

Chi: A Monetary System for the Planetary Era

<https://social.network>*

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Abstract

The planet as a whole is a living self organising system. If we look at the evolution of organic life across time, it is only when we develop systems to scale our network sizes that allow for breakthroughs in the evolution of life. For example, it was not until language was developed that humans for the first time could communicate information across generations, progressing their intelligence past all other species. Agriculture, religion, culture, and financial markets were invented merely for the reason of scaling the human social network sizes without collapsing into disorder and chaos.

Over the past two decades, humanity has witnessed the size of their social network grow to populations greater than the largest nation states. Over half of the worlds' population is now connected through online information networks, and the complexity of coordinating this many people risks collapsing society into chaos if not properly managed. At this scale, it is important that the governance, economic, and social systems of the network are at least as well thought out as the most advanced nation states. This paper will outline an alternative architecture for the global social network in order to meet the needs of this new scale of human society and enable human life to evolve.

1 Government

In all of human history, systems of government have developed to meet the needs of their time. Ancient Egyptian Pharaohs, Greek Democrats, Chinese Emperors, European Kings, and American Presidents all had one thing in common - their system of governance only worked so long as the people in power value the principles of the system more than they value their own desires. The more this is true, the more successful the system will be. On the other hand, when the people in power are not aligned with the principles of the system, that system will fail and the society tends to collapse. The current system used by a majority of the world, is largely based on the principles of the United States Constitution which is fundamentally driven by four assumptions - central government, standing armies, rotating office, and the executive branch. We will take a look at these now.

1.1 Decentralized vs. Centralized Systems

In 1787, the Confederation of America had just ended a large war, and was in dire shape. War debt, unpaid soldiers, depreciating currency, and a slew of other issues caused a battle between anti-federalists (decentralists) and federalists (centralists) to design a new system of governance which would later become the United States of America. The anti-federalists claimed that a decentralised governance system would be optimal for the nation, whereas the federalists claimed a centralised governance system would lead to the best outcome.

The most significant defence of central government rests on one crucial premise; that national politicians will be wiser and more far-sighted than state and local politicians, who were said to be "the wrong kind of men", uneducated, unenlightened, lacked foresight, experience, and national

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vision. Nationalists argued that a wise senate would protect the people from being manipulated by fear to see the larger picture.¹ This then became the core reasoning behind not letting people govern themselves.

Fast forward 200 years, and this assumption could not be farther from the truth. With the advent of the internet, access to knowledge has allowed anyone to be far more educated, enlightened, and far thinking than national politicians. The premise that national politicians will attract the best and brightest can be proven false simply by looking at the types of leaders that are being brought to power in democracies across the world. Most modern political parties run massive fear campaigns against opponents, and manipulate the public through fake news and sophisticated psychometric based targeting on social media.

However, this does not mean that central government has failed and that decentralised systems are any better. In fact, decentralisation leads to its own set of problems. The problem of decentralisation is not too much power, but too little. This lack of coordination, makes government ineffective in uniting different members together, and in directing the common forces to the interests and happiness of the whole. This other extreme is playing out in relatively new blockchain governance experiments, where experiments with smart contracts and other on-chain governance systems have raised billions of dollars, and achieved very little non-speculative results when compared to their centralised competitors.

The solution is not to give up hope on centralised systems, but to find a better way of identifying far-sighted, educated, enlightened, experienced, and visionary leaders. This can likely be done more effectively if the population were to determine subject leaders through an online platform, and a governance protocol would determine which subject expertise was required to solve the most pressing problems of society at the time.

1.2 Rotating Executive Branch

Without a strong executive branch, anarchy will occur. This was the principle behind giving executive power to the president proposed by Hamilton in Federalist Paper 70.¹ The problem with decentralising executive power is that it becomes impossible to determine who the responsibility falls on if the execution is split between any more than one person. Or in other words, responsibility is shifted with so much dexterity that the public is always left in suspense to determine who to blame. It is simply much easier to monitor a single executive for good behaviour than any number of executives greater than one. This can also be seen in the various experience with decentralised blockchains, where lack of responsibility and guidance typically leads to a 'social leader' emerging to unofficially lead the community without an official responsibility if things go wrong.

