

## Evaluating The Sustainability of Bitcoin

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### Article Info

Page Number: 139 - 151

Publication Issue:

Vol 71 No. 3 (2022)

### Abstract

The past decade has seen a massive financial upheaval due to the recent developments in the FinTech. Bitcoin has become a catchphrase and one of the most searched word over the internet. There has been a bitter debate across the globe between the supporters and the antagonists of the bitcoin, many believers of bitcoin feel that the cryptocurrency will successfully replace the fiat coin, while others call it a too long a shot.

Should the bitcoin replace the fiat currency? That is more appropriate question for the policy makers and the economic thinkers, however, this article shall attempt to identify how sustainable the bitcoin and the underlying technology could be. The bitcoin will have to prove to be a successful replacement in various parameters in order to replace the fiat money or come closer to it. Though, sustainability is a very wholesome term and encompasses various critical factors, this article shall try to limit its research only to the Environmental, Economical and Social. Further, the researcher does not propose this article to be one 'Fiat currency V. Bitcoin', rather, this article focuses only upon the sustainability of the bitcoin as a medium of exchange upon the stand alone basis. Though, some analogies or comparisons may come out between both, but same will be only to understand the nature of bitcoin better and how close could it be to being the money.

**Keywords:** - Bitcoin, sustainability, financial inclusion, environment, energy.

### Article History

Article Received: 12 January 2022

Revised: 25 February 2022

Accepted: 20 April 2022

Publication: 08 June 2022

### 1. **Background-** 'Chane is the only Constant'

Since the inception, money has undergone numerous changes, in terms of appearance, composition, process, size etc and technology has been the predominant player in evolution of money<sup>1</sup>. Barter, commodity, gold, metal, IOUs (bank's I Owe You), paper notes, plastic cards and the recent electronic money. How sustainable it is? this key question has always been the bedrock of the evolution of money. For clarity, money here is not used in the sense of a legal tender as both are overlapping, yet different. All these transformations in the money have been brought by the sustainability of its given form, at relevant period of time. All forms evolved in order to present a

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more appealing and a more sustainable money. However, one thing is sure, that money has never remained the same and has persistently changed itself to suit the needs in a better way<sup>2</sup>. Has the time come for another change?

It was 2008 when the world across was shaken by the debacle of financial sector, led by American banks. The financial failure led to loss towards trillions of dollars, public wealth and trust was eroded<sup>3</sup>. Trust is the key factor which differentiates a money and a legal tender<sup>4</sup>. Legal tender inspires confidence as it is backed by the sovereign and money relies upon the overall trust market puts in it, like the bank cards, which are though money, but not legal tender<sup>5</sup>. Not only cards, we have store credits function as money such as in wall-mart chains you could earn credit points and redeem it at any of its branch across the globe and it acts as money. So, the trust is the key driving factor behind a success story of money. In October 2008, when people had started losing trust in the prudence of big financial institutions<sup>6</sup>, it was perfect time to sneak in a new money, the bitcoin, the founder of bitcoin, Satoshi Nakamoto, a pseudonym, used by a person or a group, released a white paper called "Bitcoin: Peer to Peer Electronic Cash System" and the world was never the same place<sup>7</sup>. Bitcoin picked like a wild fire and spread its wings across the globe, much on this will be discussed in later parts of this paper.

The term cryptocurrency was originated, in 1998, by a China based computer engineer Wai Dei<sup>8</sup>, however, the term got real popularity only after release of bitcoin. Bitcoin is made of two words 'bit' and 'coin', a coin which exists only in the form of internet digital bits, therefore, bitcoin has no physical form, much like the electronic money. Bitcoin works upon a system of operating nodes across the globe and is generated by a process called 'mining' using mathematical algorithms, having no central control, just like gold and IOUs<sup>9</sup>. Bitcoin rests on the premise of solving the safety issues related with the banks and the institutions, the reason for change in form of money. Also, it relies heavily upon the trust of the market players, just like debit, credit cards, store credits and travellers cheques<sup>10</sup>. Some believe money has taken yet another form, but, each form has been tested on the touchstone of its sustainability. In fact each form of money too came out as a reaction to weak sustainability of financial system. This brings us to the key question, is bitcoin sustainable?

