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ENERGO LABS AND BIOTA (A): PERSEVERE, PIVOT, OR PERISH?

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Ray Chu, the highly technical CEO of Shanghai-based Energo Labs, listened carefully to the report from the Philippines, thanked the caller, terminated the call, and studied the calendar on his mobile. He felt that if all went as planned, the young Energo team could not only survive, but succeed. However, if their cyber currency holdings continued to decline in value and expenses continued to rise, a cash flow crisis might result. Ray fervently believed in the potential of Energo's technology to revolutionize the way organizations used data. He hoped to develop a sustainable revenue source to supplant the foundation grants and crowdfunding windfall that had carried them to this point. Worried about the sustainability of their funding model, he wondered how they could package their technological capabilities to generate the revenue stream they needed to survive.

Energo Labs, an international startup in the pre-revenue stage, applied blockchain technology in the renewable energy sector to enable energy producers, such as buildings equipped with solar PV panels, to buy and sell energy to their neighbours or other energy consumers in the local microgrid, through peer-to-peer (P2P) energy trading, by accessing stored energy. The Energo applications suite had been formed through a strategic alliance with the Qtum Foundation, a Singapore-headquartered decision-making body founded to accelerate development of the Qtum (pronounced 'quantum') blockchain network and protocol, which was instrumental in enabling smart contracts for Energo apps such as energy trading and shared electric vehicle (EV) charging.

The next steps were crucial. Above all Ray wanted to avoid losing key members of his team, who would be critical in the months ahead. Many of these young people had joined Energo to pursue its "3 Ps" mission to implement new technology that was environmentally, socially, and financially sustainable. Sustainability was not only the right thing to do for the planet, but an important element in the social glue that held the startup together in this difficult time. The savvy entrepreneur knew that decisions at tomorrow's Board of Advisors meeting would determine their course, and that his team was preparing a report that would influence those decisions. He felt his management team had to get this right.

Dr A. Lee Gilbert prepared this case with the assistance of Yvonne Chong, Assistant Director of Asian Business Case Centre, based on published sources and interviews with Energo Labs. We thank the team for contributing their knowledge, thoughts and scarce time. This case is intended for class discussion and learning, and is not intended as a source of research material or as illustration of effective or ineffective management.

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Founding Energo

In October 2016, experienced technopreneurs from Taiwan, Spain and China joined in Shanghai to found Energo Labs. CEO and co-founder Ray Chu was a serial entrepreneur, with years of experience in payment systems and blockchain technologies. Chief Technical Officer (CTO) and co-founder Jose Miguel Duque Vehils was a seasoned entrepreneur, drawing on his experience as a software engineer with deep knowledge of mobile systems. As COO of Energo Labs, Kaikai Yang was until recently responsible for its strategic layout and global expansion, as well as tracking the overall execution and innovation progress of the newly formed business.

> *Our concept and project are the perfect way to solve the energy trilemma, which is energy security, energy accessibility and energy sustainability. I believe that the blockchain technology in the energy sector can help governments around the world to work on and solve this energy trilemma. Since the energy sectors are facing the revolution right now, this technology is very well timed and I am very excited to introduce this idea worldwide and be remembered for this.*[1]
>
> Kaikai Yang

The Mission

The three founders intended Energo to harness blockchain technology to power a trading platform for renewable energy, and were quick to initiate action. In March 2017, the small team unveiled the first version of its clean energy trading app. Over the next three months, they created the first working version of the Energo smart meter, specifically designed for energy trading applications, and demonstrated their platform at Hanergy Lab in Beijing. In July 2017, Energo successfully launched its first 'decentralized autonomous energy' (DAE) community in the Philippines, providing both a proof-of-concept site and a live testbed for improving their blockchain-based energy trading platform.

Energo's core technology consisted of a decentralized software system designed for the measurement, registration, transaction, and automatic settlement of clean energy exchanges. Energo sought to develop this into the infrastructure needed by a shared economy that would enable community-based access to renewable energy. This platform integrated emerging technologies such as blockchain and the Internet of Things (IoT) with more mature energy-related technologies such as solar panels, smart meters, and energy storage systems (ESS) that drive the recent trend toward community microgrids.[2]

The Energo ecosystem deployed decentralized applications (DApps) on the Qtum blockchain platform, which were embedded with a cryptocurrency (TSL) token that enabled its owners to access or share energy stored in their community's ESS facilities. Within community microgrids, Energo would eventually connect stationary and mobile (electric vehicle or EV) batteries to more flexibly and effectively meet local energy demand (see **Exhibit 1**).

Funding Energo

Seed funding, provided by the founders, foundation grants, and early-stage private investors, was sufficient to move Energo forward to the proof-of-concept stage. In July 2017, the founders initiated an initial coin offering (ICO) [a] that promised buyers of their tokens access to renewable energy resources. Crowdfunding for Energo's ICO started on July 25, 2017, and ended on August 1.[b]

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[a] An ICO is an event in which an organization sells digital tokens for the purpose of obtaining public capital to fund software development, business operations and development, or other initiatives. Tokens are cryptographically secured digital representations of a set of rights. Depending on the token, this could include the right to access and use a network or software application, to receive a share of future earnings, or to vote on decisions made by the organization.

