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Final Report on Capacity Building for Digital Innovation Using Blockchain Technology

APEC Policy Partnership on Science Technology and Innovation

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Produced by
Beibei Cheng, Yu Bai, Fengyun Wu, Daiqing Zhao, Zhigang Luo
Guangdong Low Carbon Promotion Association
Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences

For
Asia-Pacific Economic Cooperation Secretariat
35 Heng Mui Keng Terrace
Singapore 119616
Tel: (65) 68919 600
Fax: (65) 68919 690
Email: info@apec.org
Website: www.apec.org

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Executive Summary

We live in a society where people begin to think about those questions: Are those foods before us uncontaminated and how can I trust if they are safe and healthy? Can we do something or install PV in my rooftop to help reduce emission as part of my responsibilities to combat global warming? All these questions are related to sustainable development. It calls for new business model and also novel technologies.

Blockchain technology features decentralisation, openness and transparency, security and credibility. It is suggested as part of the emerging technology to face such challenges, as it has potential to facilitate distributed, peer-to-peer trading with increased security, prosumer choice and reduced transaction costs.

The APEC Forum on Capacity Building for Digital Innovation using Blockchain Technology was proposed through PPSTI and funded by APEC. Given that blockchain technology has great potential to transform society, this project, by harnessing the technology, was designed to address the challenges.

This report is a part of APEC project deliverables. From 2019, we worked in cooperation with experts from other APEC economies to collect more than 30 best practices on blockchain application in three areas, namely, green supply chain, green energy development, innovative financing. We defined criterions and finally selected 11 best practices to be included in the report. We hope those cases will serve for demonstration on how to employ blockchain technologies to transform our society and help our lives better.

To share good practices and conduct capacity building, we also held a two-day workshop on 16-17 December 2021 in Guangzhou, China. This symposium, co-sponsored by economies including Australia; Malaysia; Chile; Peru; Korea; Hong Kong, China; Thailand; and Papua New Guinea, was successfully held with the involvement of participants from APEC member economies, non-APEC economies and international organizations. More than 100 representatives from eight APEC member economies and four non-APEC economies attended this event. The APEC workshop ran through six themes, namely blockchain capacity building, and case studies in the green supply, energy sharing, carbon neutrality, green financing and policy suggestions, and sharing stories.

The symposium bore fruit as nearly 80 percent of participants showed their interests in blockchain case sharing and reached consensus that they will employ blockchain in the aforesaid fields.

This symposium, using blockchain technology to the full, made energy transition and low carbon development the centrepiece. Green development, riding on the wave across the globe, typifies the direction of scientific and technological revolution and industrial transformation in the current era. The answer to taking the path of sustainable development is to facilitate the energy transition. Targeting at net zero emissions by 2050 or 2060, it is needed for ongoing transition of energy decarbonization, decentralization and digitalization.

Finally, key policy recommendations are also put forward in this report. As blockchain is an emerging technology and gap exists between developed and developing economies, we suggest APEC to develop several initiatives to address the gaps and challenges, such as establishing APEC Blockchain Policy Forum, the APEC Blockchain Policy Centre, and the APEC Sustainable Infrastructure Policy Initiative. Secondly, an openly accessible, standardized “toolbox” is also necessary for APEC regions. Thirdly, APEC should also clarify

regulatory treatment, particularly in the realm of securities law, tax law, the legal recognition of data stemming from blockchain databases, as well as data privacy and consumer protection. Lastly local authorities from each member economy are encouraged to work out more policies to pilot blockchain applications in the selected three areas: 1) sustainable green energy, 2) traceable, green safe food supply, 3) decentralized financial applications. For example, authorities who take charge of emission reductions and climate target should work jointly to encourage blockchain applications in carbon emission reporting, carbon trading across APEC regions.