Sustainability, a complex term, is the quality of the money to maintain itself over a given point of time. Therefore, it is must that any study of sustainability must restrict itself to certain standard parameters of given point of time. In respect to bitcoin, this paper focuses on three parameters, environmental, economic and social parameters only. Researcher shall try to assess the sustainability of the bitcoin and cryptocurrencies in general for coming future.

## **2. Environmental Stability**

Bitcoin works on a complex system of mining. The process of mining is one through which new bitcoins are minted and also the transactions entering the bitcoin framework are authenticated in a chain forming blocks of transactions called the block chain<sup>11</sup>. The chief process of mining in bitcoin is also known as the Proof of Work. Proof of work, PoW, is a kind of computer mechanism which is the underpinning technology behind the unanimous success of the bitcoin<sup>12</sup>. Every time a bitcoin is mined or a transaction is performed on the bitcoin, the computer generates an algorithm based upon the hash function of the previously mined bitcoin or the transaction approved. The algorithm used by the bitcoin is SHA-256 algorithm, this algorithm was first invented by NSA, USA<sup>13</sup>. The proof of

work is designed in such a way that the energy and computing power required, with each succeeding transaction/mining, keeps escalating<sup>14</sup>.

*A. Energy Consumption of Bitcoin:* During the initial years of the bitcoin, the mining could be done easily by regular computers and notebooks, however, the reward have decreased over the time and the efforts and computing power required for same has increased manifolds. This increasing competition is known as ‘network difficulty’<sup>15</sup>. A peer reviewed study has revealed that the mining process of bitcoin alone consumes around 2.55 GW of electricity, which is sufficient enough to power the whole Nation of Ireland for a year<sup>16</sup>. Also, it expressed the concerns about the amplification of such energy consumption, at a doubling rate of 6 months. When this figure of energy consumption is compared to the countries, it reveals a shocking state of affairs, as bitcoin mining alone surpasses the energy consumption of more than 175 countries in the world including 20 European countries<sup>17</sup>. It has been calculated that bitcoin mining consumes on average 30,582 MW of electricity per month, taking 400 transactions per second as the base for calculations<sup>18</sup>. Cambridge University has stated that the bitcoin mining has led to the rapid consumption of electricity in the past decade and the bitcoin mining alone consumes around 132 TWH energy each year, which is nearly 0.60% of the global annual energy consumption<sup>19</sup>. Bitcoin mining activity alone contributes to the 13% annual electricity consumption of the Turkey. According to another index, the cost of the energy consumed in bitcoin mining is around \$1.86 billion per year which is supposed to reach \$200 billion in coming decade<sup>20</sup>.

Further, more energy is required to keep these computers cool using large fans and ACs which will also account for its own energy consumption as well as releasing heat in the environment, that is one reason why most of the biggest cryptocurrency farms have found locations in the coolest countries of the world like Scandinavia, Iceland, Canada, Ireland, Russia and Sweden<sup>21</sup>. Also, the bitcoin mining has been found to be highly contributing towards the air pollution, as per a survey, the China and India accounts for the most number of deaths caused due to air pollution in the world<sup>22</sup>. Another survey reports that the China, due to its cheap electricity rates, is a favourite destinations for the bitcoin miners and almost 58% mining of the bitcoin is conducted through the China only which highly depends upon coal as a source of energy and thereby causing high air pollution<sup>23</sup>.

*B. Carbon Emissions Assessment Vis-a-Vis Present System of Currency:* carbon foot printing is another way of assessing the impact upon the environment by the bitcoin and related activities. As per a study published by the Harvard, it is estimated that annual activity generates CO<sub>2</sub> within the ranges of 21.5 to 53.6 Mt which is equivalent to the emissions generated by Portugal and Bolivia. The ten year estimated range of CO<sub>2</sub> emissions generated by bitcoin related activities have been estimated to be around 212 CO<sub>2</sub>Mt, which is equal to the CO<sub>2</sub> emitted by the recent Australian bushfire. Just for comparison the US alone would contribute around 5269 CO<sub>2</sub>Mt in a 10 year horizon and in the present scenario, the whole cryptocurrencies would generate around 1% of the global CO<sub>2</sub> emission<sup>24</sup>. Now if these figures are compared against the costs and carbon footprints of the present system of currency production, the figures are rather surprising. As per a research published in year 2014<sup>25</sup>, the data is presented below in two figures. Though the study was conducted in year 2014, therefore, the data presented in the research report are fine tuned for present times and therefore present a different picture than the original research. While the bitcoin figures represent real time data available as of today, the other data such as gold, banking, currency have been adjusted according to

inflation and a 10% increase has been adjusted, considering the lapse of 6 years since original publication, while the energy emissions have been increased by 5% only.