[b] Energo Labs sold **0.51 billion TSL**. Later, in response to Chinese government policy, 138,256,692 TSL was returned to investors who voluntarily applied for a refund, and **69,128,346 TSL** was awarded to continued token holders. As TSL is not an equity currency and cannot be created by mining, the number of TSL tokens issued will never increase. TSL can be bought and traded on cryptocurrency exchange platforms and used to enable energy trading on Energo-authorized trading platforms.

While ICOs could represent a relatively inexpensive and straightforward path to fundraising, market value of the resulting tokens tends to be volatile. For example, over a week in 2017, the price change for 41 of the largest 100 (by market capitalization) cryptocurrencies exceeded 5%. Price changes over the week ranged from a 400% increase to a 50% drop.[3] This volatility, coupled with other factors such as a six-month prohibition on token trading after the ICO, and poor investor understanding of the underlying value of the tokens, cast a shadow on the ICO phenomenon, which regulators in some markets (but not in Singapore) sharply curtailed in late 2017.

Industry Overview

Blockchain technology, by allowing digital information to be distributed and accessed but not altered, formed the backbone of a new type of Internet-enabled capability. A blockchain was essentially an incorruptible digital ledger that could be programmed to record financial transactions or other records of value. Blockchain implementation had evolved to provide different types of value: payment via currency (such as Bitcoin), asset management (asset registration and voting), and more recently, contracts (insurance, leasing, or warranties).[4] They rest on distributed structures: public, private, and consortium topologies. Each of these structures had features that might add value in one context, but not in another (see **Exhibit 2** for blockchain technologies overview).

> *A microgrid is a nucleus that sets the stage for an energy future consisting of networks of energy cells. Blockchain also supports this process, because it makes it much easier to conduct energy trading within cells.*[5]
>
> Stefan Jessenberger, Siemens' Energy Management Division

The first electrical grids were decentralized, privately owned and operated, and served a local customer base. By end of the 19th century, as electricity demand and levels of industrialization and urbanization grew, power plants were centralized at the peripheries of load centres and the state emerged as the regulator of electrical supply.[6] Today's microgrids began to meet the power needs of isolated communities and to take advantage of the emergence of affordable sources of renewable energy.

Barriers to entry and trading

In most of Asia, the electrical power industry had yet to move beyond the traditional state-regulated monopoly model. Regulatory issues facing microgrid operators posed a key hurdle to energy trading among microgrid users:

Evolving liberalization and competition requirements: Liberalization is the first phase of transformation of the energy supply structure. Many Asian nations were in the early stages of liberalizing their electricity market structure from a vertically integrated, government-owned, supply structure to an unbundled and deregulated structure governed by a state watchdog agency. Incorporation of climate and renewable energy measures would mark a transition phase in shift to a more central role for microgrids.[7]

Sharing of energy and ownership: Ownership had several facets: first, ownership of generation and supply facilities such as PV units, CHP units, ACs and cooling pipelines; second, ownership of locally generated energy; and finally, ownership of rights to internal and external electricity markets.

Interconnection with larger infrastructure: Connection of a microgrid with the main grid introduced several operational, financial, and legal challenges including 1) *licensing*; 2) *grid access rights*; 3) *grid safety* issues; 4) *islanding* protocols; and 5) the responsibility to provide and maintain additional *energy infrastructure* required for microgrid operation and the sharing of locally generated energy.

Energo's Business Model

The dynamic Energo model continued to evolve. During the current startup phase, the leadership focus had been on refining and demonstrating the potential of their technology platform rather than applying it to generate sustainable revenue. Dr Sanjay C Kuttan, Program Director of the Energy Research Institute at Nanyang Technological University (ERI@N), observed:

> *Energo, like many startups, are pushing crucial boundaries that will enhance services and performance of system level solutions incorporating renewable energy and enabling novel business models.*[8]

The Energo value proposition sought to provide the operators and members of smaller grids access to clean energy, and to enable them to capture revenue from the sale of renewable energy assets that are surplus to immediate needs, through the blockchain-based Energo trading platform.

Energy trading channels: A few years ago, a producer of renewable energy could sell surplus renewable energy only back to the main grid at a feed-in tariff (FIT) determined by an approval body. FIT rates had declined globally, in some markets creating an opportunity for P2P trading and aggregation and resale by virtual power plants (VPP) as alternative channels for renewable energy. In some markets, net metering was an option for consumers who own renewable energy facilities (such as solar power) that enabled them to receive credit for exporting their excess production to the grid.[9]

The target market for the Energo value proposition was the local electrical power microgrid with the capability to connect entities served by the local grid, or that could be connected to other nearby grids, with an initial focus on Southeast Asia.

Revenue model: The founders were keenly aware that at some point in the near future, the young firm would have to demonstrate the capability to meet market needs and generate a sustained revenue stream. Their current thinking was to establish a transaction fee-based P2P model for Energo platform users, offering both prepaid and postpaid billing schemes to users equipped with their digital wallet.

> *By digitising energy storage, we essentially want to create a network of storage systems, which include stationary batteries such as those in households as well as mobile batteries such as those in electric vehicles (EVs), to enable energy trading between them. During the day when solar energy is being produced, households and microgrids can supply power to EVs, and at night when there are limitations to renewable energy production, EVs can trade electricity with houses or microgrids so as to provide the minimum amount of electric power needed at any given time.*[10]
>
> Kaikai Yang

Energo's proposed B2B revenue model sought to offer their platform as software-as-a-service, tailored to meet the needs of smart meter providers, microgrid owner/operators, and utility companies.

