Blockchain as Social Innovation
How the technology behind cryptocurrencies could support Transformation to Sustainability

Diana Kaliff

Supervisor: Per Olsson
Co-supervisor: Victor Galaz
Affiliation: Stockholm Resilience Centre

Co-supervisor: Jannis Angelis
Affiliation: KTH Royal Institute of Technology

Examiner: Sarah Cornell
Affiliation: Stockholm Resilience Centre
ABSTRACT
This study addresses the need to understand the role of technology in transformation to sustainability, at the same time as evaluating the transformative capacity of the novel, yet under-researched blockchain technology. It relates to the need to evaluate what social innovations holds the greatest promise for sustainability transformation in the light of emerging environmental crisis. It is the first study of blockchain as a social innovation and identifies four mechanisms through which blockchain could support transformation to sustainability and proposes a lack to acknowledge ecological variables in the transformation process. These finding are useful for future studies of blockchain as a social innovation as well as for the development of transformation theory.
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“To our grandparents, who labored and dreamed for us. To grandchildren the world over, for whom we labor and dream” — The Global Scenario Group
1. INTRODUCTION

“The global transition has begun - a planetary society will take shape over the coming decades. But its outcome is in question. Current trends set the direction of departure for the journey, not its destination” - Global Scenario Group

Blockchain technology (hereafter referred to as blockchain) is an emerging, distributed database technology said to have transformative potential (Swan 2015, Mougayar 2016, Gupta 2017). This study looks at this potential from an interdisciplinary, social-ecological systems (SESs) perspective of social systems and ecosystems being interconnected to the degree as to representing one system (Folke et al. 2002, Folke et al. 2010). The SESs linkage is increasingly important because of alarming anthropogenic pressure on the planet, such as climate change, threatening the future of human well-being (Chaffin et al 2014). Heinberg (2017) argues that overshoot caused by systemic issues in sectors such as e.g. production, energy, and finance is the root cause and climate change only being a result and calls for systemic transformation.

In this study, transformation is defined as “the capacity of people in a SES to create a new system when ecological, political, social or economic conditions make the existing system untenable” (Walker et al. 2004). This requires an understanding of the agency needed (Westley 2013) and how blockchain could support transformation to a sustainable, just and equal society (Westley et al. 2017). Blockchain has transformative potential for transactions similar to how internet transformed communication (Swan 2015, Mougayar 2016, and Gupta 2017). The technology is hyped (Michelman 2017) and often claim to hold great potential for sustainability (Hannam 2016) despite only a few hundred academic articles dealing with its implications (as of January 2018). The objective of this study is to contribute to the development of SES transformations theory by analyzing a rapidly emerging novel technology through a transformative social innovation framework, answering research question one;

1. To what extent can contemporary blockchain cases be regarded as having transformative capacity?

And contribute to the general understanding of blockchains transformative capacity through research question two;

2. Through what mechanisms can blockchain support transformation to sustainability?
2. THEORETICAL BACKGROUND

This study builds on SESs research, particularly the field of transformation to sustainability and transformative social innovation. Sustainability entails “prosperous social, economic and ecological systems” Folke et al. (2002). Transformations theory provides insight into what processes need to be addressed for a SESs system to transform. The transformative social innovations framework provides a tool to evaluate transformative capacity of contemporary innovations and thereby identifying mechanisms that could support transformation. Theories and underlying assumptions contributing to this study are presented below.

2.1 Social-Ecological Systems (SESs)

“For every complex question, there is an answer that is simple, elegant and wrong.” – Venkatesh Rao

SESs research recognizes the important linkage between social and environmental aspects of resource systems (Folke et al. 2002, Olsson and Galaz 2012, Chaffin and Gunderson 2015). This linkage is viewed as non-linear (Galaz 2014) and provides a more solid picture of the dynamics, complexity, and uncertainty inherent in the SES (Chaffin and Gunderson 2015). SESs research is based on resilience theory and represents a “forward looking vision of
“sustainability” where people can alter their SESs actively to achieve sustainability and not only change as a reaction to crisis (Barnes et al. 2017). The need to address sustainability issues derives from alarming anthropogenic pressure on the planet to the degree of risking human well-being (Chaffin et al 2014). One example is climate change that threatens the capacity of SESs to “support traditional livelihood systems such as farming” (Barnes et al. 2017) as a result of crossing thresholds in e.g. the global carbon cycle that could cause irreversible changes at global scale that are reinforced by new feedbacks (Rockström et al. 2009). Embedded in SESs research is the field of transformation focused on how these unsustainable trajectories could be altered towards sustainability (Liu et al. 2007, Rockström et al. 2009). Because of its origin in resilience theory, originating from the field of Ecology, Cote and Nightingale (2012) argues that application to societal change has certain limits and that the role of power is often ignored.

2.2 Transformation to Sustainability

“What we are doing to the forests of the world is but a mirror reflection of what we are doing to ourselves and to one another” - Mahatma Gandhi

SES research provides a useful approach to transformation (e.g. Moore et al. 2004) since unsustainable trajectories are created in the complex interactions of social- and ecological systems (Abson et al. 2017). Transformations theory apply a needed systems approach since narrow perspectives risks solving contemporary issues at the cost of future generations or moving issues from one sector to another (Olsson 2017). There are however difference of opinion and unclarities regarding what a transformation entails (Moore et al. 2014, Barnes et al. 2017). Walker et al. (2004) define transformation as “the capacity of people in a SES to create a new system when ecological, political, social or economic conditions make the existing system untenable”. This results in apparent normative challenges such as; who decides what aims that get prioritized in the transformation and new system? (O’Brien 2012). Olsson et al. (2017) presents a visionary aim of transformation where negative human impact is not only minimized – but shifted toward being a positive force on the planet. It is important to emphasize that the transformation concept is contested, related to the statement that no SESs transformation has yet happened (Brand 2016). Despite this, there are common patterns in historical transformations that can be studied (Westley et al. 2013, Moore et al. 2014, Westley et al. 2017)
The following sections provide an overview of processes that need to be addressed to achieve transformation to sustainability, including: Institutions, Knowledge, the SES properties of Cross-scale interaction, Feedback and path dependencies, and a new focus on Reconnection to biosphere. The aim is not to provide a complete overview or to emphasize the division of the processes (they are very much connected) but to present some of the key concepts most commonly associated with SES transformation.

**Institutions**

Transformation require changing norms, rules and regulations in order to achieve behavioral changes. This includes changing and challenging the institutions that maintain them. (Westley et al. 2003, Barnes et al. 2017) “Human societies organize themselves through institutions – the structures that make societal interactions predictable and guide human action toward collective goal” (Abson et al. 2017). Institutions can be formal like laws, regulations and agreements, or informal such as customs or code of conduct. Institutions are important but difficult to transform since they are maintained by reinforcing feedbacks (Abson et al. 2017) and can actively resist necessary changes (Gunderson and Holling 2002). One example is contemporary institutions’ limited incentives for sustainable innovations in the business sector. The focus on externalizing costs and maximizing shareholder value links sustainability goals to competitive benefits that reinforce the “growth-oriented regime” and limits companies’ capacity to operate transformations. (Westley et al. 2011) The concept of transformation includes decentralization of power (Folke et al. 2010, Olsson et al. 2014) and inclusion of diverse stakeholders (Olsson 2008) to create more sustainable SESs. Barnes et al. (2017) highlights that such collaborations among different actors, despite being necessary for transformation, can also create inefficiencies, undermine conflict management and inhibit knowledge sharing.

**Cross-scale interaction**

Achieving transformation is not only about scaling out (reaching more people) but also about changing dynamics at different levels of the system (scaling up) as illustrated in previous sections (Olsson 2017). The important cross-scale interaction is what separated transformation from change in general (Moore et al. 2004, Folke et al. 2010, Westley et al. 2013). Westley illustrates the scales et al. (2017), based on the Giddens (1984) social structural theory that analytically divides society in three levels; micro (interactions between individuals), meso (communities or organizations) and macro (laws, economic power
structures, political, beliefs- and values). A transformation is a change that has happened at all three levels.

Knowledge
To shift SESs toward sustainability, contemporary perceptions, socially constructed assumptions and beliefs that inhibit such transformation must be challenged (Folke et al. 2010, Westley et al. 2013, Abson et al. 2017).

“It is broadly acknowledged that the way in which problems are framed and how knowledge is produced has significant implications for policy development and societal outcomes. Re-thinking knowledge for sustainability transformations requires an understanding of how knowledge flows through systems of interest, and how we identify the goals and expectations of sustainable transformations (intent) or select the methods and means that help us to get there” (Abson et al. 2017)

This relates to imagining a new possible future outside current unsustainable trajectories to unlock mindsets from current regimes (Olsson and Galaz 2012, Olsson et al. 2014). Barnes et al. (2017) hypothesize about how engaging “resourceful actors” in environmental resource discussions possibly could unlock their mindsets, but how these at the same time, enjoying benefits of the status quo, might want to use their influence to preserve it. This illustrates that while imagining another future is important, it does not imply a causal relationship with transformation, it is “simply one of many processes” (Moore et al. 2014).

Feedbacks and path dependency
Related to interconnected SES is the need to transform not only interactions but the feedbacks that reinforce current unsustainability (Moore et al. 2014, Olsson et al. 2014, Abson et al. 2017). But alternative trajectories are limited by the history of the SES – illustrating path dependency (Olsson et al. 2014, Olsson et al. 2017). This means that our actions build “on the way things have been done previously and relying on established, often institutionalized, knowledge” (Abson et al. 2017). Olsson et al. (2017) stresses that if we aim at sustainability but do not challenge path dependencies, we may end up reinforcing them instead. This approach implies changing balance of power (Motion 2005) and politics that maintain current systems (Olsson 2014), which becomes problematic since SES research is criticized for not
accounting for power and admits to the challenge in especially transformations theory (Olsson et al. 2014) and therefore risks sustaining power asymmetries (Moore et al. 2014).

*Feedbacks* is a way to illustrate systems dynamics (Abson et al. 2017) and they exist on multiple levels in a SES. Just like feedbacks could reinforce unsustainable trajectories that cascade to other levels and finally backfire on societies (Steffen et al. 2007), they could also reinforce positive changes on one scale that leverage to other levels and spur further changes (Moore et al. 2004, Barnes et al. 2017).

Transformation of SES are often initiated by crises such as e.g. geopolitical issues or ecological crises (Olsson 2008) that open up the old system to change (Olsson and Galaz 2012, Moore et al. 2014). Others view this *window of opportunity* as possibly purposefully created (Abson et al. 2017), even by marginalized groups that use “alternative sources of power” (Moore et al. 2017) or that opportunity to change the system has always been there but a crisis makes them visible (Dorado 2005). Olsson et al. (2014) acknowledge crisis as important but sees it as “part of the larger opportunity contexts such as political elections and economic incentives for change” (Olsson et al. 2014) There is no panacea for transformation (Olsson and Galaz 2012, Olsson et al. 2014) but shifting SESs do often require innovation, novelty (Folke et al. 2010) and increased understanding (Olsson and Galaz 2012, Olsson et al. 2014).

**Reconnection to the biosphere**

Since ecological aspects are included in sustainability, transformation need to entail measures for humanity to *reconnect to the biosphere*. The biosphere is the thin layer of the earth containing all life and their interactions in a global ecosystem. (Folke et al. 2011) This is an important viewpoint since society might change and experience technological transformation without considering and ecological variables and dynamics (Olsson et al. 2014) and thereby not changing unsustainable trajectories. Multiple scientific studies propose that the human disconnection from the biosphere contributes to unsustainability (Abson et al. 2017). The importance of including ecology is illustrated by a case from Murray Darling Basin, Australia where economically prosperous agricultural activities represents a fourth of the State of Victoria’s export value. But when including ecological variables such as widespread native vegetation clearing together with high irrigation water usage, resulting in grave water table rises, the SESs is on the verge of crossing an irreversible threshold, risking the continuation
of the agricultural activities. (Walker 2009) This highlights the need of systems thinking and reconnecting humans and societies to the biosphere outside current connection of merely consuming natural resources (Abson et al. 2017).

**Figure 2** Thesis structure.

*Using the transformative social innovations framework together with SESs approach to identify mechanisms that could alter the five processes needed for a transformation to happen. The reconnect to the biosphere process that is not considered through the framework is included through the SESs research approach.*
2.3 Transformative Social Innovation

Since people can have an active role in creating a more sustainable future (Walker et al. 2004) social innovation could provide an instrumental tool in achieving transformation (Olsson et al. 2017) and has been proved doing so in multiple social, historical examples (Westley et al. 2017). Social innovation is defined as “a new program, policy, procedure, product, process and/or design that seeks to address a social problem and to ultimately shift resource and authority flows, social routines and cultural values of the social system that created the problem in the first place” (Westley et al. 2017: 4). The definition lacks the crucial ecological aspect of the SES perspective. This missing connection is one of the critiques of social innovations applicability to sustainability issues, further enhanced by these innovations being “frequently not connected to any ecological context at all” (e.g. Olsson et al. 2017). This study addresses this issue by focusing on blockchain cases with ecological connection.

Westley et al. (2017) developed the transformative social innovations framework by studying eight diverse historical transformations supported by social innovation. Seven patterns were identified from these historical transformations. The first is related to the importance of meaning and how these new beliefs can affect behavior for centuries to come, and how “for the most part a breakthrough social philosophy lay at the origin of the cascade of innovation” (Westley et al. 2017: 240). Second is the time for a social innovation to transform ranging from 50 years (the Internet) to 300 years (legalization of birth control) meaning that no single individual is responsible for social transformation (Westley et al 2013). The third pattern is; despite all the innovations trajectories being vastly different, the initial idea could be identified even after the innovation being combined with other innovations, suggesting the importance of the beginning affecting the future of innovation for a long time. Fourthly is the importance of combining the innovation with “ideas, resources and routines/technologies borrowed from the adjacent possible” (Westley et al. 2017: 243). The fifth is about how paradox and tensions drive the evolution of innovation forward. The sixth pattern is related by identifying that conflict and push-back drive bricolage of the innovation. “The capacity of the social innovation to transform is not about the absence of conflict: it is about how that conflict is managed”. Ways could include; “alliances with the right supporters, through switching tactics and making new partnerships to manage opposition and even to coopt it”. (Westley et al. 2017) In the beginning of an innovation, push back or conflict is likely to be missing, but could emerge as the innovation grows
Transformative social innovations include strategies to influence policy intended to impact broader institutional structures (values, laws, routines, policies). As opposed to for-profit innovations focusing on market diffusion, the social innovator has to understand the political landscape and how to achieve influence and support to resource the idea. (Westley et al. 2017) There are innovations that were not intended to be social in the beginning, like the internet, which can now be regarded as the “largest and most rapidly generalized social innovation ever” (Franz et al. 2012). Social innovation requires a radical idea but there are innovations based on radical ideas that do not transform just as there are radical elements of innovations that are not always evident in the beginning. (Westley et al. 2017)

2.4 Blockchain as transformative social innovation

Blockchain is a decentralized database technology with potential applications for sustainability. This study addresses the shortcoming of SESs research to account for the role of technology in transformation (Olsson et al. 2017) through studying blockchain.

To the author’s best knowledge, this is the first study of blockchain as a social innovation. There are studies of other applications sitting on the Internet as social innovations (Kaletka and Pelka 2011, Franqueira and Gomes 2017). This study differs from earlier studies of blockchain as radical innovation (Beck and Müller-Bloch 2017) and disruptive innovation (Zamani and Giaglis 2017, Gomber et al. 2018) in that it adds the interconnected SESs perspective. It is closer to the socio-technical perspective on blockchain in Paziatis et al. (2017) but adds the important ecological connection (Folke 2002, Olsson and Galaz 2012, Olsson et al. 2014).

Because of blockchain’s promises for sustainability and transformation (Forbes 2015, Ahmed and Broek 2017, Chaprin 2017, Kuznetsov 2017, Paziatis et al. 2017) it is in this study regarded as a social innovation. Blockchain is said to enable “participatory governance models that might support sharing and commons-oriented communities to scale and become
“sustainable” (Paziatis et al. 2017), resulting in “(r)evolution in institutions, organisations and governance” (Davidson et al. 2016). This illustrates the common approach of innovation as the solution to the emerging sustainability crisis, but Olsson et al. (2017) remind us that if current feedbacks are not altered “their impact is as likely to be negative as positive”.