Type of currency	Yearly cost in Dollars (Gross)
Mining and recycling of Gold	160 Billion
Paper currency minting	31 Billion
Banking system electricity consumption	60 Billion
Banking system (All expense)	2050 Billion
Bitcoin mining	1.86 Billion

Fig. 1 Total annual global cost of printing the currency and maintaining the banking systems

Type of Currency	CO2 Produced
Paper currency minting	7 CO2MT
Banking system	410 CO2MT
Bitcoin mining	212 CO2MT

Fig. 2: Total annual CO2 Emissions of printing the currency and maintaining the banking systems

The study further concluded that even if the current trend would continue till next 30 years, the costs, environmental as well as economical, would be insignificant in comparison to the existing system of currency printing in the world<sup>26</sup>.

### **3. Economic Sustainability**

The money has constantly undergone significant changes in order to be more and more economically sustainable. This economic sustainability was one of the arguments mooted at the time of the birth of the bitcoin. Therefore, it is imperative for the bitcoin to project itself as an economically sustainable product in order to entrench itself as a viable alternative of the fiat money or to the least, a parallel alternative.

**A.** *Can bitcoin be called a money?* It is very hard to say, given the complexity around the nature of bitcoin. However, chiefly, the money is said to possess 4 chief features, medium of exchange, store of value, standard unit and as a common medium to value things<sup>27</sup>. However, centrally issued or controlled has not been a very peculiar feature of the money as in the past, the banks have been the issuers of money without any central control and in the present too the cards issued by the banks act as money when they are accepted, though, not the legal tender. Therefore, a money could be a mode of settlement and at the same time may not be a legal tender or have any intrinsic value at all like bank cards or currency notes, which do not represent intrinsic value<sup>28</sup>. Cryptocurrencies, on the other hand may act as medium of exchange like bank cards, may not have intrinsic value like a fiat note, may be used a standard to value things like gold as well. Therefore, though not a perfect money, but still, cryptocurrencies do possess some prominent features of money<sup>29</sup>. Moreover, there are many countries which now permit the bitcoin to be used as a mode of payment settlement, legally, though it is nowhere been declared as a legal tender. Therefore, it will be safe to treat bitcoin as a hybrid form of money and its economic sustainability could be then evaluated on this premise.

B. *Is there a demand for bitcoin?* Bitcoin do not rely upon a third party like bank to authorise or settle a payment, rather, the payment mechanism is quite direct peer to peer and highly swift<sup>30</sup>. As of March 2021, the market cap of the cryptocurrencies stood at a massive \$2 Trillion, out of which the bitcoin alone accounted for more than 50% of the transactions standing tall at \$1 Trillion market cap<sup>31</sup>. A study published by the Bloomberg quint in year 2017 projected that the bitcoin will face an upward trajectory in the coming years and could reach a market cap of around \$ 3.5 Trillion by the year 2028<sup>32</sup>. Also, the companies accepting the bitcoins as a mode of payment are also increasing day by day, recently big giants like Google<sup>33</sup>, Microsoft<sup>34</sup>, Tesla<sup>35</sup>, Overstock<sup>36</sup> etc have confirmed that they are accepting bitcoins as a valid purchase settlement mechanism. As per the number of users around the world, the bitcoin has managed to garner around 70 million users across the world as by March 2021<sup>37</sup> and the numbers are expected to grow. In a country like India, where the govt is ready to ban the bitcoin any moment<sup>38</sup>, the users are mushrooming each passing day and have reached around 8 million by February 2021 holding more than \$1.5 Billions<sup>39</sup>.

C. *Cost to production:* As we have already seen, bitcoin mining is a high energy intensive operation and how miners are shifting to locations which have low energy costs and cool temperatures. A study published by the Harvard conducted a deep research upon the cost to benefit analysis of the bitcoin in coming 10 years and has concluded that return on investment in the bitcoin, taking all factors in consideration is positive and bitcoin would consume wealth around 10% of its market value for production<sup>40</sup>, making it a profitable product despite all costs.

