platform for trading electricity in the over-the-counter market, which aims to transfer the entire cycle of transactions to the blockchain and allow the entire ecosystem of service providers to connect to the platform. On such a platform, various participants can interact in real-time—from generators, traders, energy sales, and energy supply companies to network organizations, consumers, and prosumers.

6. Conclusions

Thus, the implementation of the project opens up free access to the energy market for small producers. They get the opportunity to sell energy to other network participants with low transaction costs, which significantly increases their competitiveness. At the same time, the role of third parties, including retailers, is reduced, and smart contracts increase the automation of processes that previously required significant manual labor and the participation of a large number of parties.

Therefore, it can be argued that distributed ledger technologies can not only be energy-consuming but also bring significant savings in energy resources, significantly influencing the reduction of energy poverty. In addition, based on blockchain technologies, it is possible to fully automate the work of social and communal institutions that work with vulnerable segments of the population.

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