Background

The significance of digital innovation was unmistakably put under the spotlight at the APEC summit in Chile and even G20 summits. The rapid development of new forms of information technology and its ever-closer integration with our daily lives have made it increasingly significant. Yet challenges remain in key areas: first, The misuse of ICT applications and services as a facilitator for digital financial speculations instead of industry development, and secondly, The establishment of an effective mechanism for international coordination on curbing tax evasion and terrorism financing in cross-border activities.

Blockchain technology may be an answer to these challenges. Its design ensures that access to data is transparent, verifiable and traceable when policy and technical implementation is done properly through consensus mechanisms. By using blockchain technology, the complexity of implementing a flexible, modern innovation framework may be simplified as many intermediate processes.

This project was committed to sharing best practices on the blockchain applications for the APEC region with a focus on effective policy, regulatory frameworks and regulatory approaches that are innovative as well as agile, flexible, and adapted to the digital era as the use of regulatory sandboxes.

The project, a boon to sustained benefits for all APEC economies, tackled issues in bridging the digital divide and fostered the adoption of digitalisation among micro, small and medium enterprises (MSMEs) and all individuals throughout APEC regions, particularly women and other vulnerable groups.

Workshop Summary

Opening ceremony

The opening ceremony was moderated by Dr Yu Bai, chief director of the Science and Technology Department of Guangzhou Institute of Energy Conversion (GIEC), Chinese Academy of Sciences. Dr Bai firstly expressed sincere gratitudes to the sponsors, especially the APEC Secretariat and co-sponsors. Her opening remarks touched upon the process of approval of this project and gave thanks to the support of Australia; Malaysia; Chile; Peru; Korea; Hong Kong, China; Thailand; and Papua New Guinea. This project was aimed to share good practices in the application of blockchain and came up with effective frameworks and policy suggestions. Prof Jiancheng Lv, director of GIEC, emphasized the importance of blockchain business technology in promoting the transformation of energy as well as the building of a low-carbon economy.

The symposium also received congratulatory notes from the Department of International Cooperation, Ministry of Science and Technology (MOST), the People's Republic of China. Ms Xuemei Yang, the division director, reaffirmed in her speech PPSTI's purpose to further promote innovation in policies and projects, a move to push forward the development of policy suggestions. APEC's blockchain technology boosts the construction of digital innovation capacity. It aims to better benefit society, and further address the challenges we are facing by using blockchain technology.

Topic 1: Blockchain Capacity Building

- **Yongdong Wu, College of Cyber Security, Jinan University, China.**

- Wu's introduction covered the basic principles of blockchain.
- Blockchain is a database that cannot be tampered with. At the same time, blockchain can create a very good peer-to-peer network, integrating the principle of cryptography. In this sense, no one can falsify blockchain.
- He also briefed on the application scenario of blockchain in low-carbon cities. One can, for example, make use of data sharing, digital business services and low-carbon applications for the governance of low-carbon cities.

- **Siliang Luo, Deputy Secretary General of the Guangzhou Blockchain Association, China.**

- His presentation touched upon the status quo of blockchain development and the support policies of the Guangzhou Blockchain Association. In March 2018 Huangpu district, upon approval, turned to be a blockchain software base in China. In March 2020 Guangzhou was approved to establish a blockchain development demonstration zone, the first of this kind in China.
- The association has identified 30 or more blockchain application scenarios for next-step work. The efficiency of blockchain is notably evident in cutting costs, saving more than 4.5 million yuan.
- Blockchain can also combine with intelligent parking. The use of blockchain in 1,500-strong parking lots has brought forth intelligent charging and other functions. In October 2016, blockchain was written into the local government report.