### C. Social Sustainability

Social sustainability of the bitcoin and other cryptocurrencies in general could be evaluated in terms of the social outreach it has and is capable of achieving. Further, its potential in alleviating the social conditions too shall be a standard of social sustainability and ultimately, it will also depend whether the countries across the spectrum are willing to adopt it in their respective jurisdictions.

A. *Social Outreach:* In terms of social outreach and popularity, the bitcoin has broken the internet and has become the highest searched term upon the internet<sup>41</sup>. The bitcoin heavily relies upon the social euphoria and cooperation in its sustenance and thrive. In fact the whole security is based upon the participation by the people in the system and more the number of people acting as nodes, higher the security and lesser the chances of any scam or hack happening in the system<sup>42</sup>. This is also one reason why some people call it a truly democratic currency as well<sup>43</sup>. Bitcoin and the blockchain technology is receiving massive attention from the public and the institutions across the globe and many countries, states and institutions are looking for ways to incorporate the bitcoin or blockchain into its system<sup>44</sup>. A study published in Journal of Transitional Management concludes that there exists a positive co relation between cryptocurrency, mobile phones, internet and financial sustainability<sup>45</sup>. A survey conducted by the Statista reveals that there are around 3.6 billion mobile phone users across the globe, making it around 40% of the population of the world. Therefore, around 60% of the population still remains aloof from a mobile phone, however, these numbers are expected to escalate to around 5 billion by the year 2024<sup>46</sup>. Therefore, almost 75% of the population shall be connected through mobile phones by next three years, which will ultimately make digital finance more accessible to people. Internet users too are in great numbers today, as per another survey conducted by the Datareportal, there are around 4.72 billion active internet users across the globe and out of them around 93% access it through mobile phones<sup>47</sup> only-a perfect recipe for bitcoin soup.

*B. Bitcoin, A Criminal Tool?* As a common feature with each new technology, the Bitcoin, too, has also gained notoriety for being the new favourite of the anti social and anarchist elements<sup>48</sup>. Various ransomware attacks have been conducted across the globe seeking payments in the bitcoin<sup>49</sup>, the infamous silk road scandal of the US also brings out the potential misuses the currency could be used for<sup>50</sup>. Many other concerns also underline the technology such as terror financing, cross border parking of funds, money laundering and tax evasion, however, all these have always been associated with any form of the money, but the bitcoin has certainly raised to concerns to the new level, mostly because of its unregulated nature and the amount of anonymity it provides to these transactions. Though the anonymity provided is not absolute in terms and rather the transactions are much transparent as each movement is tracked upon a public ledger, still the improvement in the KYC norms for opening up the accounts with the wallet service providers and adherence to the Anti money Laundering Codes will do good in allaying the fears associated with this Fintech. However, the report published by Forbes in 2021 shows that the total share of cryptocurrencies in criminal activity is around 2.1% of the total cryptocurrency use which fell to just 0.34% in year 2020<sup>51</sup>. However, in contrast, 3-5% of global fiat money used for money laundering activities, as per the UN report<sup>52</sup>. Another report by Asia Times suggest that use of fiat money in money laundering could be around \$ 2 Trillion in a year and only a small fraction of it uses cryptocurrency<sup>53</sup>. Another report published by Financial Advisor points out that fiat currency is used 800 times more than the cryptocurrency for criminal activities<sup>54</sup>. Considering these data and research reports, it could be said that bitcoin and cryptocurrency do not pose any threat, bigger than fiat currency, when it comes to crime and related activities.

*C. Social upliftment through bitcoin?* Bitcoin has also been seen to be positively associated with uplifting the GDP of the countries with a study published in Japan pointing towards positive correlation between the bitcoin popularity and the consumer demand. The study suggested that the bitcoin alone added a massive \$28 Billion towards the wealth of the land of the rising sun and has resulted in the spike in consumer demand by nearly \$855 Million, which is 0.3% of the total Japan GDP<sup>55</sup>. It needs to be mentioned here that Japan has more than 3.5 million bitcoin user in the country and houses one of the world's biggest bitcoin exchange, Mt. Goax<sup>56</sup>. Another report commissioned by Mckinsey suggested that inclusion of the digital currency in the national economies could boost the GDP of emerging countries by around \$ 3.5 Trillion by year 2025 resulting in a 6% boost in the GDP of emerging countries<sup>57</sup>.