Alliances and partner networks: Energo actively pursued linkages with industry associations and companies with a compatible set of values. They became a member of ACCESS (Singapore Cryptocurrency and Blockchain Industry Association) and the Philippines Energy Efficiency Alliance (a non-profit aimed to accelerate renewable energy in the Philippines). Other Energo allies included Power for All, the Alliance for Rural Electrification, Energy for All, CLEAN Energy Access Network, the Qtum Foundation, Energy Blockchain Labs, TusStar, TellHow, RHT Law Taylor Wessing, Berlin Partner, PowerArkSolar, and the PreAngel funding network. Several of these allies were represented on Energo's Board of Advisors. Vertech Capital, a boutique advisory services firm helping innovative firms scale in new markets, had worked closely with the Energo management team to design go-to market strategies, product development roadmaps, technology commercialization, and identifying cross-domain applications of their platform.

Technological capabilities: The Energo Clean Energy P2P platform design integrated blockchain database technology with a smart meter and app to enable solar panel-equipped communities to locally produce and directly exchange clean energy in a system providing more cost-efficiency and freedom than a traditional grid that might offer FITs. The platform incorporated these five elements:

- Blockchain: Energo applied Qtum technology to track and record energy usage and transactions.
- TSL was a token, listed on cybercurrency sites such as coinmarketcap.com, which provided access to power in distributed storage systems (DSS). Both the seller and consumer would need to hold TSL to store and retrieve electricity stored in devices within an Energo-enabled site.
- Watt was a blockchain-based digital asset whose value was backed by energy; each Watt token represented 1kWh of energy in a distributed storage device. Users might buy or trade Watt via Exchange, manage their Watt via Wallet, and check Watt inflow or outflow via the blockchain ledger.
- Exchange was one of the major functions on its platform. When users had excess energy (Watt) stored in storage, they could sell it by putting a sales order on Exchange or by putting a purchase order instead if they want to buy energy, and orders were automatically matched by smart contract.[11]
- Smart Meter was used to measure the energy production and consumption of individual structures or households and its design could be tailored to local standards in various markets. The meter would then send this data to a mobile app, which could show individual users their energy usage statistics and facilitated transactions.

Key Energo Team Members

Energo management and staff had responded to the opportunity to develop the energy platform for a wide variety of reasons. Some focused on the technological challenges, while others were fascinated with the idea of an innovative venture that combined all three elements of the sustainability paradigm: people, planet, and (sometime in the future) profit. The management team was extremely diverse:

- CEO Qu Lei (Ray Chu): Shanghai-based Ray, with experience in the financial services industry and blockchain R&D, had mastered blockchain platforms such as Ethereum, Bitcoin, Lisk, and Ripple.
- CTO Jose Miguel Duque Vehils: Software developer and entrepreneur, Jose came to Shanghai from Spain in 2013 as a mobile systems architect.
- COO Kaikai Yang: Prior to co-founding Energo, Kaikai was with incubator Tencent WeStart. She left Energo in August 2018, when it appeared that marketing efforts would move to the background.[12]
- Business Development – Sharon Luo, Lathika Chandra Mouli
- Product VP - Kelvin Chen
- Project Manager - Leslie Cheng
- Project Manager - Jack Pegler

Staff capabilities: Energo management recruited top technical experts to build R&D capabilities during the first year. In the following year, they began to hire experienced business development staff to increase local outreach and efforts to secure a market for its platform and services. By mid-2018, the total head count had grown to more than 35 full-time staff.

Energo Milestones

In April 2018, Energo set up a regional hub in Singapore with the intent to collaborate with research programmes and campus microgrids as a testbed for smart energy research, potentially allowing P2P energy trading using blockchain technologies on campus. The hub was supported through a joint venture with Vertech Capital, which conducted thought leadership workshops for Energo focused on the intersection between blockchain and the energy industry.[13] Energo's Jessica Shieh said:

> *We're also working to establish a publicly accessible incentive system that encourages a larger network of virtual users to make sustainable and environmentally-friendly decisions in their everyday lives. Enabled by our TSL token, this platform will reward individuals for things like bicycling their daily commute, using less electricity in their homes, and recycling in bulk.*[14]

Successful Initial Coin Offering. Energo's ICO, launched on July 25, 2017, and officially closed one week later, raised more than 500 Bitcoins and 1,000,000 Qtum tokens. At that time, the tokens had a total dollar value of approximately US$7.5 million.[15]

Alliance with Qtum. Energo based its energy-sharing capabilities on Qtum's blockchain platform, which enabled smart contracts through integration of the Ethereum Virtual Machine, a user-friendly interface for coding terms and conditions. Qtum users had developed DApps across a broad spectrum ranging from IoT to market forecasting, healthcare and clean energy. Energo was the first energy player to use Qtum.[16]

Philippines DAE projects. Approximately 17% of Filipinos had no access to electricity. Less than 1.5% of all electricity generated in the Philippines was from renewable sources. Although the government had approved FIT payments in 2012 for electricity fed by users into the grid, the approved tariff rate was lower than expected by investors, leading to minimal impact.