Blockchain is connected to ecosystems through e.g. its potential to transform global supply chains (Kim and Laskowski 2018), support transition to renewable energy (Andoni et al. 2017) and increased capital efficiency (UNEP 2016). If these measures only support the “growth of more producers and consumers” and “ignore the need to support a shift in how production and consumption could be developed to consider ecological feedbacks” these solutions are not likely to alter the unsustainable trajectory (Olsson et al. 2017). The technology sits on the Internet (Tapscott and Tapscott 2016), regarded as “the major social innovation of the past 20 years”. This clarifies that technology is an instrument used by many social innovations but is in itself not a solution. (Franz et al. 2012) It is important to study blockchain as transformative social innovation since it is not an innovation with one area of application but is proposed to enable systemic changes (Davidson et al. 2016) as opposed to e.g. renewable energy that address single issues but do not change the surrounding “socio-technical systems, e.g., energy infrastructure”. Decentralized energy markets through blockchain could be an example of such potential infrastructure change (Mengelkamp et al. 2018).

Blockchain as an innovation with potential transformative capacity is not unique. Humans have an incredible capacity to innovate, backing up the hope we put in innovating solutions to the emerging environmental crisis (Westley et al. 2011). The shift from an industrial- to a knowledge society suggests that the importance of social- compared to technological-innovation is increasing (Green and Vergragt 2002, Franz et al. 2012), further motivating the social innovation approach.

Risks
Technological shifts creates risks (Nelson et al. 2007) such as e.g. the Internet bringing the possibility to infringe on privacy and reinforce inequalities (Loader and Dutton 2012) or humans’ amplified impact on the planet enabled by technological development (Holling 2001). Global innovations thus enable increased well-being in one place but could negatively affect it in another place. As blockchain sits on the Internet it could spread quickly and relates
to Westley et al. (2011) view of Internet as “can make possible the rapid decentralized innovation our world urgently needs”. Transformation is needed at an unprecedented speed related to global environmental challenges (Olsson et al. 2017) but the transformation concept includes shifting to sustainable, just and equal society (Westley et al. 2017) that might not be represented if only focusing on speed or lost when scaled to other places (Olsson et al. 2017). Another issue of scaling innovations is the top-down perspectives where one solution is applied in multiple contexts and does not consider different “ecological, social and cultural conditions” (Olsson et al. 2014).

3. EMERGENCE AND IMPACTS OF BLOCKCHAIN

3.1 Origins of blockchain

Blockchain was introduced together with the World’s first cryptocurrency; Bitcoin, in 2008. Cryptocurrencies are digital currencies that are issued online as opposed to traditional fiat currencies issued by countries. (Tapscott and Tapscott 2016) The alias of Satoshi Nakamoto published a paper that explained the decentralized, electronic currency system without the need of financial institutions (Nakamoto 2008) for validation, settlement, or currency issuance (Antonopoulos 2017). The introduction was timely; the financial crisis of the same year “spurred growing distrust in mainstream finance, including both corporations and the governments that are normally supposed to regulate them”. Similar distrust issues followed such as whistleblower Edward Snowden’s leak of active intrusion of governments in citizens’ privacy. (Buterin 2016 as cited in Mougayar 2016, Tapscott and Tapscott 2017)

*The “chain” = database*

The “chain” derives from blockchain being a database that register all validated transactions one after another in a chainlike manner. Databases are well used for holding assets. In the case of banks, your bank account does not really contain your finances but instead gives access to a database record depending on the amount of money on your account. “Owning” money is therefore partly misleading since the bank “owns the database that points to that entry that say that you have the money, and you assume you have your money”. The system works because you trust the bank, and you get access because you gave the bank that trust to handle your finances. The bank’s complex function is in the cryptocurrency world replaced with the online blockchain network. (Mougayar 2016) Instead of a central database belonging
to a third party (e.g. a bank), every computer connected to e.g. the Bitcoin network get a copy of the whole blockchain. This means that instead of one database, everyone working on the blockchain has a copy of the whole chain, from the first transaction ever made to the latest, downloaded on their computer. This means that trust is distributed to all computers on the blockchain. The internet was designed to move information, not value, and a file sent by email is therefore a copy, not the original file. The blockchain can transfer the original digital asset and is thus designed to move value. (Tapscott and Tapscott 2016)

**Public vs. permissioned blockchain**

The evolution of blockchain has divided the innovation in two different approaches, *public* and *private* blockchains. The blockchain network and appurtenant transactions can be open to anyone and are in that case called *public- or unpermissioned* blockchains, like the Bitcoin blockchain. *Private- or permissioned* blockchains have been developed by e.g. financial institutions allowing transactions to be visible only for members of that particular blockchain. (Tapscott and Tapscott 2016)

**Trust building**

Blockchain is said to have transformative potential for transactions similar to how internet transformed communication (Swan 2015, Mougayar 2016, and Gupta 2017). Transactions does not only imply financial services but every context where a third-party validation is needed. This includes land owner registry, supply chains, carbon mitigation (Paziatis 2017), policy making, voting (Chapron 2017) and energy trading (Green and Newman 2016) among others. Third parties, such as online marketplace Airbnb, add the trust-dimension missing on the internet to, in this case, safely allowing a paying stranger to sleep in your house. This trust is built on personal data collected by the company to verify the tenant (and landlord for that sake). In blockchain the users do not need to trust another human or central organizations, instead they trust decentralized organizations and computers. (Mougayar 2016) Gupta (2017) calls this aspect “relational software” and argues that it has the potential to transform social relations while Paziatis et al. (2017) argues that “*when it comes to more complex social relationships, involving sharing of resources and assets, blockchain technology alone does not suffice for people to develop trusted interaction*”. 
3.2 Blockchain hype and risk

There is often substantial hype and underestimation of challenges when new technologies are introduced (Michelman 2017). Despite this, respected newspapers (Forbes) and journals (Nature, Elsevier) publishes articles about blockchain ending world poverty (Forbes 2015, Kuznetsov 2017), enabling a new economy with transparency and anti-corruption (Paziatis et al. 2017) and how blockchain “is helping to meet sustainability challenges” (Ahmed and Broek 2017) referring to an article by Chapron (2017) in Nature. The ambiguity continues with blockchain safety explained as provided by encryption (Swan 2015, Mougayar 2016), while the Ethereum blockchain, removed the word “Safe” from their website in 2015 (Scott 2017). Another proposed application of blockchains are Decentralized autonomous organization (DAOs), which as the name implies, are decentralized online organizations that carry out tasks without human participation (Swan 2015). At the same time, Tesla founder Elon Musk and Physicist Stephen Hawking, among others, has signed a referendum against DAOs (Kewell et al. 2017). Despite this, 10% of GDP is predicted to be stored on blockchain by 2025 and between 2014 and 2016 USD 1 billion was invested in blockchain startups (World Economic Forum 2015).

3.3 Blockchain 1.0, 2.0, 3.0 and Sustainability application

To understand the differences in blockchain, Swan (2015) has divided the technology into three different definitions; blockchain 1.0 representing crypto currencies such as Bitcoin and appurtenant financial applications. Blockchain 2.0 represents contracts and functions that are more complex transactions and storage of values. Blockchain 3.0 is blockchain applications beyond currency and finance (Swan 2015). Blockchain 2.0 and 3.0 started developing in 2015 and is for given reason only in its infancy (Leon Zhao et al. 2016). It is in the light of the latter that potential for sustainability is seen since the technology could address issues such as “lack of trust, power structures and citizen empowerment” (Chapron 2017). Proposed applications in the focus areas of this study; Supply chain, Energy trading and Green Financial technology (fintech) are presented below and represents a brief summary of the literature review in Appendix I. The aim is to briefly explain applications outside the efficiency gains and cost saving opportunities that is often the focus in blockchain literature. (e.g. Tapscott and Tapscott 2017). Most blockchain applications are still at a theoretical stage and not tested in its context (Paziatis et al. 2017).
Supplies chain

“Global supply chains play a critical role in many of the most pressing environmental stresses and social struggles identified by the United Nations’ Sustainable Development Goals (SDGs)” (Thorlakson et al. 2018).

Highlighting the importance of transforming these systems to sustainability. Blockchain could add traceability and provenance to products in complex global supply chains by providing real time data about a product to the retailer and in the end, access to immutable supply chain data to the customer (Kim and Laskowski 2016). Tracing a product to its source could, as proved by Walmart’s blockchain pilot project, take 2.2 seconds instead of over 6 days.

Another aspect of increased traceability is that farmers could be compensated faster and preventing retro payments, price coercion and removing middlemen. This could lower transaction costs and provide fairer payments (Charlebois 2017). Removing middlemen also mean workforce displacement (Tapscott and Tapscott 2017). There has already been work done to make supply chains more sustainable including sustainable energy generation and raw material extraction methods, but it is difficult for e.g. policy makers to encourage the needed sustainable behavior among consumers (Green and Vergragt 2002) where the added data provided by blockchain could provide a viable option. But it is important to highlight that a decentralized system operating without a third party, like e.g. the Bitcoin network “can and does breed illicit behavior” (Hurlburt 2016) and that in practice, these systems become undemocratic due to the technical knowledge required to maintain and develop it (De Filippi and Loveluck 2016, Hurburt 2016, Redshaw 2017)

Energy trading

A third of global carbon emissions are produced by power plants and these emissions need to decrease by 75 percent per generated kWh by 2050 (Climate Communication 2018). At the same time renewable energy installations have increased by 81 per cent in 25 years (Green and Newman 2016). This decentralized form of energy generation requires new energy markets, enabled by blockchain, where local energy can be traded by consumers and prosumers in their neighborhood. (Mengelkamp 2017) A study from Australia showed that the large-scale energy grid is unlikely to be abandoned because solar power storage systems not being able to provide the household with energy throughout the whole year. Instead, they
propose a solution where households are connected to the grid but also sell- and generate renewable energy. Technologies like blockchain could handle associated transactions through a shared database and thereby support “transition from a centralized to a distributed energy system, facilitating equitable market pricing”. (Green and Newman 2016) This could decrease carbon emissions and “keep revenues in the community” (Andoni et al. 2017). In contrast, early blockchains such as e.g. Bitcoin uses an enormous amount of energy that might consume potential energy gains (Yli-Huumo 2016) but there are solutions applicable for new blockchains and e.g. private blockchains uses far less energy (Fairley 2017).

**Green financial technology (fintech)**
The cost for financial remittances has not changed in hundred years, proposing major inefficiencies. At the same time that “10 million US households and 1.5 million UK adults have no bank accounts, not to mention the two billion ‘unbanked’ in the developing world”. (UNEP 2016) The fintech sector is therefore in need of innovation where blockchain enable peer to peer (P2P) transfer at lower cost since a third party is not needed. The immutability of blockchain transactions could provide settlement, and historical records of transactions. (UNEP 2016)
The decentralized structure of blockchain “tend toward democracy” and a possible future application includes “great global expansion of cooperative forms of ownership and management of wealth”. This could be seen as a transforming the centralized economic- and political power of today. The proposed solutions include circumventing the financial system and creating alternative cryptocurrencies built on alternative values that can be managed through a smartphone. (Manski 2017) Supported by the idea that people have historically used vastly different currencies and introducing new currencies, in this case cryptocurrencies, is a natural part of that evolution (Butgereit and Martinus 2017). Relating back to Bitcoin, there are evidence of it starting off as an inclusive idea that has been appropriated by powerful actors (Redshaw 2017). The finance sector sees an opportunity to increase its competitiveness (Zhao et al. 2016) which is interesting since cryptocurrencies started as an alternative to the current financial system but is not being used by it to fulfil its purpose (Redshaw 2017).
4. METHOD

4.1 Research approach
I have used an interpretive epistemological approach illustrated by Geertz (1973: 9) as “what we call our data are really our own constructions of other people's constructions of what they and their compatriots are up to”. It suits the qualitative nature of this study as it emphasizes viewing the reality as subjective and constructed through human experiences and perceptions (Bryman 2012). The philosophy sees identified mechanisms of a phenomena as an account of possible futures instead of “wholly predictive for future situations” and does not claim to “generate truth” (Walsham 1995). This is important since researching mechanisms of an early innovation also include the possibility of the innovation to evolve towards many different trajectories (Westley et al. 2017).

The study builds on a constructivist ontology implying that “meaning and experience are socially produced and reproduced, rather than inhering within individuals” (Braun and Clarke 2006). Social phenomena are therefore inconstant (Bryman 2012) and the research takes a holistic approach to understand the wider context that forms individual experiences and perceptions (Braun and Clarke 2006). This is a qualitative study since I focus on understanding process (blockchain in transformation) and providing rich description suited for an under-researched field (Braun and Clarke 2006).

4.2 Research design
The transformative capacity of blockchain cases is studied using Westley et al. (2017) transformative social innovations framework. Most social innovation case studies look for transformative capacity in cases “less than a decade old” and therefore lack an evaluation in a longer timeframe (Olsson et al. 2017). This study looks at a novel technology and thus does not aim at addressing this continuity gap, but instead presents a first study of blockchain as a social innovation that can be used as benchmark for future evaluation of transformative capacity.

Transformative social innovation framework
The framework consists of four questions based on findings from eight historical transformations. The questions are proposed to be used to evaluate the transformative capacity of contemporary social innovations to support action or research through identifying
“contemporary social innovations in their early stages that hold promise of transformative impact” (Westley et al. 2017: 239). There are limitations in using a framework based on historical transformation to analyze a novel innovation, since transformation happens in phases and each phase have different strategies (Moore et al. 2014). The social innovation perspective is still useful because of its history of seeing systems as complex and not only describing but identifying factors that might contribute to transformation (Biggs et al. 2010). This is further supported by sometimes unnoticed “dramatic changes in attitudes toward the environment, support for inclusive, democratic practices” that might contribute to opportunities for transformative social innovation (Biggs et al. 2010). Table 1 presents the framework questions.

Table 1 Transformative social innovation framework.

<table>
<thead>
<tr>
<th>Framework Questions</th>
<th>Background (from Westley et al. (2017))</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the innovation contain a radical seed?</td>
<td>The social innovation’s raison d'être related to intent to transform and attractivity of the idea to allocate resources to the cause.</td>
</tr>
<tr>
<td>2. Is there evidence of the possibility of push back, of conflict with those who control the status quo? Can that conflict be managed?</td>
<td>Conflict pushes the innovation forward and this question is not about absence of conflict but rather how conflict is managed.</td>
</tr>
<tr>
<td>3. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand, securing more resources?</td>
<td>Compromise is important since it is necessary to cooperate with diverse partners to move the innovation forward, related to the need to allocate resources to the cause for it to have an impact (Westley et al. 2013, Westley et al. 2017).</td>
</tr>
<tr>
<td>4. Are those associated with the innovation, even in the earliest stages, aware of the need for cross-scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>What separates transformation from change is the cross-scale impact (Moore et al. 2004, Folke et al. 2010, Westley et al. 2013) and fundamental changes.</td>
</tr>
</tbody>
</table>

Before conducting the research, a pilot study was performed where the lack of scientific blockchain information was identified through comparing the tens of millions of Google hits to the barely 300 scientific articles in the field. This supported the decision to use an exploratory case study approach and thematic analysis of data to provide rich descriptions as a broad basis for further research. Exploratory case study approach is suited for studying transformative capacity of blockchain as a “contemporary phenomenon” as it enables my interest to study the technology’s “real-life context” (Yin 2003) represented by sustainability applications. This method requires multiple sources of evidence (Yin 2018) and I have
performed interviews that resonates with an interpretive approach (Walsham 1995) and literature review. During the pilot study, the applicability of the framework to interviews was confirmed and resulted in the interview guide (presented in Appendix III) being based on the framework. An overview of the research and method is presented in Figure 3.

**Figure 3** Method: Phases of research and method presented together with overarching research approach and research design

4.3 Case selection

The selected blockchain cases have both **social- and ecological connection** related to the required transformative process of reconnecting to the biosphere (Folke et al. 2011) and with **an intention to transform** related to required transformation process of challenging feedbacks and pathways (Olsson et al. 2014). I started the case search in November 2017 through Google searching “blockchain” +” sustainability”, to find cases and key words for further search. The word sustainability provides a wide enough scope within the social-ecological focus. 81 keywords were identified and sorted into categories; Supply chain, Social, Environment and Energy that guided the case search (all key words presented in Appendix I). 150 cases were identified through this process and 15 cases were found through other sources.