- **Bo Shen, Professor, the Berkeley Laboratory of the National Department of Energy, USA.**

- Shen shared the case about building a climate-friendly refrigeration system through digital blockchain technology. This blockchain case served as a coordinator for multiple stakeholders.
- If a city-scale climate-friendly refrigeration system is wanted, the establishment of a Platform as a Service (PaaS) state is required. The service can be improved in a constant fashion. From decoration to financing, resource sharing to compliance supervision, improvement and efforts of the corresponding service can be achieved.
- This platform affords a database of customer equipment, detection and optimisation of energy use and energy efficiency, support for decoration and transformation, financing assistance and resource direction, support for the power grid, and trading of carbon credit. Many of these, an integral part of the platform, can be available to users.
- Energy-saving service companies can avail themselves of the opportunity to connect with customers and track the performance of the project, so as to solve the corresponding problems, such as payment default, information asymmetry and market supply mismatch.
- The second application scenario is about financial services, promoting services between customers and financial institutions. At the customer's end, for example, they can upload real-time cooling operation data, apply online, sign loans, and complete loans and other

payments. For financial institutions, they can apply for online loans and sign loan contracts online. The initiator and receiver of data provide relevant intelligent areas to ensure that the initiation and acceptance of data are authentic without any illegal acts and falsification.

- Blockchain can distribute account books underground and help people achieve smart contracts. In terms of data tracking and information tampering identification, information cannot be falsified in such a setting. Blockchain helps people further deploy and expedite the use of PaaS platform. In addition, customers can rely more on the blockchain for transmission and verification in support of building a high degree of trust among different immediate stakeholders.

■ **Li Zhu, Marketing Director, Intelligent Technology Business Department of Ant Group, China**

- He shared the group's perspective on blockchain with the audience. The group has a very clear mission to further bolster the development of the digital economy and probe into the promotion and clout of various technologies on the digital economy.
- From 2016 onwards, Ant Group has published ESG (environmental, social responsibility and corporate governance) report every year to echo its attempts in detail in CSR and ESG. The report also covers a variety of technologies such as blockchain, helping people create more enabling platforms. The application in environmental protection and information disclosure is bound to have rosy prospects.
- In March 2018, the launch of Ant Forest into the market has enabled everyone to turn to a low-carbon lifestyle, while accumulated points of a low-carbon credit can help achieve more forest planting. Ant Group will attain zero-carbon emissions in 35 years' time.
- The group's rollout and deployment of the Ant chain have triggered more industries to set green development plans and take action. Ant Group’s technology was applied to this blockchain in the advancement of carbon neutrality. It helps the group make some values of carbon emission and efforts of emission reduction, including clearing and settlement, as well as supervision and audit, more open and transparent. Moreover, it is very convenient for the management of the group's own carbon assets, because it can improve the management efficiency of carbon assets and let customers have a clearer strategy and access to data.
- Blockchain can also make the underlying assets of green finance more transparent and credible. Some technologies of the blockchain, such as simplifying the process and stepping back in time, as well as the nature of non-falsification data on the blockchain, can be applied to green loans, green claims and green bonds to ensure the green destination of funds.

■ **Christopher Vagalia, Chief Director, ATO organization of Papua New Guinea**

- Vagalia briefed on the status quo of blockchain in Papua New Guinea (PNG). PNG puts the development of blockchain technology high on agenda, such as the central bank’s very clear deployment of blockchain technology. In the 2016-2020 development plan, a key goal was to promote financial inclusiveness. This means the financial system should serve all people even with lower costs. Meanwhile, there should be corresponding measures in fiefs of data sovereignty, privacy and legislation.
- PNG’s plan, the so-called policy sandbox, was officially launched in April 2019. In the sandbox, any innovations are welcomed so long as it is useful to the citizens. In the policy sandbox, attempts and innovations are exhorted to see which policies and

regulatory measures can bring forth the greatest benefits to the development of the whole economy and the people. This is crucial.

- The regulatory sandbox acts as a credible environment in which credible technologies are offered to see which technologies can bring opportunities for social and economic development.
- In terms of carbon trading and carbon credit, they can exert imagination to exhaust every possibility. As for supply chain and logistics management, they can, of course, also achieve better traceability through blockchain.