> *As a developing country, the Philippines has the second highest electricity price in Asia, second only to Japan, a developed country, and more natural disasters are likely to cause damage to the national grid. In fact, the power system in the Philippines is in a sub-healthy state during power outages, which gives Energo Labs a chance to promote the development of a DAE community in the area.*[17]
>
> Kaikai Yang

On the De La Salle University–Dasmarinas (DSL-D) campus microgrid project, Energo deployed its Qtum-based decentralized blockchain technology with other stakeholders to enable users in different buildings to conduct P2P transactions and balance the supply and consumption of electricity across the campus. Industry partner FirstGen provided the smart meter system to record transactions and ensure data storage security. Energo donated a 10-kilowatt (KW) solar system to the DSL-D microgrid, which would boost renewable energy production and complement its push to become one of the world's most sustainable campuses as well as save up to P1.2 million on electricity bills over the next 20 years.[18] DLS-D was a member of the International Sustainable Campus Network (ISCN), a global forum to support leading colleges and corporate campuses in achieving sustainable campus operations and integrating sustainability in research and teaching.[19]

India, Australia, and Southeast Asia. Energo strategically partnered with CLEAN, India's largest decentralized energy organization, to jointly promote the application of clean energy in off-grid areas within India. By end-2018, Energo planned to implement Australia's first DAE community.

> *Apart from the Philippines, by the end of 2017, Energo Labs will also cooperate with other domestic and overseas government agencies and strategic partners in many Asian countries such as India and Taiwan, launching more microgrid projects to unlock the boundless potential of the clean energy market in Asia. We will also keep developing products that will apply blockchain to EV charging, planned to be piloted early next year.*[20]

To accelerate entry into the Southeast Asian market, Energo's regional hub in Singapore would provide market research, offer blockchain and energy-related R&D opportunities and internships, host events and hackathons to promote discussion about smart cities and smart energy trading using blockchain technologies.[21] Energo was also in talks with local authorities and partners to launch P2P and electric vehicle smart charging pilot projects, in response to energy demand trends.

At an ASEAN solar summit held in November 2017, Energo's proposal on a point-to-point power trading system to integrate blockchain with microgrids, smart meters, and energy storage systems, attracted interest from a number of ASEAN governments and industry stakeholders. Participants expressed optimism regarding the new mode of energy production and sales as one government official noted, "The driving force behind the innovative energy industry is unimaginable."[22]

Taiwan. In early 2018, CEO Ray announced Energo's plan to build DAE communities in Yunlin and Jiayi counties as the first step toward entering the Taiwanese energy market. Energo would collaborate with the local government, green energy organizations and cryptocurrency exchanges to establish the Taiwan Green Energy Blockchain Research Center, with the aim to further explore the integration of blockchain technologies in the green energy industry.

Barriers

However, Energo was facing the reality that industry governance was a key barrier to their success:

> *Across the region the economic case for distributed renewables is already very strong. Regulation is the key barrier to shift from captive use to presumption. Some countries in the region (for e.g. the Philippines) have policies in place to start to allow more distributed assets but implementation is slow. What is likely is that dropping prices of storage might accelerate the adoption of DERs by allowing people to make better use of the energy they create. Prosumer-consumer interaction can already happen behind the meter (for e.g. campuses, shared accommodation and industrial parks) but we will need a critical mass of DER and some good proof of concept examples to be able to bring these models to regulators and policy makers to make the necessary changes.*
>
> Jack Pegler, Project Manager, Energo Labs

The Energo team, while aware of the many difficulties lying along the path, were confident that they had the capabilities, leadership, and will necessary to overcome the obstacles to success. However, they worried about being able to adapt their business model to take advantage of emerging opportunities.

Valuation of post-ICO companies was inherently difficult, especially for pre-revenue companies such as Energo. Firstly, although venture capital and angel investors usually involved only a handful of wealthy players responding to an opportunity they were able to evaluate, an ICO was crowdfunded and driven more by momentum. Next, the issue of ICO tokens (often carrying uncertain intrinsic utility), in exchange for a coin that might be itself be volatile. Also, the value of tokens retained by the issuer would not only be even more volatile than the leading coins due to uncertainty regarding the future of the issuing company, and their sale might be time-restricted to minimize downward pressures on the market value of tokens already issued. Blockchain technology did not change such fundamental economics, and not all tokens were created equal. Tokens with intrinsic utility would increase in value, while those whose purpose was to extract value or exchange equity from within a business would likely lose most or all of their value.[23] However, popular tokens such as IOTA and Ripple were already well-established in valuation terms and had a significant market capitalization.[24]

Energo Finances[25]

Energo's market capitalization rose from its post-ICO value of US$7 million to peak at about US$58 million. As of August 22 in 2018 it was less than US$3 million, all in the form of TSL tokens - exchanged for QTUM in early 2018 (**Exhibit 3**). Energo spent only a fraction of the difference between these two figures, due to the volatility issues noted above.

2018 Reorganization

Energo had no pressing need for an organization chart in the initial stage. With few staff, each with a diverse skill set, teams tend to form around time-critical tasks. However, as the organization grew to over 30 full-time staff and Energo faced implementation challenges, these tasks and roles shifted.

The majority of Energo technical staff were managed by the CTO, as small teams focusing on tasks such as coding for Web, IOS and Android interfaces with clients, developing and testing software to interact with grid operations, and tending to Energo's core Blockchain software. But by mid-2018, market-facing tasks ranging from event planning to public relations and business development were increasing in importance. The emergence of new products and project opportunities, coupled with the rapid evolution of the blockchain itself, posed many challenges for the small firm.