From the 165 identified cases, 11 were selected for an in-depth study based on their social-ecological connection and intention to transform.
The 11 selected blockchain cases implemented blockchain between 2014 and 2017, illustrating the recent development of blockchain 3.0 or application of blockchain (Swan 2015) and highlighting how novel blockchain applications for sustainability are. All cases are founded in either North America, Europe, or Australia. Their organizational structure is strikingly different; from multinational corporations, private companies, NPOs (Non-profit Organizations), consortiums and start-ups. From well-known companies to completely new actors. The available funding varied from limited self-funding to tens of millions of dollars invested in the case. Their areas of focus are; supply chain (e.g. traceability or specializing in agricultural services to farmers and customers), energy trading and a variety of financial innovations promoting environmentally beneficial behavior or projects. Since blockchain is an IT technology, all cases are working with software to various extent. A summary of the cases and related data is presented in the table 2 below.

Table 2 Overview of 11 blockchain cases.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Blockchain introduced</th>
<th>Sector</th>
<th>Organization form</th>
<th>Size</th>
<th>Funding [Type]</th>
<th>Funding [Size]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2015</td>
<td>Supply chain</td>
<td>Start-up</td>
<td>Medium</td>
<td>Venture capital</td>
<td>Medium</td>
</tr>
<tr>
<td>2</td>
<td>2016</td>
<td>Supply chain</td>
<td>Start-up</td>
<td>Small</td>
<td>Internal</td>
<td>Small</td>
</tr>
<tr>
<td>3</td>
<td>2015</td>
<td>Supply chain</td>
<td>Multinational corporation</td>
<td>Large</td>
<td>Internal</td>
<td>Large</td>
</tr>
<tr>
<td>4</td>
<td>2017</td>
<td>Supply chain</td>
<td>Private Company</td>
<td>Small</td>
<td>Internal financing and revenue</td>
<td>n/a</td>
</tr>
<tr>
<td>5</td>
<td>2015</td>
<td>Energy trading</td>
<td>Start-up</td>
<td>Small</td>
<td>Venture capital</td>
<td>Medium</td>
</tr>
<tr>
<td>6</td>
<td>2016</td>
<td>Energy trading</td>
<td>Start-up</td>
<td>Medium</td>
<td>ICO</td>
<td>Large</td>
</tr>
<tr>
<td>7</td>
<td>2017</td>
<td>Energy trading</td>
<td>Consortium [For-profit]</td>
<td>Large</td>
<td>Internal</td>
<td>Large</td>
</tr>
<tr>
<td>8</td>
<td>2017</td>
<td>Green fintech</td>
<td>Consortium [Non-profit]</td>
<td>Small</td>
<td>Donations</td>
<td>Small</td>
</tr>
<tr>
<td>9</td>
<td>2015</td>
<td>Green fintech</td>
<td>NPO</td>
<td>Medium</td>
<td>Donations</td>
<td>Small</td>
</tr>
<tr>
<td>10</td>
<td>2015</td>
<td>Green fintech</td>
<td>NPO</td>
<td>Small</td>
<td>Donations</td>
<td>Small</td>
</tr>
<tr>
<td>11</td>
<td>2014</td>
<td>Multiple</td>
<td>Start-up</td>
<td>Large</td>
<td>Internal financing and revenue</td>
<td>Large</td>
</tr>
</tbody>
</table>
Table 3 Definitions to Table 3.

<table>
<thead>
<tr>
<th>Organization form</th>
<th>Start-up</th>
<th>Private company</th>
<th>Multinational corporation</th>
<th>NPO</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Companies created together with the blockchain implementation</td>
<td>Companies that were active before implementation of blockchain</td>
<td>Large companies, global actors.</td>
<td>Non-profit organization</td>
</tr>
<tr>
<td>Size</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td>&lt;20 employees</td>
<td>20 to 100 employees</td>
<td>&gt;100 employees</td>
<td>No access to data</td>
</tr>
<tr>
<td>Funding [Size]</td>
<td>Small</td>
<td>Medium</td>
<td>Large</td>
<td></td>
</tr>
<tr>
<td></td>
<td>&lt; USD 1 million</td>
<td>USD 1-20 million</td>
<td>&gt; USD 20 million</td>
<td></td>
</tr>
<tr>
<td>Funding [Type]</td>
<td>Internal</td>
<td>Donations</td>
<td>Venture capital</td>
<td>ICO</td>
</tr>
<tr>
<td></td>
<td>The case is financed by other activities within the organization or by founders</td>
<td>Funding from Government/individuals, funds, grants etc.</td>
<td>Private capital in form of investment in return for e.g. ownership stake</td>
<td>Initial Coin Offering</td>
</tr>
</tbody>
</table>

4.4 Data collection

Data was collected from semi-structured- and structured interviews and supported by literature review.

*Semi-structured interview*

In order to gain insights into a phenomenon that is distant to many of us (geographically scattered and cognitively), interviews are a useful tool (Peräkylä and Ruusuvuori 2011) to understand questions related to “hows” and “whys” (Yin 2018). One key individual for each of the cases were interviewed in early 2018 using semi-structured interview technique. Semi-structured interviews provide the possibility of going off at tangent and to provide rich answers (Bryman 2012) which is needed since this study tries to address and capture complex issues such as transformative capacity. It also provides the opportunity to interview a person more than once and follow up on data (Bryman 2012) which is useful regarding the exploratory approach of the study. The interviews were between 30 to 45 minutes in length except one interview that was 15 minutes long due to time constraints of the interviewee. All
questions were asked but without follow-up questions in that particular case. Interviews were held in person (1 case), by video link (3 cases) or by phone (7 cases). In four cases the project manager of the specific blockchain case was interviewed instead of the founder because the case was one of many in a larger organization.

Structured interview
After an analysis of the first three interviews it became evident that the interviewee’s own reflection on transformative capacity was missing despite them working in the blockchain sector every day. This perspective is useful in providing answers to the research questions and to compare to my interpretation of their transformative capacity. After these interviews it also became clear that interviewees’ available time was to different degrees limited. Structured questions provided a useful tool in answering complementary questions. Interviewees were asked to rate the transformative capacity of blockchain and of their own case from 1-10. This resulted in interesting discussions and semi-structured follow-up questions to why the interviewee chose to state a specific number. The first three interviewees answered the structured questions by email.

Interviewees were given the opportunity to receive the transcripts from the interview for validation (Kvale and Brinkmann 2009).

4.5 Data analysis
Interview data was thematically analyzed since it provides an opportunity to keep the “rich overall description” useful in an under-researched area (Braun and Clarke 2006). It is also a “useful method for examining the perspectives of different research participants, highlighting similarities and differences, and generation unanticipated insights” (Nowell et al. 2017). This method provides flexibility and does not commit to theorizing (King 2004, Braun and Clarke 2006) which suits this study’s exploratory approach aiming to contribute to development of theory rather than develop theory as such.

This study followed Braun and Clark’s (2006) approach to thematic analysis. Their recommendation to use dated memos for interviews, transcribing and readings was useful to record thoughts and support further analysis. The transcripts were thereafter organized in the programme MAXQDA to facilitate structure, coding and identification of general themes.
Data that contradicted the initial findings were also identified and coded (Braun and Clarke 2006). The thematic analysis was done in two phases related to the two research questions;

**Research question one: Deductive and inductive analysis**

To answer the first research question regarding transformative capacity of the cases, coding was guided by questions in the social innovation for transformation framework (code book in Appendix IV). A deductive coding process since it is guided by theory (Bryman 2012). To evaluate the transformative capacity of the cases, I rated each extracted segment under each code on a scale of 1-5 for every case. By comparing the segments belonging to each code from the framework between all interviews, I have defined what each scale from one to five represents, which can be seen as inductive since data is driving coding (Bryman 2012). This method was developed with the intention of creating a process to deepen analysis of the cases as well as understanding the applicability of the framework. The method is presented in Table 4.

**Table 4 Method to estimate transformative capacity**

<table>
<thead>
<tr>
<th>Theory</th>
<th>Question to data</th>
<th>Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the innovation contain a radical seed?</td>
<td>How radical is the counter truth presented by the case?</td>
<td>1-5</td>
</tr>
<tr>
<td>2. Is there evidence of the possibility of push back, of conflict with those who control the status quo?</td>
<td>Is there evidence of push back, of conflict with the status quo?</td>
<td>1-5</td>
</tr>
<tr>
<td>Can that conflict be managed or sidestepped?</td>
<td>Are there strategies for managing that conflict?</td>
<td>1-5</td>
</tr>
<tr>
<td>3. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand, securing more resources? (Working with emergence and adjacent possible).</td>
<td>Is the founder or project manager prepared to make compromises to see the idea grow and expand?</td>
<td>1-5</td>
</tr>
<tr>
<td></td>
<td>Is the case well-funded? (now and in the long-run)</td>
<td>1-5</td>
</tr>
</tbody>
</table>
Are those associated with the innovation, even in the earliest stages, aware of the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?

Are the founders or project managers, aware of the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?

How transformative do they estimate their project to be? (scale in interview was 1-10 meaning that it needs to be divided by 2)

Answers from interview (scale 1-10) divided by 2.

Definition of what 1-5 entails in estimation of transformative capacity are explained in table 5. The definitions were decided after going through all coded segments for each question of the framework.

Table 5 Definitions of coded segments.

<table>
<thead>
<tr>
<th>Question to data</th>
<th>Number</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>1</td>
<td>Ideas similar to increasing efficiency</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Providing one tool addressing one specific issue</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Providing a tool that could be used to change systems</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Changing market rules</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Actively aiming at changes at systems level</td>
</tr>
<tr>
<td>2. Is there evidence of push back, of conflict with the status quo?</td>
<td>1</td>
<td>No conflict at all</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Cognitive barriers</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Conflicts will come in the future</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Regulations</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Present conflict</td>
</tr>
<tr>
<td>Are there strategies for managing that conflict?</td>
<td>1</td>
<td>Not mentioning anything that can be seen as strategies</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Mentioning strategies not directly associated with possible conflict</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Adopting to current conditions</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Strategies to mitigate possible conflicts/issues</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Strategies to manage active conflict</td>
</tr>
<tr>
<td>3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?</td>
<td>1</td>
<td>Not mentioning anything that can be seen as compromise.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Possible compromise</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Compromises related to reaching market acceptance</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Compromise on a larger scale but not well defined</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Compromise to get funding, collaborations or to have an influence</td>
</tr>
<tr>
<td>Is the case well-funded? (Now and in the future)</td>
<td>1</td>
<td>Small funding with limited plans to increase future funding.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Small funding with solid plans to increase future funding or Medium funding with no plans for future funding</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Medium funding with plans for future funding</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>Large funding with no plans for future funding</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>Large funding with plans for future funding</td>
</tr>
<tr>
<td>4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>1</td>
<td>Not mentioning how the case could contribute to cross scale changes, talking in general terms about blockchains possible impact but not the specific case.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Mentioning changes but not related to</td>
</tr>
<tr>
<td>Scales</td>
<td>Description</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>-------------</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Providing a tool that could change broader institutional structures.</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>General cross-scale changes not directly related specifically to the case. Or aiming at changing one to two institutional structure.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Actively aiming at changing three or more institutional structures</td>
<td></td>
</tr>
</tbody>
</table>

The evaluation for each case is presented in Appendix IV.

**Research question two: Inductive analysis**

I used an inductive approach to answer the second research question regarding mechanism that can support transformation to sustainability, since the aim is to contribute to general understanding and therefore supporting development of theory from coded extracts (Bryman 2012). The code book can be found in Appendix IX.

**4.6 Methodological discussion**

This study is based on 11 blockchain cases which implies that results may not be illustrative for all blockchain cases. However, I decided to use an exploratory case study approach since there are no other studies of blockchain in a SES transformation context. By providing rich description of the case, these results can be used for further insights by comparing to other cases (Kvale and Brinkmann 2009).

The rich description derives from the choice to use thematic analysis that is lacking extensive literature describing the approach in comparison to other methods such as e.g. grounded theory (Nowell et al. 2017). I chose the method since the article by Braun and Clarke (2006) addressed this issue and provided clear method steps. They explain how attempts to perform e.g. grounded theory sometimes do not fulfil the commitment to theorize and end up being very similar to thematic analysis anyway, related to Bryman (2012) stating that the time required to generate new theory is often not sufficient.

Since blockchain is under-researched, there is a lack of scientific literature that could affect the multiple evidence requirement of a case study (Yin 2003). I could thereby possibly only
support those identified mechanisms in the interviews that was already in the scientific literature. The struggle to provide multiple evidence was approached by;

I. Comparing identified mechanisms with earlier transformative social innovations in the Westley et al. (2017) framework.

II. Identified mechanisms also rely on the choice to include 11 different interviewee narratives on a common theme instead of studying e.g. just one case.

Interviews uses the researcher to collect data and therefore my skills as an interviewer affects the research (Kvale and Brinkmann 2009). I therefore conducted two test interviews where my approach could be evaluated and performed the research interviews after I had studied the field (blockchain, transformation) and interacted with the blockchain sector to better understand what the interviewee talked about and to provide more fruitful follow-up questions.

11 out of 20 identified cases wanted to participate. Although this could be seen as a small sample it is a fairly high positive response rate. I focused on interviewing founders since they are assumed to contribute with the vision and directing the case forward.

The cases were identified using search engine Google.com which is not neutral but provide bias hits based on past searches (Goldman 2005). Google was still chosen since it provided easy access to large amount of cases worldwide. The bias issue was addressed by searching for “blockchain” together with 81 different key words to get a width of search hits (Appendix III). Searches were only made in English therefore potentially excluding projects from a large part of the world.

The unparalleled rate of innovation in the Internet suggests that social science academics have to consider the “credibility and limitations of their own research approaches” (Loader & Dutton 2012). When results are presented they are often already obsolete. The same authors therefore question the “usefulness of traditional social scientific methodologies which take more time to be proposed, funded, designed, undertaken, analyzed, published and disseminated than the actual rate of change of the online environment”. (Loader & Dutton 2012) This study still follows traditional social science methods related to the aim, to
contribute to theory but acknowledges the challenge of rate of innovation by the interpretive approach suggesting results as one of many possible predictions (Walsham 1995).
5. RESULTS

This results chapter starts by presenting an evaluation of contemporary blockchain cases’ transformative capacity, answering research question one. In the process of evaluating the cases, four mechanisms were identified through which blockchain can support transformation to sustainability, answering research question two. These mechanisms are presented in the second section. Cases are referred to with abbreviations such as C2 (representing Case 2).

5.1 BLOCKCHAIN CASES TRANSFORMATIVE CAPACITY

These results derive from applying the transformative social innovation framework on 11 blockchain cases. Quotes supporting the estimation of transformative capacity are presented for each case in Appendix V.

Three cases (C3, C7 and C8) estimate their own transformative capacity as 5 or lower on a 1-10 scale. C7 and C8 are the two only consortiums in this study and C3 the only multinational corporation. These cases are not presented in this section since their expressed will to transform was not confirmed when the definition of transformation used in this thesis was presented during interviews. All other cases rate their transformative capacity as 8 or higher. The cases not rating 9 or above motivate their rating with blockchain being hyped or that they will only be part of a larger transformation (different initiatives will contribute with different parts of the puzzle). A summary of answers is presented in table 6.

Table 6 Transformative capacity of case on scale 1-10 appreciated by the founders/project managers.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>C1</th>
<th>C2</th>
<th>C3</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C7</th>
<th>C8</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated transformative capacity of case</td>
<td>8</td>
<td>8</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>10</td>
<td>4</td>
<td>3</td>
<td>8</td>
<td>9</td>
<td>10</td>
</tr>
</tbody>
</table>
Table 7 Framework questions representation in figure 4.

<table>
<thead>
<tr>
<th>Question in framework</th>
<th>Dimension in figure 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the innovation contain a radical seed?</td>
<td>Radical idea</td>
</tr>
<tr>
<td>2. Is there evidence of the possibility of push back, of conflict with those who control the status quo?</td>
<td>Evidence of push back or conflict</td>
</tr>
<tr>
<td>Can that conflict be managed?</td>
<td>Conflict management</td>
</tr>
<tr>
<td>3. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand?</td>
<td>Compromise</td>
</tr>
<tr>
<td>Securing more resources?</td>
<td>Funding</td>
</tr>
<tr>
<td>4. Are those associated with the innovation, even in the earliest stages, aware of the need for cross-scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>Cross-scale interactions</td>
</tr>
</tbody>
</table>

| Estimations in Table 6                                                                 | Estimated transformative capacity             |

The results suggest that C1, C6 and C11 fulfil all the dimensions of the framework to a seemingly large extent. C2, C5 and C9 fulfil the dimensions to a medium extent where the main difference is that C2 and C9 have small funding while C5 have medium funding but do not mention conflict management strategies. There is no available funding data for C4 and this case therefore fulfil the transformative framework to a lower extent despite fulfilling all other dimensions to a large extent. C10 is regarded as having the lowest transformative capacity due to small funding and no compromises. An overview of the estimated fulfilment of transformative capacity is presented in figure 4.
Figure 4 Overview of estimated of transformative capacity (blue area) of eight cases based on dimensions in transformative social innovation framework. Variables in pink sphere are evaluated by the author. Funding is based on a three-point scale and numeric estimation of transformative capacity is stated by the interviewee.
Each question 1-4 with sub-questions is presented below.