*I. Financial Inclusion:* Connecting the unbanked with financial services is another area where cryptocurrencies such as bitcoin could shine really very well. It is believed that there are around 2 billion people who remain to be unbanked even till this day, the numbers are alarming and making banking services available could involve huge infrastructural costs, though, it is said that 2/3<sup>rd</sup> of these unbanked people hold smart phones and have access to internet<sup>58</sup>. India too is struggling on this very aspect and it is reported by the World Bank that India has around 20 crore adult people as unbanked, even despite a massive Jan Dhan Yojna and Direct to Account schemes initiated by the Indian Government, almost half of all accounts remain inactive<sup>59</sup>. Trust factor has also been an important indicator in general population's discord with the banking services<sup>60</sup>. However, if we compare the trust deficit between the traditional banks vis-a-vis the cryptocurrency, the cryptocurrencies have a long, long way to cover as only 48% people presently trust the bitcoin as stated by a research<sup>61</sup>.

However, it is understood that the cryptocurrency and market currencies are slowly gaining the trust, going by the increase in number of crypto account holders. Facebook, which is trusted by billions user across the globe, is trying to introduce 'Facebook Libra' as another digital currency and the ultimate aim is to increase financial inclusion<sup>62</sup>. A recent study published by Block Chain Centre of The Frankfurt School in 2019 suggests that the cryptocurrencies could open the door of finance to the unbanked people as it does not require great infrastructural changes and only requires mobile phones and network connectivity, which is rapidly increasing day by day<sup>63</sup>. Confidentiality and the integrity provided by the platform of the bitcoin is another factor which could propel more people to enter into crypto-money wallets. Another study commissioned by the Committee on Economic and Monetary Affairs of European Parliament suggests that Virtual Currencies could hold a true potential in the future and suggested that banning cryptocurrencies would not be a correct approach<sup>64</sup>. Recently iSPIRIT, a technology think tank, suggested that the inclusion of cryptocurrency could boost the financial access to the SME (Small and Medium Enterprise) through out the country and believes that cryptocurrency hold huge promise for India in coming years<sup>65</sup>.

*II. Global Remittances:* Further, the bitcoin could have a very decent market for the global remittances as well. Global remittance, a \$500 Billion a year, industry is suffering from the monopoly of only two companies<sup>66</sup>. A commissioned by the European Union has suggested that remittances through cryptocurrency is expected to save 10-15% of the principle amount, as commissions, and to bring down the remittances time from some days to some hours or minutes<sup>67</sup> due to the lightening speed of transactions. Taking the case of India, it is reported that India on average receives around \$75-80 billion in remittances, each year<sup>68</sup>. There are various start ups and companies across the globe which are now making the remittances through the bitcoin a possible feat. Abra, in America, provides peer to peer bitcoin remittances in US Dollars spreading across 150 countries<sup>69</sup>. The future of Abra look promising as it has found investors like Ratan Tata and American Express<sup>70</sup>. African countries are not behind and BitPesa<sup>71</sup>, an African company, is providing services, similar to Abra, in African nations. Bit2me<sup>72</sup>, Rebit, Stellar<sup>73</sup>, Bitspark, Volabit are other such companies which are assisting people with remittance through cryptocurrency<sup>74</sup>.

*D. Global Reception:* In terms of global reception, the bitcoin is gaining popularity each passing day and more and more countries are coming forward to adopt, allow or permit the use of the cryptocurrency. The figure below will present the picture of bitcoin reception and acceptance across the globe.



Fig 3<sup>75</sup>: The status of bitcoin acceptance around the world.