Biota Platform Pivot

The old Yiddish adage "Mann Tracht, Un Gott Lacht" means "Man Plans, and God Laughs." (Sometimes, despite all our efforts, our best-laid plans can be derailed by unexpected changes.)

At the time Ray discovered the potential to obtain foundation funding for a blockchain-and-energy trading platform, he was deeply involved with Biota, a post-Ripple public blockchain project for which he was architect and principal developer. After forming the Energo partnership, development effort on Biota was set aside for the time being. Ray's long-term vision was to develop the Energo platform, find additional funding to build and deploy a suite of energy trading apps, use these to generate a revenue stream, and later to complete the Biota platform and shift the energy trading apps to the new Biota public blockchain (**Exhibit 4**).

However, gaining market access to enable energy trading proved to be more difficult than expected, and Ray worried that current financial reserves might not carry the young startup to the point where revenue exceeded expenses. He saw only three general options: 1. persevere with the current business model until the firm either reached the break-even point or failed; 2. abandon the Energo effort and return to developing the public blockchain, or 3. find a way to combine the two projects in a way that would preserve the key members of his team, and satisfy the expectations of early-stage investors.

Current Issues and Challenges:

Several key members of the Energo team, in Singapore for an urgent meeting with allies, gathered at the coffee room of the 18th floor shared workspace at Millennia Towers to discuss the current situation with their advisors. They began by highlighting market development challenges:

Challenge 1: Despite its prior successes, Energo had yet to fulfil its aspirations to establish commercially viable projects based on its technology.

Team members agreed that developing a sustainable revenue stream, the young company's most pressing current issue, was entering the crisis stage.

Challenge 2: Although Energo had successfully implemented proof-of-concept projects, it had yet to overcome the regulatory barriers to significant expansion of these projects beyond their initial scope.

Despite their success in the Philippines, and their donation of microgrid components to the University, Energo was unable to convince regulatory authorities to expand the scope of their project beyond the initial campus proof-of-concept project.

Challenge 3: Despite an emerging trend for main grid operators in advanced economies to adopt microgrid and related energy storage technologies as solutions to edge-of-grid demand growth and peak shaving issues, few utility companies in Asia currently sought to explore this alternative.

The team saw batteries as too capital-intensive. "The reality is that storage hasn't been widely financed yet, and we're still several years away," said Ravina Advani, of BNP Paribas. "Financing with a renewal asset is something the market hasn't yet seen."[26]

Challenge 4: Recent cryptocurrency thefts suggested that the blockchain might be vulnerable to hacking, despite the inherent security derived from its underlying cryptography. Some security experts agree.

The Energo team believed they had this problem under control, despite media reports such as - "In less than a decade, hackers have stolen $1.2 billion worth of Bitcoin and Ether, two of the most popular digital currencies," said Lex Sokolin, global director of fintech strategy at Autonomous Research LLP.[27] However, CTO of McAfee Steve Grobman viewed the blockchain as a growing market opportunity, "In many cases, our existing products can help secure the ecosystem. In general, it will be vulnerable to threats just like any other software system."[28]

Challenge 5: In terms of current capabilities, while the Energo platform enabled electricity trading, it did not address the fulfilment issue; physical delivery of electrical power from the seller to purchaser.

Energo's white paper specified the Qtum-based architecture of all layers of the trading platform down to the physical layer, on which the white paper was currently silent. While one team member felt that "a universal solution to this issue requires more resources than it is worth," not all agreed. One project manager observed, "We are currently working to design a platform that can be extended to fit the current design and architecture of existing microgrids."

Challenge 6: The lack of an interface between the many models of microgrid controller and the Energo trading platform represented a major barrier to its widespread adoption.

While one project manager felt that this barrier would soon be overcome, he could not predict when: "The first step is to enable energy trading via our blockchain solution. The next, and somewhat more difficult step, is to enable fulfilment across diverse grid architectures."

Challenge 7: Although certain features of the current Qtum blockchain model were clearly superior to its more mainstream Ethereum competitor, blockchain technology development was accelerating, and there was a risk that Energo might find itself stranded on a path, as did Sony's Betamax, that ultimately leads nowhere.

Qtum was a cryptocurrency developed by Patrick Dai and Jordan Earls.[29] More than a crypto coin, Qtum was a *business-facing* ecosystem designed to foster lightweight business applications that were compatible with other blockchains Qtum, by combining ideas from two of the world's leading cryptocurrencies (Ether and Bitcoin), allowing its users to develop smart contracts and DApps.[30]

Challenge 8: The length of Energo's startup "runway" (the date at which the company's cash reserves would be exhausted) was uncertain, due partly to the volatility of the cryptocurrency holdings from its successful ICO.

The reported market capitalization of Energo's TSL cryptocurrency in circulation varied from just under $58 million in late January to slightly under $3 million by mid-August of 2018.[31] This inherent volatility meant that Energo was not able to identify the exact value (in the form of fiat currency) of cash reserves that Energo could draw on to cover operating expenses until its revenue rose to meet expenses. The relationship between value of their cash reserves and their market cap depends on (at least) two variables:

the exchange rate among their cryptocurrency holdings and a specific fiat currency, and the proportion of its market cap held by the company.

Challenge 9: Pivot window was rapidly closing as cash reserves decline.