1. Radical idea

All eight cases present ideas with radical elements related to changes at systems level together with conservative elements related to themes such as e.g. increase efficiency. The estimations in the figure are based on the most radical idea presented by the case. These ideas are what constitutes mechanisms that could support transformation to sustainability. These are presented in debt under the next section. Three cases explicitly state that blockchain is just one of technology applies and that it need to be used together with other technologies (see Appendix VI).

2. Evidence of possibility of push back, of conflict with status quo

There is one identified, direct conflict with status quo (C10). Six other cases are experiencing indirect push back in terms of regulatory barriers (both national and in terms of expansion to other markets). Lack of understanding as push back is mentioned by two cases. One case (C3) expand on the topic and focuses on internal resistance among customers related and inside their own organization. This resistance is based on fear by employees to lose their jobs. What is more prevalent is the absence of conflict and seven of interviewees instead talking about how the changes they are bringing are being positively received. Three cases specifically state that there has been a change in attitudes happening between one and two years ago. Three cases independently mention the Facebook and Cambridge Analytica scandal as a warning example. Another three cases mention the possibility that conflicts could emerge as the case grow and gains significance but the appreciated magnitude of this is dual (Appendix VII).

Conflict management and 3. Compromise

Only one conflict is identified as seen in previous section. Despite this, strategies to manage conflicts are identified. Identified strategies are presented order related to frequency amongst cases (most common first); Collaboration with various actors (4 cases), building trust (3 cases), adapting to current conditions (2 cases), communication (2 cases), choosing partners strategically (1 case) and education (1 case). Two of the strategies also represents compromises by the cases such as including others and adjusting the idea for it to receive greater acceptance on the market.
Funding

Two of the cases have Medium funding that is between USD 1 and 20 million. Two of cases have Large funding meaning USD 20 million or more. Implying financial strength. Fintech cases are mostly financed by donations and in one case by ICO. This is the current and future funding model for cases that does not rely on fees (from e.g. license agreements, transactions or subscriptions) or donations. Even cases that are foreseeing a revenue through fees sees venture capital and/or ICOs as a source of income. Implying that the cases are currently funded and have a plan for future revenue line to assure continuation of case. Funding variables are presented in the table 8.

Table 8 Funding and long-term funding of eight blockchain cases.

<table>
<thead>
<tr>
<th>Case</th>
<th>Funding [Type]</th>
<th>Funding [Size]</th>
<th>Long-term funding</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>Venture capital</td>
<td>Medium</td>
<td>Venture capital</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Token generation</td>
</tr>
<tr>
<td>C2</td>
<td>Internal</td>
<td>Small</td>
<td>Transactional fee [paid by users]</td>
</tr>
<tr>
<td>C4</td>
<td>Internal financing</td>
<td>n/a</td>
<td>Subscription Fee [paid by users]</td>
</tr>
<tr>
<td></td>
<td>and revenue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C5</td>
<td>Venture capital</td>
<td>Medium</td>
<td>License agreements</td>
</tr>
<tr>
<td>C6</td>
<td>ICO</td>
<td>Large</td>
<td>License agreements</td>
</tr>
<tr>
<td>C9</td>
<td>Donations</td>
<td>Small</td>
<td>ICO</td>
</tr>
<tr>
<td>C10</td>
<td>Donations</td>
<td>Small</td>
<td>Donations</td>
</tr>
<tr>
<td></td>
<td>Token generation</td>
<td></td>
<td>ICO</td>
</tr>
<tr>
<td>C11</td>
<td>Internal financing</td>
<td>Large</td>
<td>Revenue ICO</td>
</tr>
<tr>
<td></td>
<td>and revenue</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

C4 sees choosing a private company business model based on revenue as a way to have increased impact;

“this was obviously a non-profit project for benefit, the software was open source, the service was very much for consumers. And we have always kept that mission alive, so we still have a free software, a consumer facing platform even though it doesn't make any money. What we did was that we built the other services to bolster the mission. We've had more impact to create transparency in supply chains as a for profit than we ever could as a non-profit” (C4)

4. Awareness of the importance of cross-scale changes in the broader institutional structures (values, laws, routines, policies).

All eight cases talked vividly about having a systemic- or cross-scale impact. This intended impact varies in terms of what institutional structures that are intended (values, laws,
routines, policies). The mentioned dimension for every case is crossed in table 9 below and thereafter explained. Full list of representative quotations and codes in Appendix VIII.

**Table 9** Awareness of importance of cross scale changes in the broader institutional structures divided according to; values, laws, routines, policies.

<table>
<thead>
<tr>
<th>Case:</th>
<th>C1</th>
<th>C2</th>
<th>C4</th>
<th>C5</th>
<th>C6</th>
<th>C9</th>
<th>C10</th>
<th>C11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Laws</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Routines</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Policies</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Despite the dimensions being presented separately in table 9 there are a lot of overlaps between the different institutional structures. The overlap between routines, policy and values illustrated by one supply chain case;

“How can we make our supply chains more modular? And less linear and transactional and if that's the case, obviously that is going to have some policy impact over time because we are looking at a changing role of the participants.” (C1)

The division between the dimensions is therefore not to be seen as strict but rather to be viewed as highlighting what dimensions that are not mentioned.

**Routines**

All cases show awareness of the importance in changing the order of how things are currently done. C1, C2, C5 and C6 (supply chain and energy trading cases) mention changing the market related to including and/or rewarding market actors instead of targeting e.g. laws;

“But the reality that lot of people have to face up to is; [...] How the existing market place in the energy space, are they very powerful? Are they; influencing government? They're not gonna get up and walk away if you bring in some blockchain replacement, so that is not what we are seeking to do. We come from the energy market and we built our application to be used today, to solve problems today” (C6)

C4 instead focuses on providing transparent data to existing market actors and they can decide on how to use it [V];
“we're not changing the rules of business, we're not changing the rules of government. We're creating an accountability system that makes it possible for governments and brands to know the impacts of supply chains and then to fix them.” (C4)

Finance includes both providing financial solutions for unbanked individuals mentioned by C2, C9, C10 and C11 as well as seeing currency as a mean that should be updated (C9 and C10). C11 as well mention broader systemic changes in changing the status quo;

“Blockchain I think will be more transformative than any of the other technologies because yes, big data analysis and other sorts of things will reshape how we do business, but I think this will be, have a deeper effect on the fabric of economic-, social- and political systems” (C11)

Policies

None of the green fintech cases mention having an impact on policies. The supply chain cases awareness of policy impact is directly related to changing the routines related to their customers (businesses) mentioned in past section and roles of participants. The energy trading cases awareness of policy impact is also related to changing the market and therefore indirectly policies of actors already on the market.

C1 add an interesting aspect on how being first mover in an emerging field can affect policies to come through setting a standard;

“We're only just starting to see policy and at a regulatory level of how digital assets or digital currencies should be treated and that's kind of really unfolding and we think that we need to be at the forefront of that and providing front leadership and engagement with regulators and others as to how these new assets will evolve and how they can be used in the future” (C1)
5.2 MECHANISMS THAT COULD SUPPORT TRANSFORMATION TO SUSTAINABILITY

This chapter answers research question two by presenting blockchain mechanisms that could support transformation to sustainability. These have been identified through analyzing the cases’ radical counter truths and supported by literature. Identified mechanisms are; Transparency, Digitalization, Decentralization and Finance. These are presented in figure 5 below and thereafter explained in depth.

Figure 5 Blockchain mechanisms that could support transformation to sustainability. Example articles supporting findings are referred to with abbreviations such as A2 (representing Article 2 from selected blockchain articles in Appendix III). And cases are referred to with abbreviations such as C2 (representing Case 2).

Despite blockchain applications being in their infancy, one overall mechanism is already apparent, and it is connected to all other mechanisms. It relates to blockchain allowing us to
think differently and imagining new systems. One illustrating example is questioning the role of institutions like banks;

“Who needs a central bank when you can have crypto-currencies existing? [...] And maybe that is because we had to kind of wire funds in a different way and maybe it made sense but in a real time, digital internet world [...] it’s ridiculous.” (C3)

**Transparency**

This mechanism captures the many dimension of transparency that is mentioned by all cases but entails many different things and is not properly represented by one word. Transparency could support transformation through revealing value added by intermediaries and also incentivize sustainable actions or behavior through *Incentives mode*;

“I think that one of the areas that is very hard to replicate though and doesn’t really exist at the moment is the incentives model. So, when we have a blockchain, what we are able to do is create incentives to good actors within the blockchain and to reward those actors” (C1)

Adding transparency is not only potentially beneficial for supply chains that could create systems with incentives to reward “good” actors. It is extended to the energy trading cases where transparency enable their blockchain platforms that for peer-to-peer (P2P) energy trading.

Blockchain has the possibility to contribute to sustainability by revealing true supply chain data without revealing data that is sensitive for e.g. the supplier. This has not been possible earlier and could contribute to *Compensation based on contribution* representing fairer compensation for the value added to the supply chain;

“there are some intermediaries who have been regarded as providing very little value but in fact provided enormous value. In part of making supply chains more transparent, is actually making that value more transparent. “(C1)

The supply chain for any product could be revealed, adding *Provenance* – meaning information about origin. This transparency has not been available to customers earlier, but could with blockchain demand to know where their products are coming from;
“but I think in the future you’ll say; well prove to me that it's organic before I pay the 50% difference. Right now, as consumers, we don't have choices, so like, it's organic, Ok I'll pay.” (C3)

With the possibility to not only demand to know but also Adding trust to companies and suppliers that wants to prove that their supply chains are e.g. sustainable or equitable. This trust is especially important for fintech cases handling finances and applications such as green bonds for investors. An organization or individual could follow their investments and products in detail and possibly real-time.

It is important to mention that;

“transparency is not a value that is shared universally […] we have a long road ahead in many parts of the world just to start transparency” (C4)

As a contrast to the overall positive notion of transparency as adding opportunities presented earlier.

Digitalization

This mechanism highlights the opportunities that blockchain bring to transformation through being a software application constructed in digital environment. Blockchain applications sits on top of the internet, could be used on a smartphone and is scalable and therefore could reach a lot of people;

“we have this ambition to reach everyone in the world. To do that, to have the infrastructure to carry that out technically speaking, blockchain is a good solution for this” (C9)

Decentralization

This mechanism illustrates how the distributed nature of blockchain could remove middlemen and enable new forms of institutions and ownership. If two neighbors can trade energy P2P as mentioned earlier, the function of the institution providing that service today is questioned. This related to the introductory quote about the function of a central bank;

“why the financial services? Because they are the quintessential definition of middlemen. Banks are middlemen, insurance companies – middlemen.” (C3)
Which could through that possible support inclusion;

“the cryptocurrency might just be important because [country] has a lot of unbanked, and not because they don't have ID, but because they choose to be unbanked because they keep getting by 35-dollar fees, and most just can't afford to be in the banking system.” (C11)

The Bitcoin blockchain has proved that a system that is decentralized and maintained by its members is possible with blockchain. This has spurred ideas of creating cooperative forms of ownership where members could own e.g. the online platforms they use;

“they can certainly go about their business and we can let the people decide whether they want to use a centralized […] system or whether they want to own a platform that they also use” (C11)

These examples of decentralized institutions would enable people to have control over their personal data as opposed to today’s few options to control what personal data that is collected on the online platforms used daily exemplified by (C2);

“individuals do not own their own data, if you look at the fiasco of Facebook, and Cambridge Analytica, it’s because we don’t really own our data and we have no control of our data” (C2)

Blockchain enables a platform that has the possibility of being open (public blockchain) and not only access markets through being able to facilitate money transfer to e.g. other countries but to opening up markets. One illustrative example challenging notions of the energy sector;

“the goal here is to enable the sharing of data and then anyone could develop an application across that platform” (C5)

**Finance**

This mechanism relates to blockchains possibility to create cryptocurrencies and appurtenant applications that could contribute to transforming financial institutions. Related to providing financial solutions, by blockchain could be a way of promoting inclusion and Access to Markets;

“there is a lot of unbanked in the world and important application, just being able to buy something from another country is difficult for many people, not because the vendors won't sell their wares or shift the wares, but because there is no way to pay for them. So, enabling access to global markets to anybody in the world is important.” (C11)
Supported by the possible affordability of the technology as opposed to traditional financial solutions;

“on her own device; smartphone, computer at very low cost, so these apps are virtually free, the internet is virtually universal so in principle you could get to the place where even a smallholder farmer would be able to manage her own transactions personally and be part of a global traceability scheme that gets communicated all the way to the end consumer.” (C4)

This is related to other proposed financial solutions being more affordable on the blockchain such as e.g. green bonds that could support sustainable investments and transformation through;

“it's like many financial market players are stuck in problems that belong to an old paradigm and it's like traditional solutions cannot really unlock these barriers and we need to think outside the box and then financial technology, such as blockchain, will come from, from the side and is doing something completely different and thinks totally different” (C8)

Two of the green fintech cases takes this idea and sees it as an opportunity to Connect currencies to other values such as coupling economy and ecology;

“I think it certainly challenges peoples’ notion of how they look at our biosphere, how they look at nature, and how they perceive value. Because often we have a very concrete perception of what value is, when it comes to kind of euros or dollars because we use it every day and we understand that “(C9)
6. DISCUSSION

This study shows that the blockchain cases have transformative capacity to different extent and that applying the transformative social innovations framework on a contemporary innovation is possible and generates insights but comes with challenges. The study also shows that there are four mechanisms through which blockchain could support transformation to sustainability.

The applicability of transformative social innovation framework on blockchain

The framework is proposed to be used for evaluating the transformative capacity of contemporary social innovations (Westley et al. 2017). While it provided a useful tool to structurally approach the evaluation of cases, there are challenges when applied to analysis.

The first main challenge is; if cases are to be evaluated and compared, on what grounds are they compared? One example is the result showing that e.g. C2 and C5 fulfilled the framework to similar extent (figure 4) but C2 has small funding while C5 has limited conflict management strategies. Since the framework presents all the questions together (leading to the interpretation of all questions as equally important) this resulted in the importance of funding and conflict management being regarded as equal when applying the framework. This might not be the case since the transformative capacity is dependent on the ability to allocate resources to the innovation (Westley et al. 2017).

The other challenge when comparing cases using the framework is how to compare fulfilment of the questions in the framework. It became evident that answering “yes” or “no” to the framework questions would not provide enough basis for comparison. My approach to dealing with these challenges was to develop the 1-5 scaling approach, which helped give comparative insights. The method encounters its own problems, since it is based on the same cases that it later evaluates leading to questions about what scoring a “5” on the “radical idea” dimension mean in other contexts. Despite this shortcoming, it is a first proposal of how to address the challenge of evaluating transformative social innovation by comparing cases further than the closed-ended nature of the questions in the framework.

However, the framework did provide interesting insights that are presented below:
1. Radical idea

It is a challenge to evaluate what ideas that are strictly related to blockchain since it need to be used with other technologies (Appendix VI). Illustrating the potential challenge to evaluate one innovation separately since impact is often a result of multiple combined innovations (Olsson et al. 2017).

2. Push back, conflict with status quo

The dominating theme of all the interviews was not the magnitude of push back or conflict but the absence of it. Three cases instead mention movements that are working in their favor which might imply a possible window of opportunity or that the cases are not challenging status quo (absence of resistance) (Westley et al. 2017). It could also be that they have not yet gained significance enough (Westley et al. 2017) in line with explanation by three cases (Appendix VII). It could also be possible that the conflict management strategies presented by the cases are decreasing resistance.

What is interesting is that two cases independently mention a specific time (two years ago) that these movements in their favor started. I had the opportunity to ask the last interviewee, also talking about movements in their favor, about when these started and got the answer that things started changing a year ago. This highlights a dimension that is missing in the framework: Is there evidence of movements in the innovation’s favor?