Further, this positive attitude of the govt reflects heavily upon the consumer acceptance of the bitcoin, leading to a rise in its popularity<sup>76</sup>. Mogo, a financial technology company has recently reported a 141% increase in the new accounts for the cryptocurrency in month of January 2021 as compared to December of the previous year<sup>77</sup>. In 2017, Venezuela became the first country in the world to launch its own cryptocurrency, Petro<sup>78</sup>. In 2021, China has become the first major country to release its own cryptocurrency<sup>79</sup>, meanwhile, various other countries across the globe are planning to launch its own cryptocurrency including Russia<sup>80</sup> and UAE<sup>81</sup> among some of those. Even Reserve Bank of Indi, which has suggested a ban on the cryptocurrency in India, plans to launch its own cryptocurrency<sup>82</sup>. Further, the ever increasing size of the blockchain evidences the deep entrenchment of the bitcoin in the society at large which has reached to a mammoth size of 300 GB<sup>83</sup>.

E. Security through bitcoin? the social audit of the bitcoin and its sustainability would not be complete unless the security protocol of the bitcoin and how potent could it be to prevent against cyber attacks is undertaken. *Fork* is one such security challenge that bitcoin must address, though, it is a rare situation but increase in number of users and transactions could see more forks occurring. Fork is a situation where miners start their own separate blockchain, from the existing blockchain, though the situation is not common, but needs to be addressed<sup>84</sup>. The bitcoin system also relies heavily upon the honesty of the players involved, which may not be a good idea at all. A study has reported that if 51% miners group together than bitcoin protocol is prone to hacking and scams and one of the easiest way it to bribe the miners to reach a different consensus upon a transaction and nullifying a valid block or authenticating a null block<sup>85</sup>. Also, the network speed is also another issue with the bitcoin protocol. Due to its inherent protocols, the network speed is restricted to 4-7 transactions per second, which is highly slow when compared to the 1700 transactions per second of Visa or Mastercard<sup>86</sup>. Further, the password protection is another security issue associated with the bitcoin protocol, as the bitcoin does not have any central authority, there is no repository of the passwords of bitcoin accounts, thus if a password is lost, it is lost forever and the bitcoins shall be lost forever and it is estimated that around 20% of all bitcoins are forever lost due to such reasons<sup>87</sup>. However, this problem can be solved through setting up account via wallet service providers which could provide ways to recover forgotten passwords. Cyber attacks of the exchanges of the bitcoin poses another security threats, in 2015, the MT Gox, a bitcoin exchange was attacked and bitcoin of almost \$460 Million were stolen<sup>88</sup>. *Poloneix*, lost around 13% of its bitcoin volume due to an attack in 2014<sup>89</sup>, Bitfinex, too suffered a similar attack and nearly 120000 bitcoins were stolen, valuing around \$60 Million<sup>90</sup>. However, each form of currency has suffered such attacks, a report conducted provided the data about the total value of fraud in cryptocurrency, fiat currency and gold and suggested that fraud in bitcoin is negligible in contrast to the gold and fiat currency<sup>91</sup>.

#### **D. Conclusion**

Bitcoin came out as a financial revolution and has brought another futuristic technology, the blockchain. However, it has been found out that the process involved in the bitcoin and blockchain are highly energy extensive and require great computing powers, which is a heavy burden upon the environment as well as participants. It is very difficult to believe that bitcoin will sustain itself in the longer run depending upon the present form of energy consumption. It is advisable that the bitcoin must shift to alternative methods to authenticate the transaction. Proof of stake and Proof of Authority are two such method which could bring down the energy consumption required in the process of

mining by huge numbers and it is estimated that shifting to PoS could bring down the energy requirements to almost  $1/6^{\text{th}}$  of the present which is more than 80% reduction.

Further, the alternative modes of the mining involving use of renewable energy sources such as solar energy, wind energy etc is the only apparent solution. It is estimated the around 50 % of the electricity, by year 2040, would be by the renewable sources only. Alterations into the security protocols of the cryptocurrencies would be a welcome change and go a long way in establishing cryptos as a trusted method of payment settlement.

Legal positions across the globe are expected to become more clear in the coming quinquennial and therefore further research would provide a better scope about the social sustainability of the cryptocurrencies. However, despite all the odds, the bitcoin has been growing by leaps and bounds. Also, it has brought together host of evangelist technologies. The acceptance of the bitcoin by global companies such as google, tesla, Microsoft have led the credibility to the financial innovation which is further boosted by the welcoming stances of advanced countries such as USA, UK, Canada and France to name a few. It seems that bitcoin will continue to grow in more spaces in the coming times as suggested by various researches. Timely researches and audits are required to make the situation more clear.

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