Once the executive branch has been determined, it must then be rotated frequently and disbanded after achieving its goal, which prevents absolute power from straying from the original purpose over time. The current government achieves the principle of rotating office quite well. Currently, elections are typically held every 4 years and congress tends to shift to new priorities with the election of new congress. It could be improved by more transparency on the goals, and by faster rotation of office if the logistical complexity can be solved.

This can be achieved by using a form of blockchain governance controlled digitally by the population. The coordination complexity of reprioritising issues and rotating congress for an optimal solution can be reduced significantly with the right technology. Every member of the society can vote on issues and representatives with their unique cryptographic signature, and a permission-less blockchain can automatically reorganise the senate based off the votes every 7777 blocks. Additionally, it is possible to explore likely more accurate ways of identifying the optimal congress to solve a set of issues with the use of online knowledge platforms, semantic

analysis, and artificial intelligence.

1.3 Small Factions

Madison argued in Federalist paper 10,¹ that ancient democracies and large republics all follow one failing pattern: they plummet society into chaos, lack stability/order, which leads to a demagogue rising up to restore order. America had added some safeguards prior to the constitution, but they did not suffice. The primary danger in democracy is the disorder caused by various factions competing for the reigns of power.

A faction is a number of citizens united through a common interest. The most common factions are the haves and have nots. Those who hold property, and those who do not. Those who have credits, and those who have debts. These are universal factions, and Madison argued that they can not be removed because the separate factions are necessary for survival just as air is to fire. The only way to light the fire is to give it air, but if you give too much air it will blow out the fire.

Therefore, the way to prevent factions from collapsing democracy into chaos is by preventing majority factions. Because majority factions with unchecked power will degenerate into chaos and destroy liberties. In a small society, majority factions can easily dictate to minorities, they simply do not have enough resources to voice a resistance. In a large society, however, many factions exist. So it is likely that no single faction will dominate. The constitution guards against this by creating a republic. People elect wise and virtuous rulers, and these farsighted rulers will guide the people to a long term vision. Wise and virtuous rulers rise to the top, through a representative government.

The original constitution of the United States called for each senator to represent a maximum of 30,000 individuals. However, in 2020 this number has risen to over 770,000 individuals. The good news is that this problem can be solved quite trivially online by implementing the maximum size of community to 77,777 (to account for the increased global population size from the 1800's) and giving each community the ability to elect one representative. Additionally, because there is no restriction on communities that can be created in a digital space, only the top 777 communities (determined by economic factors discussed in Section 2) will have their representatives automatically elected to congress.

1.4 Standing Armies

The truth is, almost every government in the empire era was created to fund war. The Bank of England issued the first bank note to pay off the Kings war debt in 1694, the United States of America created the federal reserve to fund military expenditure, and the list goes on since the 1400's. However, in today's global network economy, we are more connected than ever before. Any country waging war on another is akin to shooting yourself in the foot.

A standing army however necessary it may be, is always dangerous to the liberty of humanity. Soldiers are forced to consider themselves as a body distinct from the citizens. Arms always in hand, their rules and discipline are severe, they are striped to have implicit obedience to their commands, and they become almost inhuman as they are striped from their liberties.

As we move into an era where every corner of the world has been raided and looted for mans pleasure, and our war based economy only guarantees mutual destruction, humanity must evolve its entire economic system to be substantially different from the past.

2 Economics

The current global economy is measured with a 1) currency created to fund war, 2) free markets which incentivize profits in this currency above all else, and has the purpose of creating an endless supply of goods and services that will render Earth unlivable within a few more decades. To fix this, we must revisit these fundamental pieces which form the global economy and how they can be upgraded to meet the needs of the planetary era.

2.1 Currency

The history of modern financial instruments and the origin of modern paper money, really begin with the issuance of municipal bonds (which as mentioned earlier, were to fund war). In addition, this new form of money also changed the role of government; from governments being the rulers of the people, to the people owning the government. The people who owned the national bonds or currencies that were backed by these bonds, would effectively become owed by the government the debt they purchased. The better the governing system, the more attractive the outside interest would be to invest in currency, this incentive meant a healthy competition for governments to produce useful products and services to pay back their debts.

This form of currency became so widespread, and the United States Dollar has since itself as the most valuable currency. Through a mix of trusted financial institutions, healthy financial markets, and worldwide military pressure, it became the currency most used in international business. However, since the removal of the gold standard and the introduction of derivatives markets the trust in financial institutions has fallen. Productive corporations have turned into highly leveraged speculative companies overloaded on debt requiring bailouts by the federal reserve, and the use of military pressure against others have no place in the planetary era.