This relates to Olsson et al (2014) “opportunity context”, that could be more interesting to investigate rather than push back or conflict in contemporary innovations. Motivated by a majority of cases experiencing push back from regulation confirming Westley et al. (2017) sixth pattern of policies as possibly blocking opportunities, which is quite expected from novel innovations and did in this case not generate interesting insights. It would be more interesting to investigate strategies for identifying possible movements in favor of initiatives and how these can be utilized in the call to leverage transformative capacity to alter feedbacks (Moore et al. 2004, Abson et al.2017, Olsson et al. 2017). One such example could be the Facebook and Cambridge Analytica scandal where three cases highlight that their solution could address the private data management issue and thereby provide an alternative to a growing distrust. This relates to the timing of introducing blockchain when it was desired as possibly contributing to its diffusion (Tapscott and Tapscott 2017)
Push back is mentioned by C3 and relates to internal resistance deriving from risks with changes (such as unemployment) from blockchain applications bringing efficiency. This is an interesting viewpoint since the related question in the framework is phrased “Is there evidence of the possibility of push back, of conflict with those who control the status quo?” implying that somebody is controlling the status quo, assumingly with the power to do so and a majority of interviewees answered the question from that notion. However, the resistance mentioned by C3 is coming from employees since they would not benefit from the changes, in line with “resourceful actors” that resist change in Moore et al. (2014) but possibly confirming difficulties in changing institutions (Abson et al. 2017). This suggests that people have to understand their benefits from a transformation to support it and highlights that not only powerful actors resist change. For blockchain this could possibly imply that removing middlemen (Charlebois 2017) could encounter both internal and external resistance and confirms the risk of creating workforce displacement (Tapscott and Tapscott 2017).

Conflict management and 3. Compromise

Four cases had collaborations with a variety of different actors which is important to have cross-scale impact (Westley et al. 2017). But this also implies that some of the cases are compromising and adopting their ideas. This is especially relevant for those cases that adopt their idea to suit their market. It would therefore be interesting for a further study to investigate the balance between necessary collaboration and adjusting the idea to the point of potentially losing its transformative capacity.

Funding

Because of the need to allocate resources (Westley et al. 2017) it seems that some variables, such as funding might be more important than others related to cases like e.g. C10 that have radical ideas and experiencing large push back but have small funding which possible hampers transformative capacity to a larger extent than the absence of conflict to in contemporary innovations. Many of the cases’ choice of long-term funding also reveals expected income from applying their innovations in a commercial setting which might question any transformative capacity since they have a market focus and are for-profit (Westley et al. 2012). This need to be related to e.g. the Internet that did not intend to be transformative but have had enormous impact (Franz et al. 2012) and the choice by C4 to become a for profit to increase impact and the cases intent to support sustainability. This does
not disprove the limited capacity of private sector to navigate transformation (Westley et al. 2011) or to challenge feedbacks and path dependencies (Olsson et al. 2017) but rather drive thoughts that the transformations theory known to the authors cannot answer; In the shift to a knowledge society (e.g. Green and Vergragt 2002), constituting of software companies such as the studied cases, reinforcing the same “growth oriented regime” despite externalized costs (Westley et al. 2011) possibly being very different than in an industrial society?

Awareness of the importance of cross scale changes in the broader institutional structures (values, laws, routines, policies)

Two cases seek to challenge laws (C2 and C5) but have small respective medium funding that might affect this capacity related to importance of allocated resources to have transformative capacity (Westley et al. 2017). The awareness to change laws is the dimension least fulfilled by the studied cases. All cases are on the contrary aware of- and are intending to change routines and C1 mention how this indirectly could have systemic impact related to changing path dependencies (Olsson et al. 2017). There could be a chicken-and-the-egg problem since e.g. changing values in turn could have cross scale impact as implied by the Westley et al. (2017) quote “for the most part a breakthrough social philosophy lay at the origin of the cascade of innovation” (p. 240). I therefore argue that the “law” aspect of institutional structures could be of less importance when studying contemporary social innovations since they are not likely to have the resources from the start to consider- or focusing on macro level impact, supported by the large amount of time required for a complete transformation (Westley et al. 2017). An interesting addition to transformations theory is C1 illustrating how the first movers implementing an innovation sets the standard for initiatives to come and thereby possibly create new path dependencies (Olsson et al. 2017) and in the process possibly influencing the innovations future trajectory complementing the notion of the underpinning idea affecting the innovation for a long time (Westley et al. 2017).

Blockchain mechanisms that could support transformation

The four identified mechanisms could support transformation to sustainability through challenging the processes that need to be addressed in a transformation.

Blockchain is already allowing us to think differently related to imagining a new possible future outside current unsustainable trajectories to unlock mindsets from current regimes
(Olsson and Galaz 2012, Olsson et al. 2014) but (Moore et al. 2014) illustrates that this is only one of many processes that need to change for a transformation to happen.

The four other mechanisms are presented below.

**Supporting sustainable behavior through transparency**
Blockchain could support the behavioral changes that are necessary for a transformation (e.g. Westley et al. 2003).

The first incentives model is related to **providing further support in the transition towards renewable energy**, through providing a necessary, potential systemic change (Davidson et al. 2016) through decentralized energy markets (Mengelkamp et al. 2018). Managing the grid through an open platform that give participants similar prerequisites could open up the dominant centralized system without necessarily removing those actors (Green and Newman 2016) related to imagining a new possible system (Olsson and Galaz 2012) and consumers through becoming prosumers, moving part of the financial power to their community (Andoni et al. 2017). This resonate with the call to decentralization of power (Folke et al. 2010, Olsson et al. 2014) and including diverse stakeholders (Olsson 2008) in transformation. At the same time as the energy trading cases are for profit that could limit their transformative capacity (Westley et al. 2017) and the question remain if providing an open platform could alter the necessary feedbacks (Olsson et al. 2014) for the energy system to transform. C6 confirms this notion under results in “routines” and explain that they are not aiming at challenging the status quo possibly limiting transformative capacity of this mechanism through e.g. question four in the framework related to importance of founders intending to have cross-scale impact (Westley et al. 2017).

The second incentives model relate to **providing incentives for “good” actors in the supply chain to encourage continuous sustainable actions**. Resulting in normative challenges about what is regarded as “good” similar to deciding whose goal that get prioritized in transformation (O’Brien 2012). This is exemplified by C4 as highlighting that transparency is not a universally shared value. This could not only exclude the not so technical people from having influence in blockchain (e.g. De Filippi and Loveluck 2016) but also those that for different reasons are hindered from participating since transparency could be a political question, not to mention everybody that has no access to internet. Mechanisms supported by blockchain could therefore also contradict the just and equal part of transforming to
sustainability (Westley et al. 2017) suggesting more research into how digital innovations intended to sustainability, not only have to take into consideration social-ecological connections (Olsson and Galaz 2012) but also what that social dimensions that are included and excluded, possibly related to shortcoming to address power in SESs transformation research to a limited extent (Olsson et al. 2014).

Since blockchain could provide immutable data that suppliers could reveal with little risk, actors could put pressure on suppliers to reveal where their products are coming from and possibly providing a tool that empower consumers as shown by the quote from C3. This is at the same time an opportunity to influence behavior that resonates with transformations theory (Westley et al. 2011).

Compensation based on contribution could support transformation to sustainability by providing fairer compensation and contributing to the just and equal aspect (Westley et al. 2017) of e.g. supply chain sustainability.

**Momentum through digitalization**
Since the transformations concept view people as having agency to change their SESs (Walker et al. 2004) the scalability of blockchain platforms mentioned in C9 could enable a blockchain application to spread quickly over the internet to have an amplified impact on sustainability related to Wesley et al. (2011). But the question remains if this speed will be enough in the light of coming environmental changes and at the same time considering the just, equal and sustainable goals of transformation (Olsson et al. 2017). It is also important to highlight that the C9 quote focuses on reaching a lot of people (scaling out) while transformation also require cross-scale changes (scaling up) (Olsson 2017) which possibly limits the cases’ transformative capacity.

**Changing institutions through decentralization**
Blockchain could through the decentralization mechanism support transformation of institutions by removing middlemen, support cooperative forms of ownership and decentralized institutions.

All these processes support the transformation concept of decentralization of power (Folke et al. 2010, Olsson et al. 2014) and including diverse stakeholders (Olsson 2008). Through
enabling the change- or creation of new institutions, blockchain could also change the underlying parameters of behavioral changes (Westley et al. 2003). At the same time that blockchain might not be enough to generate the required trust to for cooperation (Paziatis et al. 2017). The decentralized mechanism does resonate with transformation theory since it enables the creation of new institutions that do not have to rely on the centralized economic- and political systems of today (Manski 2017). Blockchain could enable cryptocurrencies to unbanked people and therefore access to financial services through circumventing current financial actors. If this only create more consumers without considering systemic shifts, the solution is unlikely to support transformation to sustainability (Olsson et al. 2017). A decentralized system could also allow people to own the platforms that they use, as illustrated by C11 which provides an alternative to the top-down approaches often applied when implementing innovations (Olsson et al. 2014). Such a blockchain based platform could also allow for people to own- and control their private data, which could be an alternative to misuse of personal data by powerful actors (Tapscott and Tapscott 2017) and thereby addressing power structures.

**Challenging finance**

Blockchain enable transactions of digital value and therefore financial mechanisms that could support transformation to sustainability related to new financial institutions. Since blockchain could enable cryptocurrencies to unbanked people, these solutions could provide access to markets at a comparably low price supporting the equity part of sustainability (Westley et al. 2003). It is important to keep in mind that the initial idea with blockchain (through bitcoin) was to circumvent financial actors while currently the same actors are appropriating it to fulfil their purposes (Redshaw 2017). At the same time as C8 is presenting financial solutions supported by blockchain that unlock old trajectories and increase capacity for blockchain to contribute to financing projects aiming at transitioning to low carbon economy. This does not have any apparent influence on feedbacks (Olsson et al. 2014) but could unlock mental barriers among financial actors as presented by C8.

The only process that directly address the need to reconnect to the biosphere (Folke et al. 2011) are two green fintech cases that aim at coupling economy and ecology through backing up cryptocurrencies with ecological values and assets. All other processes do not mention efforts to address ecological values directly. The closest is the decarbonizing of energy
generation through the energy trading platforms that indirectly could have an impact on ecological values. Possibly confirming the shortcoming of social innovations to account for SESs connection (Olsson and Galaz 2012).

Feedbacks is also a theme that is not being addressed directly in the mechanisms. This relates to challenges in defining what feedbacks that the case could alter and how to evaluate if the cases are doing so at such an early stage which does not seem likely. This might question the transformative capacity of the blockchain mechanisms since transformation implies changing feedbacks that reinforce the current system (Olsson et al. 2014). Since the blockchain cases are so novel, the identified mechanisms could provide a basis for further evaluation in the longer timeframe (Olsson et al. 2017).
7. CONCLUSION

This study addressed the need to consider technology in SESs systems research through studying blockchain and develops transformative social innovations framework through its application on a contemporary innovation. It also evaluates blockchains transformative capacity. It contributes with a first study of blockchain as a social innovation defined as “a new program, policy, procedure, product, process and/or design that seeks to address a social problem and to ultimately shift resource and authority flows, social routines and cultural values of the social system that created the problem in the first place” (Westley et al. 2017: 4) and gives insights that can be used for further studies of transformative capacity and blockchain. In this study I found that eight of the evaluated 11 blockchain cases have transformative capacity to various extents, and thereby answer the first research question. In the process of applying a transformative social innovations framework to evaluate the transformative capacity, four mechanisms through which blockchain can support transformation to sustainability were identified.

For further research I propose; focusing on one or few blockchain cases for a more in-depth study and to perform longer interviews to gain the opportunity to follow-up more profoundly on interesting themes.
LITERATURE CITED


APPENDIX I Literature review blockchain

<table>
<thead>
<tr>
<th>Used service</th>
<th>Search topic</th>
<th>Date</th>
<th>Results (number of)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web of Science</td>
<td>“blockchain”</td>
<td>2017-12-14 to 2017-12-16</td>
<td>Total: 293 Reviewed: all Included in study: 34</td>
</tr>
</tbody>
</table>

Of the reviewed 293 articles, only 34 relate to the social-ecological sustainability framing of this study. For information, other key themes are given in the box below.

| Key themes outside the social-ecological sustainability framing of this study: | Blockchain for IoT, healthcare/health transcripts, privacy preservance, computer science, regulation/law, transport solutions, combat fake medicines, financial services, blocktime/verified time, reputation systems, business/management opportunities, E-residency/identity, gaming, disaster aid crowd-funding. |

The 34 articles relating to sustainability transformations are:


Article 4  Fairley, P. 2017. Feeding the Blockchain Beast if Bitcoin ever goes mainstream, the electricity needed to sustain it will be enormous. IEEE, [online], Sept., Available at: https://ieeexplore.ieee.org/abstract/document/8048837/ [Accessed 1st June 2018].


Article 12  Kshetri, N. 2017. Will blockchain emerge as a tool to break the poverty chain in the Global South. Third World Quarterly 38(8): 1710-1732.


Article 20  Peck, M.E. 2017. Do You Need a Blockchain? This chart will tell you if the technology can solve your problem. IEEE, [online], Sept., Available at: https://ieeexplore.ieee.org/abstract/document/8048838/ [Accessed 1st June 2018].

Article 21  Peck, M.E. and D. Wagman. 2017. Energy Trading for Fun and Profit Buy your neighbor’s rooftop solar power or sell your own—it’ll all be on a blockchain. IEEE, [online], Sept., Available at: https://ieeexplore.ieee.org/abstract/document/8048842/ [Accessed 1st June 2018].


APPENDIX II Summary of key word search

Date: 2017-11-12 to 2017-12-06
Method: Search engine Google.com

Based on first 10 results pages in Google.com

1. Sorted according to observed (preliminary) themes.
2. Sorted in alphabetical order.
3. Duplicates have been removed.

<table>
<thead>
<tr>
<th>Keywords</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Supply chain</strong></td>
<td></td>
</tr>
<tr>
<td>1. cocoa</td>
<td>34. fisheries</td>
</tr>
<tr>
<td>2. commodities</td>
<td>35. mining</td>
</tr>
<tr>
<td>3. coffee</td>
<td>36. practices</td>
</tr>
<tr>
<td>4. cotton</td>
<td>37. real-world applications</td>
</tr>
<tr>
<td>5. fashion</td>
<td>38. safety</td>
</tr>
<tr>
<td>6. food</td>
<td>39. sharing economy</td>
</tr>
<tr>
<td>7. materials</td>
<td>40. spoilage</td>
</tr>
<tr>
<td>8. minerals</td>
<td>41. trust</td>
</tr>
<tr>
<td>9. organic food</td>
<td>42. food companies</td>
</tr>
<tr>
<td>10. tuna</td>
<td>43. inclusion</td>
</tr>
<tr>
<td>11. traceable</td>
<td>44. sustainability scores</td>
</tr>
<tr>
<td>12. track</td>
<td></td>
</tr>
<tr>
<td>13. validate</td>
<td></td>
</tr>
<tr>
<td>14. validating supply chain</td>
<td></td>
</tr>
<tr>
<td>15. palm oil</td>
<td></td>
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<tr>
<td>16. products</td>
<td></td>
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<tr>
<td>17. provenance</td>
<td></td>
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<tr>
<td>18. raw materials</td>
<td></td>
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<tr>
<td>19. sourcing</td>
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<tr>
<td>20. track</td>
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<tr>
<td><strong>Social</strong></td>
<td></td>
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<tr>
<td>21. carbon markets</td>
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<td>22. certified</td>
<td></td>
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<tr>
<td>23. coffee growers</td>
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<td>24. community</td>
<td></td>
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<tr>
<td>25. corporate reputation</td>
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<td>26. corporate sustainability</td>
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<td>27. changed</td>
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<td>28. credentials</td>
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<td>29. developing nations</td>
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<td>30. disruptive</td>
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<td>31. eliminate corruption</td>
<td></td>
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<tr>
<td>32. ethically-sourced</td>
<td></td>
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<tr>
<td>33. fair trade</td>
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<tr>
<td><strong>Environment</strong></td>
<td></td>
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<tr>
<td>45. air pollution monitoring</td>
<td></td>
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<tr>
<td>46. carbon accounting</td>
<td></td>
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<td>47. Carbon currency</td>
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<td>48. climate change</td>
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<td>49. Conservation</td>
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<td>50. distributed registry</td>
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<td>51. environmentalism</td>
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<td>52. environmental management solutions</td>
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<td>53. environmental mitigation</td>
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<td>54. environmental groups</td>
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<td>55. Environmental problems</td>
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<td>56. forestry</td>
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<td>57. governance</td>
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<td>58. green</td>
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<td>59. green finance</td>
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<td>60. green trade</td>
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<td>61. greenwash</td>
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<td>62. lifecycle</td>
<td></td>
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<td>63. material recycling</td>
<td></td>
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<tr>
<td>64. reducing carbon emissions</td>
<td></td>
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<tr>
<td>65. smart farming</td>
<td></td>
</tr>
<tr>
<td>66. sustainability software</td>
<td></td>
</tr>
</tbody>
</table>
**Energy**
67. electric vehicle charging
68. energy
69. energy efficiency
70. energy management
71. energy transactions
72. energy supply chain
73. Clean energy
74. connected homes
75. control appliances
76. optimize energy consumption
77. power and utility grids
78. renewable energy
79. smart grids
80. transactive grid
81. transmission
APPENDIX III Interview guide

**Semi-structured questions**

Q1: When did the project start?
Q2: What is the long-term goal of your project?