Energo's CEO and COO saw the situation differently. Ray did not see the current model as viable in the near term, and wanted to preserve the team and pivot to implementation of the Biota platform. Kai Kai worried that the team would abandon its sustainability goals and, not seeing a role for herself in the new venture, resigned so Ray and the team could move forward.[32]

Challenge 10: As part of a broader crackdown on activities related to digital currency, the Chinese government was poised to block more than 100 foreign cryptocurrency exchanges.[33] *Meanwhile, messaging apps in China such as WeChat had become fertile grounds for mobile payment processing with over 75% share of online payments*.[34]

As the long-term impact of these issues and trends was far from clear to the remaining team members, they decided to group these challenges according to their immediate impact on the firm's alternatives. They felt they could compare the viability of two options: A. continuing to pursue Energo Lab's current blockchain-in energy initiative versus B. pivoting to deploy the emerging capabilities of the blockchain-based Biota platform. They could then present their recommendations to the Advisory Board accompanied by short- and long-term action plans.

Knowing that some of his team members were ambivalent about the idea of pivoting away from the sustainable potential they saw in the energy trading model, while others saw the current direction as futile, Ray asked each team member to identify the key facts and ideas that supported each of their recommendations, then to record these on the whiteboard, so the team could identify possible conflicts and synergies before moving to summarize their recommendations and develop an analysis of the potential impact of each plan on Energo's future.

Ray glanced at his watch: less than a day remained!

EXHIBIT 1: COINS, TOKENS AND ICOS

Coins and tokens in the blockchain were overlapping, but not identical concepts. A currency was a medium of exchange, unit of account or store of value. With all three features, the Bitcoin token thus qualified as a coin, or a form of cryptocurrency. Coins such as Ripple were linked to a public blockchain, but might be spent or received outside the issuing blockchain. In contrast, a token had a specific use in the issuing project's ecosystem. Tokens might represent company shares, provide access to a product or service, or enable owners to perform specific functions.

The two best known and most valuable tokens were Bitcoin and Ethereum with both providing a unique intrinsic utility. Bitcoin could enable rapid, near-anonymous transfer of value without a controlling middleman, while Ethereum's smart contracts engine was an enabler of documentation and enforcement of payment agreements by software not under the control of either party.

With the entire world's attention slowly starting to shift from major cryptocurrencies such as Bitcoin and Ethereum to the underlying ICO ecosystem, the market was experiencing an influx of new token buyers. In 2017, ICOs received as much as US$5 billion in funding. The entire cryptocurrency market capitalization was hovering at around US$600 billion as of early 2018. If the ecosystem would continue to grow at the current rate, that figure might soon surpass the US$1 trillion milestone. Over half of new ICO tokens were built on the Ethereum network.[35]

Source: Author.

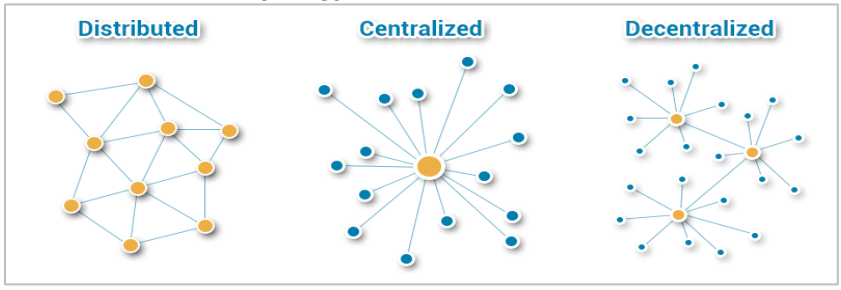
EXHIBIT 2: AN OVERVIEW OF BLOCKCHAIN TECHNOLOGIES

The model for Bitcoin, Ethereum and Litecoin, can be viewed as the original distributed ledger structure. **Public Blockchains** are able to receive and send transactions from anyone, anywhere. They can also be audited by anyone, and each node has equal transmission capability. Before a transaction is considered valid, it must be authorized by constituent nodes via the chain's consensus process. As long as each node conforms to the specific rules of the protocol, their transactions can be validated, and thus add to the chain. Since each node on a public blockchain has as much transmission and receipt power as any other, they are not only decentralized but fully distributed.

However, distributed systems are inherently less efficient than centralized systems. They are generally also slower, more costly and more complicated. Despite this drawback, Web founder Tim Berners-Lee proposed that blockchains can be used to reinvent the web in a more distributed and P2P fashion. Many blockchain enthusiasts support this concept. Tim explained:

> *At the moment there are two interfaces coming to a browser near you. One is web payments sites. You've got the code to do all that already. Coming down the pipe hot on its heels is web authentication. Instead of all those passwords, the browser will handle your identity.*[36]

Topology 1: Public Blockchain



Decentralization and distribution are seen by many to be a major benefit of public blockchains, but this is not the only benefit of public blockchains. Perhaps most importantly, their transparency makes them very secure: because they can be audited by anybody, it is easy to detect fraud on the chain. Security-via-openness is a well-known principle in the open source world, and this strategy is also popular among some in the digital currency community. For example, all tools and content produced by the Ethereum team are open source. This helps to make Ethereum widely accessible and more secure, if not absolutely unhackable.

Public blockchains are also expensive, both to implement and to operate. The time and energy required to process transactions on public chains is more intensive than that of non-public chains. A design that requires every single node on the chain to authorize each new transaction before it is added to the chain will consume a huge amount of electricity and may lead to delay.