■ **Xuran Li, Secretary General of the Energy Services Association of Hong Kong, China.**

- Blockchain is also positioned in a very important place in the development strategy of Hong Kong, China. Hong Kong, China's sandbox allows qualified enterprises to enter the market. The supervision of the regulatory commission concerned enables to better identify and address some risks. In particular, for the risks related to regulation, the government not only pays attention to financial technology but also close heed to the application of blockchain in the industry or at the government level.
- Li cited an elevator case. In Hong Kong, China, a lot of high-rises need elevators. One in third of 70,000 elevators in, China has been run for more than 30 years. The obsolete elevators quite often cause problems. Given no tracking and monitoring system before, they expect the blockchain to track the status of the elevators and see which elevators need to be repaired immediately. In fact, such a system can save many lives as accidents of such pose a danger to the life of passengers. Many people will be free from threats should such a monitoring system be installed. And this system requires no big changes. Meanwhile, information on modern and relatively new elevators can also be included in the system. The addition of the elevators into the system, in fact, can realize a unified elevator monitoring system of blockchain. Whether it be new or old, all elevators with data can be managed uniformly. In the past, the data sharing of these new elevators was confined to a limited range. Many owners are unwilling to share the elevator data simply because they think it involves some privacy. A public survey by the University of Hong Kong, China and other relevant institutions revealed that the system will work in many ways to track elevators. In fact, building such a system needs support from many aspects. Elevators are under different brands, which may have different channels of data collection and ways of presentation.

■ **Junwei Wang, Executive Director of Bangkok Center of Chinese Academy of Sciences in Thailand**

- Wang held that the Bangkok Innovation Cooperation Centre is a major cooperation centre of the Chinese Academy of Sciences abroad. He availed himself of this opportunity to give an introduction to blockchain technology and its application in Thailand and expressed willingness to weld a bridge for the cooperation between China and Thailand in this regard.
- His introduction to some policies issued by the Thai government involved six strategies for digital development. The first, the hardware infrastructure, needs to develop a high-performance digital infrastructure, which can cover the entire economy.
- Another is the application of digital technology and digital government, which is about to transform. Efforts are made, therefore, to bolster the development of the labour force, making them ready for the digital economy and digital society, and dealing with the job demand brought by it.

Topic 2: Blockchain Case Sharing in Green Supply and Finance Field

- **Nicolas de Loisy, President / Supply Chain Management Outsource, Hong Kong, China.**

- Loisy's presentation touched on three advantages that blockchain can bring to people. The first is that it really plays a part in the sharing economy, helps promote and optimize various processes, and affords people cheaper products.
- The second advantage is building trust. When people meet others online, blockchain, based on a peer-to-peer network, can use encryption technology to develop trust.
- The third, also very important, is easy for many people to ignore that blockchain itself is also a database.
- He briefed on the case of traders - a digital shipping platform. The ambitious case study engaged many parties, including freight forwarders, warehouses and customs, customs declaration letters, as well as other banks and insurance. The advantage of this platform is to achieve truly efficient delivery. The unplanned things are turned into planned ones so that the overall efficiency inventory is higher, and the inventory may change.

- **Suporn Pongnumkul, Thailand Electronic and Computer Research Center, Thailiand**