<table>
<thead>
<tr>
<th>Transformative social innovation framework</th>
<th>Interview question(s)</th>
</tr>
</thead>
</table>
| **1. Does the innovation contain a radical seed?** | Q3: Would you say that the project is contributing to challenging the status quo in any way?  
- In what way/why not?  
Q4: Would you say that your initiative contains a radical counter truth?  
- In what way/why not? |
| **2. 2. Is there evidence of the possibility of push back, of conflict with those who control the status quo?** | Q5: What resistance or conflict are you experiencing?  
Q6: Any resistance from those that can be seen as controlling the status quo? |
| **Can that conflict be managed or sidestepped?** | Q7: How are these different challenges managed? |
| **Is the founder securing more resources?** | Securing more resources is partly represented by finance (securing more financing) in the interview.  
Q8: How is the project funded now and how will it be funded in the future?  
Q9: What plans to expand are there? |
| **3. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand?** | Q10: What kind of compromises does these decisions (financing and expansion) include? |
| **4. Are those associated with the innovation, even in the earliest stages, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?** | Q11: Do you plan to have an impact on broader institutional structures (values, laws, routines, policies)?  
- Why/Why not? |

**Structured questions**

Q12: How transformative would you estimate that blockchain could be in the future on a scale 1-10 (1 is not at all, 10 is the most transformative, In term of changing and challenging values, laws, routines, policies etc.)?
Q13: How transformative would you say that your project would be in the future 1-10? (1 is not at all, 10 is the most transformative, In term of changing and challenging values, laws, routines, policies etc.)?

Semi-structured questions

If different answer to Q15 and Q16;
Q14: Why the difference between the stated numbers?

Q15: What is the greatest obstacle in achieving that transformation?
   ➢ Getting back to resistance/challenges asked in the beginning.

Q16: When do you think blockchain will have an impact on sustainability?
   ➢ Asking because the leverage is intended towards sustainability.

PPT with questions from Per Olsson received by email 2018-02-06 (modified to Times New Roman font) acted as inspiration to the questions.

What to look for in a transformative social innovation

1. Does the innovation contain a radical and appealing counter truth - a seed that will be carried in time?
2. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand, securing more resources? (working with emergence and adjacent possible).
3. Are those associated with the innovation, even in the earliest stages, aware of the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)? Are they opportunistic (prepared to take advantage of opportunities even at some risk)?
4. Can those associated with the innovation tolerate paradox (the inevitable contradictions resulting from emergence and opportunity)
5. Is there evidence of the possibility of push back, of conflict with those who control the status quo? Can that conflict be managed or sidestepped?
6. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand, securing more resources? (working with emergence and adjacent possible).
7. Are those associated with the innovation aware of its shadow? Often revealed by conflict
APPENDIX IV Code book guiding inductive coding for research question one.

<table>
<thead>
<tr>
<th>Framework</th>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does the innovation contain a radical seed?</td>
<td>Case idea</td>
<td>This code is used when the interviewee is talking about what ideas, visions, goals or counter truths the case contributes with</td>
</tr>
<tr>
<td>2. Is there evidence of the possibility of push back, of conflict with those who control the status quo?</td>
<td>Push back or conflict</td>
<td>Highlights conflicts or push backs that the case is experiencing.</td>
</tr>
<tr>
<td>Can that conflict be managed or sidestepped?</td>
<td>Conflict management</td>
<td>What the case is doing to mitigate or handle push back or conflict</td>
</tr>
<tr>
<td>3. Is the founder or originator of the idea prepared to make the necessary compromises to see the idea grow and expand, securing more resources? (Working with emergence and adjacent possible).</td>
<td>Compromises</td>
<td>How the case is compromising.</td>
</tr>
<tr>
<td></td>
<td>Funding (now and in the future)</td>
<td>How the case is funded now and will be funded in the future</td>
</tr>
<tr>
<td>4. Are those associated with the innovation, even in the earliest stages, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>Awareness of cross-scale changes</td>
<td>When the interviewee is talking about the need/wish/aim to change values, laws, routines and/or policies.</td>
</tr>
</tbody>
</table>
APPENDIX V Estimation of transformative capacity for each case.

A total estimation for each interview/case is presented under each category, represented by the highest number in that category.

**Case 1**

<table>
<thead>
<tr>
<th>Question to data</th>
<th>Representative Quotation</th>
<th>Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“So, what we're most interested in is how we can support farmer-consumer interactions and how we can drive more value across the chain by not necessarily taking out the role of intermediaries who stands between the farmer and the consumer, but enhancing the interaction so that more value is created and delivered across the chain”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>“there are some intermediaries who have been regarded as providing very little value but in fact provided enormous value. In part of making supply chains more transparent, is actually making that value more transparent. “</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“within a blockchain we're able to work with simultaneous transactions. So that is something that, adds improvements”</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>“problems that were so embedded in those supply chains that the participants didn't even think they were problems they just thought that that is the way supply chains worked”</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“what we're doing is questioning that, and saying; is that the way it needs to be? Do farmers only have a role at the beginning? Do consumers only have a role at the end? How can we make our supply chains more modular?”</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>“but I think there is more power going to the farmer over time, the farmer is looking at ways in which they can put themselves into a better position in the supply chain”</td>
<td>3</td>
</tr>
<tr>
<td><strong>Highest:</strong></td>
<td></td>
<td><strong>4</strong></td>
</tr>
<tr>
<td>2. Is there evidence of push back, of conflict</td>
<td>“not all that disruption is unwelcomed, a lot of that disruption is actually wanted”</td>
<td>1</td>
</tr>
<tr>
<td>with the status quo?</td>
<td>“now, what we are doing is seen more as exciting and more of an opportunity by some of those players”</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>“whenever you're trying to organize and bring into order and take a systemic approach to what has previously been quite a competitive industry and one that has been dominated by a series of silos and not a series of collaborative partners we're going to run into some level of resistance”</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“we don't find that we run into as much resistance, we just find that there are levels of maturity and adoption within the market which are completely natural “</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>“so, the movement in thought has kind of been working in our favor in that way.”</td>
<td>1</td>
</tr>
<tr>
<td>Are there strategies for managing that conflict?</td>
<td>“there are elements that are centralized to begin with and then we're going to decentralize after time, as we get more market acceptance”</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“So, I think that we want to be careful and to educate all parties to the value that all participants play in the supply chain”</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“think we've just got better in our approach and recognizing that, and been able to work with those who are ready to work with us as opposed to, you know, seeing that there are roadblocks in our way”</td>
<td>4</td>
</tr>
<tr>
<td>Highest:</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?</td>
<td>“but I would say that overall, that was very much in the early days, when perhaps we were not articulating what we were doing as well as we do now”</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>“there are elements that are centralized to begin with and then we're going to decentralize after time, as we get more market acceptance “</td>
<td>3</td>
</tr>
</tbody>
</table>
"We're only just starting to see policy and [...] at a regulatory level of how digital assets or digital currencies should be treated and that's kind of really unfolding and we think that we need to be at the forefront of that and providing front leadership and engagement with regulators and others as to how these new assets will evolve and how they can be used in the future”

“that's why we did an ICO [...], we could have done an ICO in the middle of all the hype. it’s very important to us that what we are building is sustainable and that it has, that we as individuals have our reputations, our integrity as we unfold and that as a company we have a reputation and are known as being a player of integrity and a thoughtful player in this space”

<table>
<thead>
<tr>
<th>Highest:</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Is the case well-funded? (Now and in the future)</td>
<td>3</td>
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</table>

<table>
<thead>
<tr>
<th>Highest:</th>
<th>3</th>
</tr>
</thead>
</table>
| 4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)? | “what we're doing is questioning that, and saying; is that the way it needs to be? Do farmers only have a role at the beginning? Do consumers only have a role at the end? How can we make our supply chains more modular? And less linear and transactional and if that's the case, obviously that is going to have some policy impact over time because we are looking at a changing role of the participants.”

“We're only just starting to see policy and [...] at a regulatory level of how digital assets or digital currencies should be treated and that's kind of really unfolding and we think that we need to be at the forefront of that and providing front leadership and engagement with regulators and others as to how these new assets will evolve and how they can be used in the future”

“how you commercialize the technology is actually commercializing standards at a global level.” | 4 |

<table>
<thead>
<tr>
<th>Highest:</th>
<th>5</th>
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</thead>
<tbody>
<tr>
<td>How transformative do</td>
<td>Questions asked to interviewees answered on scale</td>
</tr>
</tbody>
</table>
they estimate their project to be? 1-10 meaning that answer needs to be divided by 2 (to get a 1-5 scale). 8/2=4

### Case 2

<table>
<thead>
<tr>
<th>Question to data</th>
<th>Representative Quotation</th>
<th>Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“these systems provide governance model which provides [...] responsibility of everyone throughout the transaction which then mean that there is fairer distribution of the wealth across everybody's contribution.”</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>“when people become involved and they don't put the effort that is required and then they believe that they should receive a fair amount of the oxide and for having done absolutely nothing or actually having failed to do what they should have delivered. With this, you could say this is fraud, this is unfair, but this is the way our society allows them to act at this point. When you have a system, which creates that transparency you then can then say; this is what your contribution was, and this is what you get for your contribution, no more no less.”</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>“I don't think that it is a radical counter truth, I think it is a radical ideal in that I talk about the farmer as a business person”</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>“but imagine somebody who has no ability to record this, which is only receiving cash, so we talk about removing these. And these are the other norms that we are challenging, we are moving away from a cash society but still looking at providing digital cash to people without them having access to a banking facility”</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>“the bank is to provide you with liquidity but you remove the bank to have your money….and they don't want your money if your money is very little[...] but if you put that information into a distributed ledger you're kind of creating the same, you're doing ledger accounts, which is what the bank does, entry's and debits and credits, and you're providing evidence, to which you really then can provide chain of custody of information”</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>“if you think of the crops, or any goods that has</td>
<td>4</td>
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</table>
been created by someone as an asset that has been created, you can then take this idea of an asset, and an asset transfer and as a conversion, and if you can guarantee me that I’m going to get paid as soon as I deliver the asset [...] you can do evidence of delivery[...] I can trust you with my good or caring, because I know that once it is delivered you will get your payment and I will get my payment.”

“I am looking at shifts which is value based in terms of government, so data, identity, really being able to look at privacy [...] Unfortunately in technology we tend to more forward very quickly without understanding but if you look also if we are successful, or when we are successful at what we're doing, we're going to be changing how commerce is done and how information is accessed and how data is accessed, and also who owns the data”

“At this moment individuals do not own their own data, if you look at the fiasco of Facebook, and Cambridge Analytica, it's because we don't really own our data and we have no control of our data. This is going to change how information is accessed, delivered and also disseminated and providing views of where data has gone”

“So, somebody cannot just start manufacturing and using keys and getting them on to your system”

<table>
<thead>
<tr>
<th>Highest:</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2. Is there evidence of push back, of conflict with the status quo?</td>
<td>“Resistance is going to come later when people realize what you are actually doing in the transparency. Now, I don't think that the resistance will be as big as we think it will be because, maybe I'm a bit, optimistic but I really don't believe that people want to cheat”</td>
</tr>
<tr>
<td>Highest:</td>
<td>3</td>
</tr>
<tr>
<td>“I don't think there is resistance, it is lack of understanding”</td>
<td>3</td>
</tr>
</tbody>
</table>

| Are there strategies for managing that conflict? | “I think that one thing that ends up when you're working with others is the exclusivity of the idea but what I think that it does give you [...] the scale of the acceptance becomes bigger [...] It is more about to be able to do some of the parts and then creating the synergies in other parts |
| Highest: | 3 |
of finance or information to then provide a total picture. So truly an integration effort […] I then create better chance of success and that's also why we see ourselves as a service rather than an infrastructure”

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<tr>
<td>3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?</td>
<td>“I think that one thing that ends up when you're working with others is the exclusivity of the idea but what I think that it does give you […] the scale of the acceptance becomes bigger […] It is more about to be able to do some of the parts and then creating the synergies in other parts of finance or information to then provide a total picture. So truly an integration effort […] I then create better chance of success and that's also why we see ourselves as a service rather than an infrastructure”</td>
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<tr>
<td>Is the case well-funded? (Now and in the future)</td>
<td>“I am looking at shifts which is value based in terms of government, so data, identity, really being able to look at privacy”</td>
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<tr>
<td>4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>“I’m looking at changing processes, those processes will change laws but you need to be able to…, technology does not change mindsets, technology enables the changes that happen, so that's why I think, also for me, I'm very much still about the proponent of the individual human into the chain, so I get very wary when people say there is going to be a chip or a machine which is going to do the whole thing. No, at the end of the day it is an individual at the beginning and an individual at the end. So, I am going to have to shift the norms like”</td>
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|  | 5 |
| “My projects have always been about laying the foundation. I want to move water. I don't go, and I drop a big rock in there and just do a lot of splashing. I just strategically place pebbles at the bottom and as you're placing the pebbles you start |
moving and shifting the current”

“I am part of the (organization)’s [...] so I do influence quite a bit what government do talk about things. I don’t need to talk about my project to make the fundamental changes that are necessary in this space, it is more about being able to be a steady mouth in those conversations [...] it’s not about just my project it’s about the fundamentals that I’m trying to drive.”

*National organization that supports connection between government and businesses.

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<tr>
<td>How transformative do they estimate their project to be?</td>
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**Case 4**

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<th>Question to data</th>
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<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“What blockchain has the promise of doing, this is not something that’s been realized yet, but the promise of making it possible for that kind of traceability to be available for any product irrespective of the value because it would allow each stakeholder to manage her own data on her own device; smartphone, computer at very low cost, so these apps are virtually free, the internet is virtually universal so in principle you could get to the place where even a smallholder farmer would be able to manage her own transactions personally and be part of a global traceability scheme that gets communicated all the way to the end consumer”</td>
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<td></td>
<td>“globalization happened a long time ago and way before there was the ability to communicate with the people who actually make the things we buy and now the internet is here we're expanding the power of the internet to allow you to know for every single product where it comes from, who made it”</td>
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<td></td>
<td>“I like the word radical because it means to [...] and I think we are definitely on a mission to reveal the truth about supply chains”</td>
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“the problem was that companies don't know their supply chain. And so, it's very nice to ask them to be transparent but much more useful to give them the tools for them to actually know. So, we had a lot of companies saying; Yeah of course we want to be transparent, who doesn't? But we have no idea which farmer is selling Cocoa or which factory is sewing fabric, so, for me the biggest [...] the tool was the solution, the solution was; let's get these factories to actually know what's going on”

“Supply chain transparency has the chance to feed and clothe the world using way less resources while giving everybody jobs so for me that's the promise of supply chain [...]Blockchain is a tool that we can use to help with that.”