If one does not believe in the king, the value of his money goes with him. Governments worldwide have reached a point where investing in them returns no value, treasuries yield negative returns, and even the bank interest rates across the globe are negative. Without a solid material base for money, even the most trusted institutions (Federal Reserve, European Central Bank, etc) have lost the peoples trust in their ability to manage debt and fund initiatives that benefit their people equally. The trust in these institutions is gone, and no amount of money printing can fix that.

Throughout history, banking institutions developed trust among other nations and cultures through the universally known fact that gold and silver are finite on the planet, and would therefore always hold their value as a solid material base for money. Therefore, if an institution backed their currency with gold, commerce could occur much easier through this shared source of trust. However, since the removal of the gold standard, the economy does not run on a shared source of trust in a universally agreed upon finite asset. Instead, it now relies on trusting a small groups of bankers. This leads to what has been seen in both the 2008 and 2020 economic collapses; allowing bankers to play god and print infinite money, and bailing out the wealthy while the rest of society pays for it with their life and the future generations potential. As inequality and distrust reach all time highs, this will surely lead to a collapsed economy one way or another.

With the removal of the gold standard, and the introduction of credit and digital banking, the need for paper money has largely disappeared. Talks of a digital dollar are now emerging by central banks across the world. If implemented correctly, this could be a good thing for humanity. Any society that uses a physical asset as money will need to fund a military in order to protect it, including physical gold. If it were possible to create a digital money that was sufficiently decentralised, physical force could not be used to gain control of another's asset. Even with the

cybersecurity issues that may arise it is still a step in the right direction, because the need for military would decrease, and therefore increase the liberty of people worldwide.

The building blocks of this new money were introduced 10 years ago with the invention of cryptocurrency. Bitcoin² successfully demonstrated the possibility of a system of money that operates without needing to place trust in central institutions. Additionally it has a widespread understanding of its scarcity model based on the universal language of mathematics, and exists only in the digital realm. It is an open source software that is run on machines everywhere in the world, secured by hundreds of millions in mining hardware and a game theoretically secure model that transacted over trillions of dollars worth of value in its lifetime.

2.2 Free Markets

Under the free market, we've been asked to accept that the market is a self regulating system. The rising and falling of prices are a force of nature, but simultaneously we are told to also accept that markets rise and fall in reaction to interest rates set by the chairman of the federal reserve. What is wrong however, is the role of military power, because behind the federal reserve is a man with a gun. The government money was used to fund wars which caused a strain on the US gold reserves and forced them to go off the standard. As a result, US military power was the only thing backing up the currency and this system was forced to continue. All dollar bills are federal reserve notes. The arrangement is similar to the Bank of England, but the difference is the banks loaned the bank of England gold, and now the Federal Reserve simply creates the money out of thin air. The banks are no longer permitted to create money, but they are allowed to create virtual money (loans) at a fractional reserve rate (which is current set at 0).

The only reason the system works right now is because no one really knows how it actually works. As the financial crisis came to a head in the fall of 2008, no one knew what kind of derivative related liabilities the other participants had. Our free markets work when participants have good information. The sheer size of the derivatives market is as stunning as its growth. The notional value of over the counter derivatives grew from \$88 trillion in 1999 to \$684 trillion in 2008 to now over \$1.2 quadrillion. That's more than ten times the size of the Gross Domestic Product of all nations. Credit derivatives grew from less than a trillion dollars at the beginning of this decade to a peak of \$58 trillion in 2007. These derivatives are multiplied throughout financial markets, unseen and unregulated. It has essentially become a giant casino where the big banks and corporations always win, and are bailed out by the people against their will causing record high inequality.

The cause of the failure of free markets began when regulatory capture created a government that no longer primarily serves its intended purpose. The ideal government will encourage markets, and only intervene when there is too much accumulation of capital. Instead, regulatory capture occurred when too much capital was acquired and the government began serving corporate interests rather than the people. This excessive capital accumulation began when money was moved off of the gold standard and the introduction of fiat currencies, and the inability for nation states to effectively collect tax on international corporations which hold a majority of the worlds wealth offshore.