- Pongnumkul presented a specific case - the traceability analysis of coffee beans. It is about the traceability system of Thai agriculture.
- Another example is Thailand's agriculture industry, focusing on the framework of wisdom and the intelligent contract concept. Therefore, there are different stakeholders and two levels of smart contracts. One is a local contract and the other is a smart contract. From the initial planting to harvesting to processing, including some label processing at the back, all links can be fully traceable. Farmers input their planting information, including address and quantity. The system generates corresponding content and QR code, which can be scanned by downstream stakeholders. After that, coffee beans can be transported downstream. The growing of coffee beans can be seen in the factory. People can also decide how much the grinding plant processes, and then upload their processing information. The smart contract here can promote more efficient transactions. Next, information on different batches in this one is visible, indicating that the two farms also accepted different batches of products before. Later, when it comes to baking, the same baking factory can scan such QR code to know who is in this link, what has been done in the previous link, and what kind of information has been generated, including the quantity, time, and product-specific information, and then to the downstream link. Consumers can use the app and scan the QR code to see who produces, grinds and bakes the coffee beans.
- This information helps consumers make more informed decisions. Everyone can have a better understanding of the development of coffee beans and blockchain in Thailand. All processes are verifiable and traceable, and the corresponding information can be available by scanning QR code. The information of each link can be obtained quickly after scanning.

Topic 3: Blockchain Case Sharing in Energy Transition

- **Zhigang Luo, the Strategic Research Center of Guangzhou Institute of Energy Conversion (GIEC), Chinese Academy of Sciences.**

- Luo gave insights into the development of the photovoltaic in one whole given county, which involves a variety of stakeholders. Once a photovoltaic facility is installed, it means contributions to carbon emission reduction,, the emission reduction credit of China Economic Cooperation certificate, should be considered, in combination with the deployment of photovoltaics. If it is really effective, one can get a lot of benefits from CCER. How much potential for carbon emission reduction the deployment of photovoltaics has brought is something to be further considered.
- Luo elucidated how to connect blockchain with photovoltaics. A very clear schematic diagram illustrated that someone initiated such a transaction. The request of this transaction is broadcasted to a P2P network, that is, a peer-to-peer network. There are many computers on the network, which can be called nodes. After that, both the transaction and participants need to be verified. The whole process is very credible, blocking any possibility of tampering. In this way, it is very efficient to support the carbon market and carbon trading.
- Blockchain technology simplifies the process, with lower cost and no way to tamper. At present, projects are underway in a county, Guangdong, to attain these goals. Firstly, implant a blockchain platform to serve this photovoltaic system. Secondly, develop a methodology based on the carbon emission and emission reduction of this blockchain. The attempt, the first of this kind in China, is an emission reduction project based on a smart contract. And the group has also created a renewable energy and financing business model based on carbon assets, involving banks and corresponding companies.

- **Shiyang Shao, General Manager of Gulian Supply Chain Management Co Ltd, China.**

- Shao talked about data problems, including data opacity and data security risks, a pressing issue to be cracked.
- In addition, there will be a very fragmented geographic carbon market in different political and geographical areas, detrimental to the unified ETS, and the carbon pricing mechanism also lacks consistency. Different carbon trading markets see a variety of carbon pricing mechanisms. In terms of trust and scalability, the traditional market is doing very poorly. It is hoped to attract more participants to further expand the carbon market, including small and medium-sized enterprises (SMEs) and individuals.
- Shao expounded on how to use blockchain technology to bring solutions for the global carbon economy. Blockchain is distributive, meaning that the system of such based on blockchain is sustainable, with high security, and the data cannot be tampered with or erased. Transparency and traceability are also well-guaranteed. The whole solution is well-coordinated and flexible. Consensus-based transactions ensure very high reliability.

- **Xuedu LV, Former Deputy Director of the Climate Change Strategy and International Cooperation Center, China.**

- Lv shared a project experience in the application of blockchain technology. The project was designed to test the connection between carbon assets and Shanghai Energy and Environment Exchange, to establish an international carbon registration standard and carbon trading platform.

- **AKM Ahsan Kabir, Professor, School of zoology, Bangladesh Agricultural University.**

- Kabir gave an introduction to Bangladesh poultry manure utilization and blockchain scenario application to ensure food quality, aiming to create a traceable environment.
- In the past, one of the data that can be collected in the market is the data related to all stakeholders in an effort to create a traceable environment. First of all, the market system should be used to improve farmers' livelihood in a sustainable way. Better traceability can be realized based on the blockchain so that all stakeholders know more. All stakeholders showed keen interest in the system in the marketing and production process of livestock and poultry.