“basically, enabling the supply chain to be transparent without threatening the confidentiality of business sensitive data along the way and that's quite an ambitious goal because traditionally you would have had to audit purchase records of your suppliers in order to know that the products you are getting are actually coming from an authentic source. And with blockchain you do not have to have access to those books. The verification can happen in the chain without that sensitive information being revealed”

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| 2. Is there evidence of push back, of conflict with the status quo? | “I think we are seeing our biggest obstacles in, geopolitically, so we have a wide range of different priorities in different parts of the world and honestly transparency is not a value that is shared universally so, we have a lot of, we have a long road ahead in many parts of the world just to start transparency”

“‘There are remarkably few conflicts in the business side where we see companies demanding that the suppliers provide the addresses of the farms. People you know check to see whether there is de-forestation, or they check to see that the workers are paid adequately. So that part is going quite well because a lot of big companies have the gun to put some real pressure on their supply chains to step up. So, the parts that has been unexpected for me have been, so we know that it is hard for a big multinational company to disclose information” | 4 |
about their supply chain. So, we know that that takes a lot of work and often months and months of legal and marketing decision making, so that's not the big surprise. For me the biggest surprise is that, the non-profits and the industry groups that essentially certifies supply chains as being sustainable, they are in many ways not transparent enough, so you're having a really hard time finding a map of all the Fair-Trade farms or all the organic farms or all of the certified factories”

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<tr>
<td>Are there strategies for managing that conflict?</td>
<td>“there are hundreds of decisions you have to make every day, when you run a software platform to avoid making the horrible impact that companies like Facebook have made, so in the beginning, to do the opposite, to violate privacy and to violate trust. For us it is every day, very conscious decisions to increase the trust that people have in us as a source of truth.”</td>
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<tr>
<td>3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?</td>
<td>“businesses are a long negotiation, so I guess every day either we are compromising, or our clients are compromising. Look, when this started [...] this was obviously a non-profit project for benefit, the software was open source, the service was very much for consumers. And we have always kept that mission alive, so we still have a free software, a consumer facing platform even though it doesn't make any money. What we did was that we built the other services to bolster the mission. We've had more impact to create transparency in supply chains as a for profit than we ever could as a non-profit”</td>
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<tr>
<td>Is the case well-funded? (Now and in the future)</td>
<td>n/a</td>
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<tr>
<td>Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures</td>
<td>“I believe since the beginning, that the biggest impact we’re going to have is if we can empower businesses to compete on the basis of how they manage their supply chains. So, in fact it is more of a liberal project to be completely accurate because”</td>
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we're not changing the rules of business, we're not changing the rules of government. We're creating an accountability system that makes it possible for governments and brands to know the impacts of supply chains and then to fix them”

“guess from a mission point of view; we try to tackle the most complex and problematic supply chains, that's how we built our technology. That's how we do our RnD, we solve the most complex problems in the world, then we can solve all the rest of them too”

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<th>(values, laws, routines, policies)?</th>
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<td>Questions asked to interviewees answered on scale 1-10 meaning that answer needs to be divided by 2 (to get a 1-5 scale). 10/2=5</td>
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**Case 5**

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<th>Question to data</th>
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</table>
| 1. How radical is the counter truth presented by the case? | “Another could be that you’re developing a system that is inclusive for everyone and you’re not just simply somehow designing a solution, folks that are able to spend the money to install a solar panel and thermostat and are then able to reduce cost revenue whereas low income communities are not able to do that. And again, we’ve been working on mitigating that”

“I mean it is a very radically different way of managing the grid where it’s really just an open platform and anyone can sort of build upon that, that is a radically different way of doing the grid, so I think that is a significant change.” | 3 |

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<tr>
<td>1. How radical is the counter truth presented by the case?</td>
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| 2. Is there evidence of push back, of conflict with the status quo? | “It’s probably the regulation. I mean there is just so much of what we want to do today that is difficult to do in a commercial sense. We can do a technological demonstration but actually, you know, allowing customers to participate is illegal because you know, only a certain type of companies is to allowed to provide this service and so that prevents smaller, you can imagine someone with a solar panel who wants to sell energy to their neighbor, you know that can be difficult to do | 4 |
because of regulation since there is only retailers are allowed to do that. No single household is going to register as a retailer. And it gets worse If you want to get into demand management, flexibility services so there is a lot of regulatory issues.”

“Some of them are aware of this problem and they are already taking very active measures to find what would be their next business model but in other locations there are a number of companies that have not yet begun to really make any change and they view us as a competitor or disruptor instead of a partner. So, it just depends on their approach”

| Highest: | 4 |
| Are there strategies for managing that conflict? | n/a |

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| 3. Is the founder or project manager prepared to make compromises to see the idea grow and expand? | “I think it's going to take a real global expansion of the idea in a way that [...] can't do alone, that maybe requires us to find some, I guess the best way to put it would be just some localized partners or strategies that can find and implement the value in different places that have very different understandings of business” |

| Highest: | 4 |
| Is the case well-funded? (Now and in the future) | 3 |

| Highest: | 3 |
| 4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)? | “I think it's going to take a real global expansion of the idea”

“So, that would be in conflict with current business models and I think it really depends on the company. Some of them are aware of this problem and they are already taking very active measures to find what would be their next business model but in other locations there are a number of companies that have not yet begun to really make any change and they view us as a competitor or disruptor instead of a partner. So, it just depends on their approach” | 2 | 1 |
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## Case 6

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<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“so, what we do, that is the democratization aspect of it, where everyone can participate in the market, and rather than having the market rules favor the big generator and only paying a little bit of return to small generator, now we can treat everybody as equal. So, if you put, let's say 90% in, then you get 90% of the benefit, if you put 10 you get 10% of the benefit.”&lt;br&gt;“we are not rewriting the laws of physics we're just rewriting the laws of the market. And what we're doing is providing the market mechanism that can demonstrate, for accounting purposes, that energy is flowing next door [...] For instance, when you're selling solar into a network and your neighbor is using it that energy is flowing next door but at the moment, the market rules when were designed for that phenomenon, the market rules are geared upon this idea that energy comes from a big, centralized point of generation a long way away, the energy travels down a transmission infrastructure network, through a distribution network, is distributed out to households and that cost for your energy assumes that that's the case for every electron, but in reality, electrons are coming from all over the place. They are coming from everyone generating energy, the multiple points of generation, and so what we do is using modern tools, can basically just provide a software that better reflects what’s actually physically occurring inside the market. And, that technology, the [...] technology, the blockchain technology, in energy applications, in transactive layers, it seems that that is the key to incentivizing the rapid uptake of renewable technology.”&lt;br&gt;“we are already providing decarbonized energy to individuals that would otherwise not have access to that electricity.”</td>
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“so from the generators perspective, it would actually be more advantageous for them to see our platform and the reason for that is that, what we do is that software links generators directly to consumers, it just doesn't favor the centralized generator the way the market rules currently do[...]So, we are not taking anything away, we're just making it more equal[...]What's happening now is that, we are seeing a lot of small, or renewable projects coming in to the suburbs, coming into the edge of the grid, we see batteries coming, so now what we're starting to see is energy flowing the other way. That was never conceived of when these, particularly the older networks were designed.”

“don't create the wave, ride it. And, the uptake of renewables that I'm talking about is a distributed uptake and that phenomenon is already under way, we're rapidly seeing the uptake, distributed renewable energy is globally a phenomenon, and what we're doing is, we reward participation”

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<td>2. Is there evidence of push back, of conflict with the status quo?</td>
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<td>“Well, every regulatory environment around the globe is different so you can't really say that, like a barrier here in [...]is not a barrier in India, so on and so forth”</td>
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<td>“The [...] government were paying for an open-source governance model so that we can provide the revenue incentive for people to share battery and solar, in shared living scenarios.”</td>
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<td>“I guess what I would say is that energy markets are in a state of transition, they're in a state of flux.”</td>
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<tr>
<td>Are there strategies for managing that conflict?</td>
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| “Network operators, retailers, government, technically it was possible but the market rules globally, there are barriers out there to doing exactly what we want to do. And that differs all around the world, everybody has gotten different market rules, market rules are not dictated by laws of physics they are dictated by the society and culture that
create them. So, it was basically technically possible, we just found a way to do it, in the regulatory regime.”

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3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?

“I mean, we certainly see a lot of challenges in the future, in fact, the platform we want to offer, is not the platform we offer today, and so the energy market in the future will be very different, and we've got the eye [...] on that prize, but today it is all about interfacing with the existing market, getting the application taken up, but ultimately we will shift to a more decentralized, more open platform in the future”

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4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?

“So you know, not only is our tool a platform for decarbonizing the energy market, but what we are able to do as well is to dramatically have a profound impact on people's lives, and we do that by, this comes back to this idea of rewarding the participants... so these types of initiatives are the ones that we are most interested in, and that company now has been rolling this method out on every single one of their developments across the state and we are already looking into entities all over[...] and the world to do the same.”

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<p>| Case 9 |</p>
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<th>Question to data</th>
<th>Representative Quotation</th>
<th>Estimation</th>
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</table>
| 1. How radical is the counter truth presented by the case? | “and we're always kind of bottom up approach, so we start with people in communities instead of top-down bureaucratic technocratic solutions”
“So, the aim of the project, if we look at the very long-term vision, is, it is really about bound | 5 |
economy and ecology, so it’s, to link our environment to our economic thinking. So, we often use this metaphor of the forest where if you go to a forest and cut it down, you could sell that and gain a lot of economic value, but no one is paying anyone to go out and plant the forest right? So, this seems to be […], where we want to flip that around and we want to economically reward people for their environmentally good actions. So, it becomes a different kind of way in which to incentivize people to do sustainable actions because often it’s seen as a moral obligation”

“sometimes it is even more expensive to do the right or the kind of sustainable thing, so we want to really challenge that idea and to really see if we can link our economy and kind of ground it and make people think about what they actually value and how they value nature to put it kind of broadly.”

“I think it’s something that we've become, unattached, that money is a system that we can design ourselves, where were always kind of used to now seeing money as something that is just given to us and it’s a system that can never change and that's just not true. So, I think if we look at money as this technology, it should evolve, and it should update somehow so we're kind of trying to stimulate that.

“but I think it certainly challenges people’s notion of how they look at our biosphere, how they look at nature, and how they perceive value. Because often we have a very concrete perception of what value is, when it comes to kind of euros or dollars because we use it every day and we understand that we're buying X or Y but when you present people with an alternative that reflects an alternative value system, like trying to value our environment, they then have a lot of questions like; how do you define what one… coin is?[...]like, how much do we value nature over something else?”

“thousands of currencies out there on exchanges that aren't used, they're just a speculative vehicle so we've really focused on that people comes first, this is to enable people to have a better relationship with nature so that needs to be the central focus how we grow”
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<td>2. Is there evidence of push back, of conflict with the status quo?</td>
<td>“I guess maybe at the stage where we're at that we don't have that push back yet, but I do expect that to come when it grows and becomes bigger and more people get invested into it”</td>
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<td>“So, there is lots of legal and regulatory barriers when it comes to this space and that’s constantly changing depending even where you live and how you set up your currency. So that is something I'm constantly aware of. Especially if you are scaling to different parts of the world, you need to make sure that your currency is in line with any regulatory body.”</td>
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<td>“I would say greatest barriers would be acceptance push back from people who get it confused with other things or don't necessarily understand what we are trying to do. I think in the crypto space there are a lot of scams coin and making sure you position yourself as something legitimate and something transparent enough that people can invest in.”</td>
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<td>“To the project we don't get a lot of resistance, most, I think we are either just being very lucky or people really believe in what we are trying to do, but most people, like 99% its very positive the feedback, which is really surprising actually like I really, always think that there should be more negative push back towards what we are trying to do somehow.”</td>
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<tr>
<td>Are there strategies for managing that conflict?</td>
<td>“I think transparency is one, making sure that we are well informed when we come to decision making is another. So, making sure that we hear several different perspectives and try to get experts in the room and try to kind of listen and way up the different options that we could have in a logical manner is another way in which we go about it when we are making decisions we need to have lots of people at the table and make sure that when we build these things we are also including the people who would use it at the end of the day, so there is no point in us agreeing and then going and building</td>
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this thing and then people being like, no this isn't how I want this to work.”

“So, making sure that we hear several different perspectives and try to get experts in the room and try to kind of listen and way up the different options that we could have in a logical manner is another way in which we go about it when we are making decisions we need to have lots of people at the table and make sure that when we build these things we are also including the people who would use it”

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3. Is the founder or project manager prepared to make compromises to see the idea grow and expand?

“And I would say then that the compromise probably comes from how we formed this consortium or, so how we will need to be able to be very flexible to facilitate various stakeholders, or various organizations to sit under the same umbrella and all be comfortable with what we are doing. Because a university might have very different goals and very different political opinions to let’s say a business, but both might want to use the platform and wand to use the currency, so I guess there is going to be a lot of tension there and so we'll have to kind of network through that, making sure that everyone is kind of comfortable with what we present, and I'd imagine there will be some give and take there.”

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Is the case well-funded? (Now and in the future)

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4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?

“but I think it certainly challenges people’s notion of how they look at our biosphere, how they look at nature, and how they perceive value. Because often we have a very concrete perception of what value is, when it comes to kind of euros or dollars because we use it every day and we understand that we're buying X or Y but when you present people with an alternative that reflects an alternative value system, like trying to value our environment, they then have a lot of questions like; how do you define what one… coin is? [...] like, how much do we value nature over something else?”

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How transformative do they estimate their project to be? Questions asked to interviewees answered on scale 1-10 meaning that answer needs to be divided by 2 (to get a 1-5 scale). $8/2=4$

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<td><strong>Question to data</strong></td>
<td><strong>Representative Quotation</strong></td>
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<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“Of course, from my perspective the answer is 9. It is not 10 because [case] is not alone. But we very much can have an everlasting effect on our environment and world we live in. We are, the entire cryptocurrency industry, already empowering some of the most previously powerless people.”</td>
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<td>“So, I wanted to make a project, that that was the glue, life itself was the glue, our environment, people itself, everyone can relate to that regardless of what country, what race or what religion, we all can relate to that.”</td>
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<tr>
<td>2. Is there evidence of push back, of conflict with the status quo?</td>
<td>“the biggest concern is our government clamping down on crypto currencies in general.”</td>
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<td>“especially here in[...] there is a lot of regulations that are being clamped down on ICOs, Initial Coin Offerings, and different scamming projects”</td>
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<td>“This is evident by governments, financial institutions, and 'the powers that be' trying to lasso-in and handicap the industry before it erodes their fundamentals fabricated from meaningless numbers manipulated at whim. The blatant attacks and attempts to suppress are almost childish. Case in point (multinational bank) recently closed the (case) bank account with zero true reason, explanation, or disclosure of motive. I doubt they would have cared if I opened a lemonade stand. But since[...] is a currency with good at the top of the food chain, not pillage and plunder, they must &quot;cease the relationship&quot;. A relationship with a (non-profit) because the word &quot;coin&quot; appears in the name. I am honored they view our humble project as a threat to their debt-based, war-mongering, finite resource devouring, poverty-creating, fractional reserve schemes they have subjected our entire world to be</td>
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driven by greed for far too long. The rug has been pulled-out. Flailing as the fall is to be expected. Attempts at tightening legal requirements are also attempts to suppress but, will only serve as a catalyst once we gain endorsement by way of meeting the requirements fully and promptly.”

| Highest: | 5 |
| Are there strategies for managing that conflict? | “with the public transparency that I have as a developer, as a person and the legal standing, we are going to be shielded from a lot of that.” | 4 |

| Highest: | 4 |
| 3. Is the founder or project manager prepared to make compromises to see the idea grow and expand? | n/a |

| Highest: | 0 |
| Is the case well-funded? (Now and in the future) | | 1 |

| 4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)? | “So, I wanted to make a project, that that was the glue, life itself was the glue, our environment, people itself, everyone can relate to that regardless of what country, what race or what religion, we all can relate to that.” | 4 |

| How transformative do they estimate their project to be? | Questions asked to interviewees answered on scale 1-10 meaning that answer needs to be divided by 2 (to get a 1-5 scale). $9/2=4.5$ | 4.5 |

**Case 11**

<table>
<thead>
<tr>
<th>Question to data</th>
<th>Representative Quotation</th>
<th>Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. How radical is the counter truth presented by the case?</td>
<td>“So, there is a lot of unbanked in the world, [...] and important application, just being able to buy something from another country is difficult for many people, not because the vendors won't sell their wares or shift the wares, but because there is no way to pay for them. So, enabling access to</td>
<td>3</td>
</tr>
</tbody>
</table>
global markets to anybody in the world. is important. In the United States, the crypto-currency might just be important because the United States has a lot of unbanked, and not because they don't have ID, but because they choose to be unbanked because they keep getting [...] by 35-dollar fees, and most just can't afford to be in the banking system.”