To fix the first problem, money must be based and tied to a scarce asset like bitcoin, and enforced to not go beyond a reserve ratio of 10%. To fix the second tax must be collected pro-actively on a digitally connected system, that is aligned with serving the universal purpose of all of humanity. No international corporation wants to pay taxes to a system that is not aligned with their goals, but the purpose of every society should be to build a better world for future generations.

2.3 Purpose

What if there were no creditors and we were all in debt to the system that we are all living in? In a sense this is the natural way of the world. To what do humans owe the Earth that gives us life, feeds us, gives us air to breathe, and a lifetime of experiences? Everything. We do not own this, nor has any human ever owned it. Yet we continue to pretend that we do or that some day we will. This is the basic premise of the entire empire era. And it's wrong.

Humanity has the potential to re-organize society to operate from a place of abundance, rather than survival. However it requires redefining what its society values to be the optimal goal and purpose of life. If humanity does not evolve its thinking to remove the need for military pressure or the need to defend itself from its very self, mutually assured destruction is guaranteed and the human race will not last very much longer. There is no other option than to lay down all arms, recognise this new way of being, and begin to work together as one. A reserve currency does not need to be determined by who has the power to destroy any place in the world by the flick of a button.

Therefore, the ultimate goal must be to evolve all of humanities consciousness. Consciousness emerges at a certain level of complexity that requires a brain and a higher nervous system, and is a particular type of cognitive system. The central characteristic of consciousness is to be aware of one self. The study of Consciousness was long taboo from scientist as it was believed to be part of philosophy, spirituality or religion. But ultimately, it has proved to be the only thing worth striving for. All of our problems can be solved through an evolved form of human consciousness.

The way to evolve human consciousness into the planetary era, requires a dualistic approach. From the bottom up it must incentivise the creative transformation of our world towards the values defined from a top down global set of restrictions to keep the global consciousness aligned with all of humanity. Only then can we reach liberty in it's truest form. As we shift towards a world of abundance, we must restructure our economics to be aligned with what matters most. Nature and happiness. This requires a look at the current state of society.

3 Social Networks

If we look at all of humanity as one united organism, Earth as its vast nervous system, a global brain in which each of us is a single nerve cell. Like nerve cells clustering into ganglion, humans have organized themselves into clusters of communities. Society's slower forms of communication like the postal service are like our relatively slow chemical communication networks of the body. The faster, electronic based telecommunication networks are flashing billions of messages back and forth just like the fibres which link nerve cells in our brain, and our vast data centres of messages, videos, blogs, and other records can be seen as the memory storage of the global brain. The higher order functions like our ability to process information, learn and gain wisdom, are very much like the financial markets ability to gain knowledge and invent new solutions to grow the global intelligence.

The beginning of the next evolutionary jump of humanity began in the 90's when the world wide web was invented as an open place for the combined knowledge of humanity to be stored.³ This was the beginning of a phase transition of humanity to a higher order form of consciousness beyond the nation state structure. The original intention of online social networking corporations usually begin in innocent ways, i.e. as ways to share photos and videos with friends. Once they reach a scale of millions of users and terabytes of data per day collected on their users, they develop artificial intelligence (AI) algorithms to provide better recommendations to their users. As users begin to rely on these features, data collection increases, the AI potentially gets better at providing recommendations, and the cycle continues essentially as a runaway system. Taken

to it's extreme, humanity begins to rely on this intelligent system that make decisions on their behalf.

In the past two decades, a new world war has been occurring. However instead of countries with weapons fighting for resources, technology companies have battled in boardrooms to control the combined knowledge and attention of humanity, and as a result grown more power than even the strongest nation states. By collecting ever increasing amounts of data on billions of people across all borders, religions, and cultures, they are able to influence the largest nation states in the world and earn a profit from it by selling this control to the highest bidder. Without an alternative to capitalism, these social media companies will inadvertently create a AI tied to the wrong incentive, allowing the benefactors of a war based patriarchy to attempt to control an uncontrollable system by man. This will end up destroying all of human society and the very planet it calls home. Therefore, social networks must operate under a new dualistic system that takes a bottom up approach to take care of individuals, and a top down approach to taking care of the planet. Only then will society be evolved enough for this new era.

3.1 Individuals

The term social network means 'a network of social interactions and personal relationships'. Therefore, any internet platform that exists, should be created with the intention of enhancing social interactions and personal relationships. However, current internet platforms organize and exploit human beings for corporate gain, have led to an increase in depression rates, narcotizing dysfunction, and promotes consumerism in the form of games and fandom.