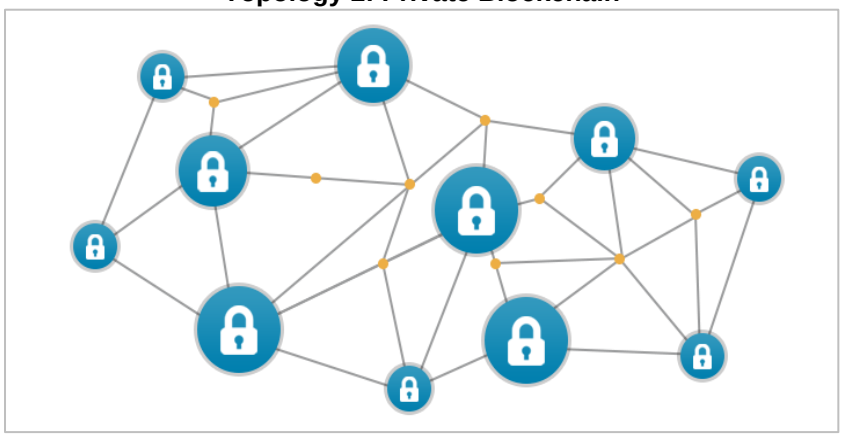
In **Private Blockchains**, only specific, pre-chosen entities are able to create new transactions on the chain. Thus, a private blockchain is a closed network that offers members the benefits of the technology, but is not necessarily decentralized or distributed, even among its members. The extent to which each constituent can view ("read") and create and validate transactions ("write") is decided by the developers of the chain. This private form of the blockchain thus resembles a traditional shared database with enhanced auditing capabilities.

Because decentralization has been viewed by many as intrinsic to blockchain's revolutionary appeal, the role of private blockchains may appear limited. However, blockchain technology offers far more than a structure that accommodates decentralization. Among other features, strong cryptography and auditability enable higher levels of security than traditional protocols, and allow for the development of new applications such as voting platforms, accounting systems, and other types of data archive.

A popular use case for a private blockchain is intra-business: when a company decides to adopt blockchain as a business solution, they may opt for a chain to which only company members have access. When nobody outside of a select few needs to be part of the chain, the private form will be more efficient and run faster than a public chain. Also, because private chains are smaller and contained, it is simpler to alter a consensus process or other technical stipulation on a private blockchain. For example, if developers or owners want to change the cryptographic method which runs the consensus process, it is easier to do this on a private blockchain.

Also, private blockchains have the capability to restrict access to the data on a chain to specific individuals, by managing viewing permissions. Companies may be able to reduce costs by using private blockchains, assuming there is no need for a public component to their blockchain.

Topology 2: Private Blockchain



Topology 3: Consortium Blockchain

A consortium blockchain is part public, part private. The divisions among public and private elements work at the consensus process level: on a consortium chain, a pre-selected group of nodes control the consensus process, while other nodes may participate in creating new transactions and/or reviewing them. The specific configuration of each consortium chain (i.e., which nodes have the power to authorize transactions via the consensus process, which can review the history of the chain, which can create new transactions, and more) is decided by members of the consortium.

Confirmation Models
The need for confirmation requires, in one way or another, achieving consensus regarding the validity of each transaction before it is entered into the chain. The design issues revolve around how this consensus works and who participates. Thus far, the dominant consensus protocol for blockchains has been proof-of-work (PoW), which addresses reliability and security concerns by rewarding mining nodes to solve computationally intensive puzzles while verifying transactions.

Mining
Bitcoin, the most widely used blockchain application, uses the PoW protocol to verify the accuracy and validity of transactions. Transactions are grouped into what is called a block; and participants called miners solve a mathematical puzzle known as a PoW problem to verify that transactions within each block are legitimate. A reward is given to the first miner that solves the problem associated with a specific block; and only these verified transactions are stored in the blockchain. The PoW protocol solves security problems such as vulnerability to distributed denial of service attacks, but requires vast amounts of computing (and thus electrical) power and restricts the scalability of the blockchain network.

Other Verification Solutions
Developers are working on alternatives to PoW, such as proof-of-authority (all nodes are equal, but some are more equal than others), proof-of-stake (PoS - nodes with more to lose determine validity), and delegated proof-of-stake (essentially, a representative democracy model).

Ethereum is gaining acceptance, partly due to its “smart contract” facilities. One proposed improvement to Ethereum’s current design involves turning off its PoW transaction verification mechanism and replacing it with one based on PoS. PoW is a powerful consensus algorithm because it allows the system to prove that work was actually done to mine a block. PoS validation, on the other hand, doesn’t use a mining process, and thus is inherently more efficient, but less democratic.