“if we can figure out decentralized governance and we're working on it, then we can perhaps, move to a world where technology doesn't enable a small number of people to pile up vast wealth, but decentralized governance can enable us all to more directly own these platforms that we use on a daily basis and have more economic agency in these systems”

“Google, who is essentially the same business model as Facebook [...]but they are a little bit concerned about this think that they've been doing so well and so powerfully, is a tiny bit fallen [...]they can certainly go about their business and we can let the people decide whether they want to use a centralized, cyber [...] system or whether they want to own a platform that they also use”

<p>| Highest: |
| 2. Is there evidence of push back, of conflict with the status quo? |
| “I don't think we have been significant enough to draw huge resistance yet” |
| “entities like Google, who is essentially the same business model as Facebook are, not freaking out, but they are hyper-aware at the top levels, we do have some access to what [name] is thinking and what [name], and [name] and [name] are thinking, different leaders in the space, and they don't really understand blockchain all that well yet, but they are a little bit concerned about this think that they've been doing so well and so powerfully, is [...] a tiny bit fallen.” |
| “There are some real use cases out there and I'm confident that some countries are embracing crypto-currencies, other countries, very confident, will shut down crypto-currencies or make them unattainable. In terms of other kinds of resistance, so that's what we're seeing on the government front, and it's going quite well I think, I’m not so worried about” |
| 5 |
| 3 |
| 3 |
| 4 |</p>
<table>
<thead>
<tr>
<th>Highest:</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are there strategies for managing that conflict?</td>
<td>“Both, so, it's bidirectional, at the start of talks with some regulators where they felt that all tokens that they've ever seen were securities and we showed many examples of tokens that could be membership tokens or [...] access tokens or consumption- and resource tokens, and by the end of our first meeting, [...] we had carved out a big space were some tokens, if properly presented, would not be considered securities”</td>
</tr>
<tr>
<td>Highest:</td>
<td>5</td>
</tr>
<tr>
<td>Is the case well-funded? (Now and in the future)</td>
<td>5</td>
</tr>
<tr>
<td>Highest:</td>
<td>5</td>
</tr>
<tr>
<td>4. Are the founders or project managers, aware or the need for cross scale changes in the broader institutional structures (values, laws, routines, policies)?</td>
<td>“Both, so, it's bidirectional, at the start of talks with some regulators where they felt that all tokens that they've ever seen were securities and we showed many examples of tokens that could be membership tokens or [...] access tokens or consumption- and resource tokens, and by the end of our first meeting, [...] we had carved out a big space were some tokens, if properly presented, would not be considered securities[...]and other sorts of entities in different countries to help them understand the technical aspects of things, maybe to help them form their own framework within which to place this new technology, we[...]think necessarily that we need new laws, I think the stringent laws in this country are fine, and the[...] should just keep going about their business, understanding more about the technology and protecting consumers, keeping markets free, the way it has done. And good projects will be fine, many projects won't really fall under their purview.”</td>
</tr>
<tr>
<td>Highest:</td>
<td>5</td>
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<tr>
<td>------------------------------------------------------------------------</td>
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</tr>
<tr>
<td>How transformative do they estimate their project to be?</td>
<td>5</td>
</tr>
<tr>
<td>Questions asked to interviewees answered on scale 1-10 meaning that answer needs to be divided by 2 (to get a 1-5 scale). 10/2=5</td>
<td></td>
</tr>
</tbody>
</table>
APPENDIX VI Blockchain does not stand alone as a technology

<table>
<thead>
<tr>
<th>Case</th>
<th>Representative quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C1</td>
<td>“‘really want to say that blockchain is an important part of what we do, but it’s just one tool in our toolkit, it’s not all we do and blockchain does not really stand alone as a technology”</td>
</tr>
<tr>
<td>C8</td>
<td>“We work with other technology as well [...] it increases reliability for investors because they know that the information, it is uncorrupted, and it is really important to create this reliability.”</td>
</tr>
<tr>
<td>C5</td>
<td>“I do think there is some of that potential there, but do I think it is also not going to be used for everything [...] That hype is just so high it’s impossible to say a 10”</td>
</tr>
</tbody>
</table>
APPENDIX VII Possibility that conflicts that could emerge as the case grows

<table>
<thead>
<tr>
<th>Subtheme</th>
<th>Case</th>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance could come</td>
<td>C2</td>
<td>“Resistance is going to come later when people realize what you are actually doing in the transparency. Now, I don't think that the resistance will be as big as we think it will be because, maybe I'm a bit, optimistic but I really don't believe that people want to cheat”</td>
</tr>
<tr>
<td></td>
<td>C9</td>
<td>“I guess maybe at the stage where we're at that we don't have that push back yet, but I do expect that to come when it grows and becomes bigger and more people get invested into it”</td>
</tr>
<tr>
<td></td>
<td>C11</td>
<td>“I don't think we have been significant enough to draw huge resistance yet”</td>
</tr>
<tr>
<td></td>
<td>C11</td>
<td>“entities like (multinational corporation), who is essentially the same business model as (social media platform) are, not freaking out, but they are hyper-aware at the top levels, we do have some access to what … is thinking and what […], and […] and […] are thinking, different leaders in the space, and they don't really understand blockchain all that well yet, but they are a little bit concerned about this think that they've been doing so well and so powerfully, is […] a tiny bit fallen.”</td>
</tr>
</tbody>
</table>
APPENDIX VIII Cases awareness of the need for changes in the broader institutional structures.

Coding has been guided by definitions from OED, en.oxforddictionaries.com/definition.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Values</td>
<td>“Principles or standards of behavior; one’s judgement of what is important in life”</td>
</tr>
<tr>
<td>Laws</td>
<td>“The system of rules which a particular country or community recognizes as regulating the actions of its members and which it may enforce by the imposition of penalties”</td>
</tr>
<tr>
<td>Routines</td>
<td>“A sequence of actions regularly followed”</td>
</tr>
<tr>
<td>Policy</td>
<td>“A course or principle of action adopted or proposed by an organization or individual”</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Code</th>
<th>Case</th>
<th>Representative quotation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Routines,</td>
<td>C1</td>
<td>“problems that were so embedded in those supply chains that the participants didn't even think they were problems they just thought that that is the way supply chains worked. So that means that naturally everything we do has systemic impact because all of the problems are very embedded, the finance problems; they're embedded, the payment security issues; they're embedded.”</td>
</tr>
<tr>
<td>Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Values</td>
<td>C1</td>
<td>“problems that were so embedded in those supply chains that the participants didn't even think they were problems they just thought that that is the way supply chains worked”</td>
</tr>
<tr>
<td>Values</td>
<td>C1</td>
<td>“what we're doing is questioning that, and saying; is that the way it needs to be? Do farmers only have a role at the beginning? Do consumers only have a role at the end? How can we make our supply chains more modular?”</td>
</tr>
<tr>
<td>Routines</td>
<td>C1</td>
<td>“what we're doing is questioning that, and saying; is that the way it needs to be? Do farmers only have a role at the beginning? Do consumers only have a role at the end? How can we make our supply chains more modular? And less linear and transactional and if that's the case, obviously that is going to have some policy impact over time because we are looking at a changing role of the participants.”</td>
</tr>
<tr>
<td>Routines,</td>
<td>C1</td>
<td></td>
</tr>
<tr>
<td>Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routines</td>
<td>C2</td>
<td>“In really allowing people to think differently, and really understanding the art of the possible.”</td>
</tr>
<tr>
<td>Values,</td>
<td>C2</td>
<td>“I am looking at shifts which is value based in terms of government, so data, identity, really being able to look at privacy”</td>
</tr>
<tr>
<td>Policy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Routines</td>
<td>C2</td>
<td>“because we don't really own our data and we have no control of our data.”</td>
</tr>
</tbody>
</table>

88
<table>
<thead>
<tr>
<th>Policy</th>
<th>This is going to change how information is accessed, delivered and also disseminated and providing views of where data has gone.”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laws Routines Values C2</td>
<td>“I’m looking at changing processes, those processes will change laws but you need to be able to[...], technology does not change mindsets, technology enables the changes that happen, so that's why I think, also for me, I'm very much still about the proponent of the individual human into the chain, so I get very wary when people say there is going to be a chip or a machine which is going to do the whole thing. No, at the end of the day it’s an individual at the beginning and an individual at the end. So, I am going to have to shift the norms like, it's the same as asking how transformative the cellphone has been through our lives. It's been, now we can say, it's a 10 but until it became a smartphone it was a 6.”</td>
</tr>
<tr>
<td>Routines Policy C4</td>
<td>“So, in fact it’s more of a liberal project to be completely accurate because we're not changing the rules of business, we're not changing the rules of government. We're creating an accountability system that makes it possible for governments and brands to know the impacts of supply chains and then to fix them.”</td>
</tr>
<tr>
<td>Routines Policy C4</td>
<td>“we still have a free software, a consumer facing platform even though it doesn't make any money. What we did was that we built the other services to bolster the mission. We've had more impact to create transparency in supply chains as a for profit than we ever could as a non-profit.”</td>
</tr>
<tr>
<td>Values C4</td>
<td>“This is a mission for me. I have also been writing and speaking and participating in documentaries and TV shows. I think knowing where things come from is fascinating, I think knowing the kind of a world that you buy into is essential and I'm always amazed by how little people know about the world that they're contributing to and you know, and I also think its culturally[...]so I grew up in Europe. But knowing where things come from is actually a huge cultural value right?[...]So I always thought, we all belong to big global trade networks and depending on what we value, what we buy, what we make, that's our impact on the whole world so, yeah, I do think that people should, people will inevitably care more over time as we become more connected through the internet about where things come from and we're right there with them.”</td>
</tr>
<tr>
<td>Laws Routines Policy C5</td>
<td>“we are actively trying to evolve regulation in a number of markets. A lot of the things that we are trying to bring to the grid we cannot do today because regulation. So, we actively speak to regulators around the world and we also work with some partners who are also very active in promoting new forms of regulations.”</td>
</tr>
<tr>
<td>Routines Policy C6</td>
<td>“we are not rewriting the laws of physics we're just rewriting the laws of the market.”</td>
</tr>
</tbody>
</table>
| Routines Policy C6 | “the saying is; don't create the wave, ride it. And, the uptake of renewables that I'm talking about is a distributed uptake and that phenomenon is already under way, we're rapidly seeing the uptake, distributed renewable energy is globally a phenomenon, and what we're
doing is, we reward participation”

*Clarification: So, you would say it’s not challenging the status quo?
“No, I mean that is the way the trend is going.”*

<table>
<thead>
<tr>
<th>Routines Policy</th>
<th>C6</th>
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</thead>
<tbody>
<tr>
<td>“but the reality that lot of people have to face up to is; How do you implement your platform to work? How the existing market place in the energy space, are they very powerful? Are they; influenced government? They're not gonna get up and walk away if you bring in some blockchain replacement, so that is not what we are seeking to do. We come from the energy market and we built our application to be used today, to solve problems today, that put the consumer at the heart, but also provide benefits for the application host.”</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Routines Policy</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>“What's happening now is that, we are seeing a lot of small, or renewable projects coming in to the suburbs, coming into the edge of the grid, we see batteries coming, so now what we're starting to see is energy flowing the other way. That was never conceived of when these, particularly the older networks were designed. obviously now it's pretty much in the mindset of planners, but, in any point back we saw this concept of the rise of the &quot;prosumer&quot;, or what we refer to as citizen utilities.”</td>
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</table>

<table>
<thead>
<tr>
<th>Routines Policy</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>“So rather than perturbating the centralized model, all you can do is incentivize users to stay connected by being able to sell their energy to each other through the network, so rather than all energy coming from the centralized generator, down to the households or down to businesses, the network operator really just becomes this transactional platform. So that is why they would be interested, and I mean the other player is the retailers, so the retailer is an entity that buys and sells energy, in that process there is a massive administrative burden and we can automate that in [...] so bringing in many efficiencies in their existing business models and save some money”</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Routines Policy</th>
<th>C6</th>
</tr>
</thead>
<tbody>
<tr>
<td>“we are already providing decarbonized energy to individuals that would otherwise not have access to that electricity…so what they are using our technology for[...]is reducing the price of electricity[...] we are decarbonizing, [...] energy on site, and having cheap electricity, those tenants are now saving money on their electricity bills, in [...]three quarters of single parents on welfare can't afford to pay their electricity bill, so this is the portion of our population that can't afford electricity, let alone anything else. So, what we are doing is reducing the price for electricity to them and the difference in that price drop actually can allow these people to turn those rentals into mortgages doing the energy on site. So you know, not only is our tool a platform for decarbonizing the energy market, but what we are able to do as well is to dramatically have a profound impact on people’s lives, and we do that by, this comes back to this idea of rewarding the participants,, so these types of initiatives are the ones that we are most interested in, and that company now has been rolling this method out on every single one of their developments across[...] and we are already looking into entities all over[...]and the world to do the same.”</td>
<td></td>
</tr>
<tr>
<td>Values Routines</td>
<td>C9</td>
</tr>
<tr>
<td>Values Routines</td>
<td>C9</td>
</tr>
<tr>
<td>Values Routines</td>
<td>C9</td>
</tr>
<tr>
<td>Values Routines</td>
<td>C10</td>
</tr>
<tr>
<td>Policy Law</td>
<td>C11</td>
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</tbody>
</table>
| Policy Law | C11 | “at the start of talks with some regulators where they felt that all tokens that they've ever seen were securities and we showed many examples of tokens that could be membership tokens or access tokens or consumption- and resource tokens, and by the end of our first meeting we had carved out a big space were some tokens, if properly presented, would not be
considered securities[...] we also have just offered ourselves to[...] and other sorts of entities in different countries to help them understand the technical aspects of things, maybe to help them form their own framework within which to place this new technology[...] think necessarily that we need new laws, I think the stringent laws in this country are fine, and the[...] should just keep going about their business, understanding more about the technology and protecting consumers, keeping markets free, the way it has done. And good projects will be fine, many projects won't really fall under their perview.”

*Clarification: (case) have an impact on broader institutional structures?*

“I hope so. Surprisingly we've seen lots of people resonate with these messages that we spend all day, every day sharing.”

<table>
<thead>
<tr>
<th>Laws Policies Routines</th>
<th>C11</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Blockchain I think will be more transformative than any of the other technologies because yes, big data analysis and other sorts of things will reshape how we do business, but I think this will be, have a deeper effect on the fabric of economic-, social- and political systems”</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>Routines</th>
<th>C11</th>
</tr>
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<tbody>
<tr>
<td>“So, there is a lot of unbanked in the world and important application, just being able to buy something from another country is difficult for many people, not because the vendors won't sell their wares or shift the wares, but because there is no way to pay for them. So, enabling access to global markets to anybody in the world is important. In [country], the cryptocurrency might just be important because the [country] has a lot of unbanked, and not because they don't have ID, but because they choose to be unbanked because they keep getting by 35-dollar fees, and most just can't afford to be in the banking system”</td>
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</tbody>
</table>
APPENDIX IX Code book inductive analysis

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentives model</td>
<td>Mechanisms through which blockchain can support transformation in behavior through providing incentives.</td>
</tr>
<tr>
<td>Compensation based on contribution</td>
<td>Fairer contribution of generated value through applying blockchain.</td>
</tr>
<tr>
<td>Adding trust</td>
<td>Mechanisms that can support transformation in regard to five processes that need to change for a system to transform related to adding trust.</td>
</tr>
<tr>
<td>Removing middlemen</td>
<td></td>
</tr>
<tr>
<td>Cooperative forms of ownership</td>
<td>Related to decentralized ownership, sharing data, or sharing platforms.</td>
</tr>
<tr>
<td>Decentralized institutions</td>
<td>Institutions that are created bottom-up.</td>
</tr>
<tr>
<td>Global scaling</td>
<td>Possibilities to scale that the internet bring.</td>
</tr>
<tr>
<td>Access to markets</td>
<td>Inclusion of people in markets provided by blockchain.</td>
</tr>
<tr>
<td>Connecting currencies to other values</td>
<td>Blockchain bringing the opportunity to back up currencies by values related to reconnecting to the biosphere.</td>
</tr>
</tbody>
</table>

APPENDIX X Review of Ethics review

The research was conducted in line with SRC Ethics Assessment Form submitted the 7th of November 2017 with a few adjustments;

- No interviews were conducted in the USA.
- Interviews were conducted by phone when Skype was not possible.
- A co-supervisor was included from KTH Royal Institute of Technology and a separate terms of supervision agreement was executed.