Nearly half of Americans always or sometimes feel alone (46%) or left out (47%). 54% said they always or sometimes feel that no one knows them well. Loneliness isn't just a U.S. phenomenon. In a nationwide survey released in October from the BBC, a third of Britons said that they often or very often feel lonely. Nearly half of Britons over 65 consider the television or a pet their main source of company. In Japan, there are more than half a million people under 40 who haven't left their house or interacted with anyone for at least six months. In Canada, the share of solo households is now 28%. Across the European Union, it is 34%.⁴

The core task of creating a better society is to ask how we can free ourselves from the constraints of capitalism to engage more actively and freely in the creation of community. This can be done by giving people ownership of the means of production, no matter how small their contribution may be. Currently accredited investor and other securities regulations restrict the average person from owning the shares of private companies they may be directly contributing to with their data and attention. Public companies make it more accessible but as discussed in previous sections the current 'free markets' tied to war economies and captured banking have their own problems. We must therefore create a free market where all individuals are equal and eligible to own the means of production, and an individuals investment can be signalled through something representing ones own attention, support, or use of products and services.

3.2 Networks

One of the biggest predictors of physical and mental health problems is loneliness. Human beings are biologically engineered for human interaction – and particularly face-to-face interaction. If there is anything that the coronavirus has shown is how connected we are as a species. We believe to be divided by nations, clans, and religions. But we are all one species unified with the same makeup, who get sick as one, and heal as one. The current social networking platforms benefit from our isolation and are incentivised to keep us online and watching ads. What if instead they benefited from creating physical spaces that were sustainable for both individuals and the Earth?

Networks (groups, communities, cities, or nations) that strive for 100% sustainability of energy, food, and life will be of the highest value. The value of a network is determined by the number of individuals that are able to sustainably live within a community without external resources, and the amount to which they are able to achieve the global goals. Anyone can create or register their existing networks, the networks themselves regulate how individuals can join and leave, and issue a local cryptocurrency to distribute ownership and connect to the open markets if they wish. This allows for both the creation of completely new cities, and the redesign of old ones looking to upgrade to a new society which balances it's needs without limiting the prospects of future generations.

3.3 Global

On October 24th, 1945 at the end of World War II, a network of nation states came together to form what is now the largest intergovernmental organization in the world - the United Nations (UN). The original intention was to promote peace and security and prevent future world wars. But with the turn of the new millennium, the United Nations expanded their role from global peacekeeping to international economic and social cooperation, human rights, freedom, and other roles around building a better future for humanity. They defined a set of 17 Sustainable Development Goals (SDG's) for the world to achieve by the year 2030.

The process for making decisions begins with individuals of 193 nations across the world who elect a governing body. Each nation selects an ambassador to represent their cultures, values, and beliefs during UN meetings and intergovernmental negotiations. The power and trust is propagated upwards to the general assembly, with the intention to integrate the best of every nation and set incentives which will benefit everyone on the planet. Examples of these include the decrease in global poverty by 50 percent in the past 20 years, the prevention of a third global war, equal access to education for girls in all developing countries, and much more.

It is clear that if we do indeed want to design a better social network, the governance structure must be aligned with the best values of our humanity. Therefore, the objectives of the United Nations provide a great place to initialize the network incentives. The downside to this approach is it relies largely on manual slow forms of consensus and organisational structures that do not leverage the availability and scale of digital technologies. That is why the new system will follow a similar approach to determining global goals, but will leverage a new set of tools which enable individuals all entire world to participate transparently, and become shareholders in the result.

4 System Architecture

The Chi blockchain is an alternative to central banking which enables nations, cities, and communities to work towards the global goals. It does this through a combination of governance protocols, economic incentives, and API's for social networking platforms.

4.1 Consensus

In Bitcoin, Proof-of-Work (PoW) algorithm is used to create a global consensus without the need for a central bank. 'Miners' run an expensive mathematical computation with varying complexity to require an increasing amount of computational hardware. This is increasing environmental footprint has the potential to use 7.67 gigawatts in the future (Ireland uses 3.1gW, and Austrailia uses 8.2gW).⁵ For this reason Chi uses a nominated-Proof-of-Stake algorithm (nPoS) tied to the Bitcoin Lightning network to leverage the security and scarcity of Bitcoin, while enabling various other features like smart contracts and on-chain governance.