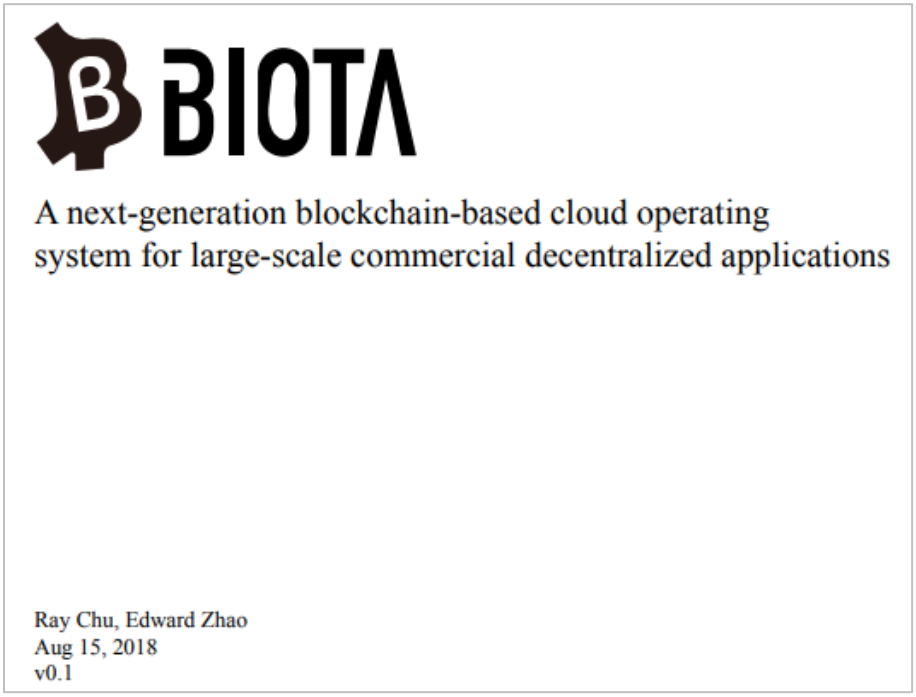
According to decentralized database provider Bitshares, delegated proof-of-stake (DPoS) is a fast, efficient, decentralized, and flexible consensus model. DPoS leverages the power of voting by stakeholders to reach consensus. All network parameters, from fee schedules to block intervals and transaction sizes, can be tuned by agreement among elected delegates.

Source: Adapted by author from *Draglet*. (n.d.) Public, Private and Consortium Blockchains. https://www.draglet.com/blockchain-services/blockchain-technology/private-or-public-blockchain/

EXHIBIT 3: MARKET CAPITALIZATION OF ENERGO'S TSL CRYPTOCURRENCY

Source: *CoinMarketCap*. (n.d.) Historical data of Energo. https://coinmarketcap.com/currencies/energo/

EXHIBIT 4: NEW BIOTA PUBLIC CHAIN WHITE PAPER



Source: Chu, R. & Zhao, E. (2018). A next-generation blockchain-based cloud operating system for large-scale commercial decentralized applications. *BIOTA.* http://biota.io/static/download/BIOTAWhitepaperEng.pdf

GLOSSARY

Acronym	Term (context)	Definition
AC	Air-conditioning	Process of removing heat and moisture from an interior space
B2B	Business-to-Business	Transactions or other relationships between companies, rather than between a company and individual consumers.
B2C	Business-to-Consumer	Retail transactions between a company and individual consumers.
CHP	Combined Heat and Power	Concurrent production of electricity and/or mechanical power from a single energy source.
DAE	Decentralized Autonomous Energy	Renewable energy as a digital asset used in P2P, machine-to-machine, and/or vehicle-to-grid transactions.
DER	Distributed Energy Resources	Electrical generation and storage performed by small, grid-connected local devices
DSO	Distribution System Operator	Operator of an electrical distribution system comprising demand management and supply generation (including DER)
ESS	Energy Storage System	Batteries or other means of storing energy and associated control systems
EV	Electric Vehicle	Any passenger or goods vehicle powered by electricity, including hybrids.
FiT	Feed-in Tariff	Rate at which a grid operator rewards a prosumer for energy contributed to the grid.
IoT	Internet of Things	The interconnection via the Internet of computing devices embedded in everyday objects, enabling them to send and receive data.
Microgrid	Energy network (electrical power)	An integrated system consisting of distributed energy resources serving multiple electrical loads operating as a single, autonomous grid either in parallel to or islanded from existing utility power grid.
P2P	Peer-to-Peer (energy trading)	Direct energy trading among peers, such as energy from small-scale DERs in dwellings, offices, factories, etc. traded among local energy prosumers and consumers.
PPA	Power Purchase Agreement (Electricity)	Long-term agreement between the owner of an electric generating facility and a wholesale energy purchaser. A PPA provides a revenue stream from the project, used to finance building or upgrading the facility.
PV	Photo Voltaic	Conversion of light into electricity using semiconducting materials, typically mounted in solar panels.
TSL	Token (cryptocurrency)	Tradeable unit of value representing a specific right (access to services, equity share, etc.) in a blockchain.
TSO	Transmission System Operator	Entity entrusted with transporting energy in the form of natural gas or electrical power on a national or regional level.
VPP	Virtual Power Plant	Aggregation of DERs for energy security and/or trading power on the open market.

LINKS

Energo Labs:	
Web:	www.energolabs.com
Medium:	medium.com/@EnergoLabs
Facebook:	www.facebook.com/EnergoLabs
LinkedIn:	www.linkedin.com/company/energo-labs
YouTube:	www.youtube.com/watch?v=7Z-qW4xvSlM
DER/Energy Trading:	
Navigant:	www.navigantresearch.com/reports/blockchain-enabled-distributed-energy-trading
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PWC:	www.pwc.com/gx/en/industries/assets/blockchain-technology-in-energy.pdf
Gartner:	https://www.gartner.com/en/information-technology/insights/blockchain
Video:	How does a blockchain work – Simply explained https://www.youtube.com/watch?time_continue=2&v=SSo_EIwHSd4
Energy Storage:	
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India:	spectrum.ieee.org/energy/renewables/innovative-direct-current-microgrids-to-solve-indias-power-woes.amp.html
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