Block production is done by a set of validators who are nominated according to the BABE protocol. BABE provides slot-based block authoring based on the evaluation of a Verifiable Random Function (VRF). Each validator is assigned a weight for an epoch. This epoch is broken up into slots and the validator evaluates its VRF at each slot. For each slot that the validator's VRF output is below its weight, it is allowed to author a block.

Block finality is useful in order to achieve deterministic consensus on blocks. This is useful for preventing long-range attacks on PoS blockchains, and provides end users with a peace of mind with a shared set of rules for when blocks can be considered 100% final. Finality is achieved using the GRANDPA protocol and occurs when more than 2/3 of the block validators have voted for a particular block.

Both algorithms require at least $2n+1$ non-faulty nodes, where n is the number of faulty or malicious nodes.

4.2 Governance

The blockchain code is represented as a WebAssembly (WASM) library called the runtime. It is placed in the blockchain storage itself, so the network must come to consensus about this binary, and verified to be consistent across all nodes. Additionally, what this allows is the upgrade to a new binary file by simply updating the WASM file located in the storage of already running nodes, enabling on-chain governance.

This allows for the development of a monetary system previously not possible. With the ability to programmatically change the rates of various chain parameters, it allows for fiscal/monetary policies to be more directly correlated with the performance of the markets, or even directly controlled by the population it is intended to serve.

4.3 Economics

Similar to how nation states created their currencies backed by gold, Chi will be backed by Bitcoin. In order to achieve this, each Chi node also runs a Bitcoin Lightning node,⁶ which is queried on the Chi network through a WASM execution environment declared within the same code as the runtime.

Each Chi node will also include a BTC address, which when funds are deposited will mint the corresponding number of Chi tokens set by the governance function (initially set as 10:1). The BTC will then be transferred to the global treasury and stored in cold storage. In reverse, when Chi is deposited into a node, it can be 'burned' which will release the inverse amount of BTC back to the node operator from the treasury.

All systems which depend on resources to grow will always follow some S-curve. They grow and grow until it reaches some carrying capacity. Overshooting the carrying capacity will cause all sorts of problems, as we are witnessing in our world.

4.4 Social Networks

5 Conclusion

Within the 2008 economic crisis an alternative to fiat currencies and central banks emerged. Inequality continued to rise, the environment continued to deteriorate, and humanity now faces an even more dire situation. The 2020 economic and environmental crisis is not only a failure in central banking, but also the failure in government and social systems. Mother Earth has the ability to defend herself from humanity in much stronger ways than what was witnessed with

coronavirus. Climate change, future more deadly viruses, and various other challenges that the 21st century will face will have much graver consequences if humanity does not evolve.

With good Social Networks, we can love humanity. With good Economics, humanity can heal the Earth. With good governance, humanity can have peace. This paper overviews an alternative monetary system that leverages the principles behind Bitcoin and online social networks to create a global governance that works for all life on Earth. Through this, humanity has the potential to become a civilized society and shift towards a better future.

References

- ¹ Alexander Hamilton, J. J., James Madison “The Federalist Papers.” (1788) (accessed 13 March 2020) <http://www.foundingfathers.info/federalistpapers/fedindex.htm>.
- ² Nakamoto, S. “Bitcoin: A peer to peer electronic cash.” (2008) (accessed 13 March 2020) <https://bitcoin.org/bitcoin.pdf>.
- ³ Berners Lee, T. “Information Management: A Proposal.” (1990) (accessed 13 March 2020) <https://www.w3.org/History/1989/proposal.html>.
- ⁴ Cigna “Loneliness at epidemic levels in America.” (2018) (accessed 13 March 2020) <https://www.cigna.com/newsroom/news-releases/2018/new-cigna-study-reveals-loneliness-at-epidemic-levels-in-america>.
- ⁵ Cigna “Bitcoin Energy.” (2018) (accessed 13 March 2020) [https://www.cell.com/joule/fulltext/S2542-4351\(18\)30177-6](https://www.cell.com/joule/fulltext/S2542-4351(18)30177-6).
- ⁶ Cigna “Bitcoin Energy.” (accessed 13 March 2020) <https://lightning.network/#intro,year=2018>.