  Thanks to such traceability of blockchain technology, these stakeholders have delivered notable results.

Topic 4: Blockchain Case Sharing in Carbon Neutrality

- **Yushi Chen, Chief Researcher of Hengqin Digital Chain Digital Finance Research Institute, China.**

- Chen proposed how financial technology and blockchain solutions can bolster sustainable investment, improve domestic resource mobilisation, and improve the transparency of the process.
- Chen explained how blockchain helps people better issue green bonds. Firstly, blockchain can be used for green bond authentication, and blockchain can also be better used by settlement and settlement systems. Digital green bonds can be issued through a token, involving different stakeholders in addition to the whole blockchain-based green bond authentication system. So there are issuers, underwriters and lawyers, while the government can integrate exchange methods by using blockchain.
- Generally, a third-party authentication process is needed in traditional systems. Yet a consensus mechanism and smart contract may replace this authentication process, more efficient, and it does not need third-party authentication. In addition, the data traceability is very strong.
- From the perspective of investment, more investment opportunities pop out and better operation safety assets are available, that is, the default rate of assets is lower. Corresponding initiatives are also put forward to build a blockchain based bond system for sustainable investment.

- **Xinyu Zhang, General Manager of Shenzhen Moke Node Network Technology Co Ltd, China.**

- Zhang shared his experience in practice in the past five years. Some isolated islands of information result in incomplete information transmission. This is the pain spot. It's quite difficult for SMEs to channel funds from financial institutions.
- It's also difficult for financial institutions to manage well the non-performed funds of SMEs. Therefore, blockchain technology can coordinate well enterprises and their needs between different institutions across industries and fields.
- Blockchain, AI and the Internet of things (IoT) can be pooled together and integrated with China's real economy to bolster the development of this digital level.
- Blockchain has many characteristics. It can empower various industries, including promoting the development of low-carbon projects and helping reach the carbon peak in advance, and realizing carbon neutrality, the two major goals of 2030 and 2060.

- **Benoit Couraud, Professor, Heriot Watt University, UK.**

- Couraud presented several UK cases of blockchain supporting renewable energy development, with a focus on blockchain technology and smart contracts, as well as energy challenges and some users' cases.
- His introduction to the application potential of blockchain in the energy industry enlightened the audience. Carbon removal is important to the energy industry. Decentralised blockchain can bring forth many possibilities to the energy industry. In the future, the energy system will also be decentralised. Blockchain can optimise energy transactions, reduce costs and improve the security of energy systems.
- As blockchain can eliminate the single point of failure, it further improves the reliability

of energy infrastructure, especially energy-related IT infrastructure. At the same time, the use of energy can be democratised, and energy governance can be more efficient through blockchain, mainly depending on distributed data and algorithms.

- Regarding the classification of application fields in the energy field, the biggest one is green, that is, decentralised energy trading. There is also a very large one, the red one, which is the cryptocurrency pass and investment effect. Of course, power grid management is also a big part, as well as the Internet of Things (IoT), intelligent devices, automation and asset management. All are actually closely related to energy.
- Electric travel can also benefit from blockchain. In terms of energy use of transportation, one may consider reducing the number of trips, sharing trips, and promoting the use of electric vehicles. For heating and cooling in buildings, financial energy efficiency and reduced demand can be provided by using more heat pumps and having more emission reduction potential in other aspects.
- Looking into the future, if net-zero emissions is targeted, more measures are needed, not only the decisions and measures at the top, but initiatives that need to influence all daily life.

- **Pengfei Li, Guangdong General Service Research Institute, China.**
- Li introduced the management and application of blockchain on the power demand side. The goal is to build a blockchain application of energy demand-side management through corresponding development. Such an application can be integrated by the State Grid app to provide the whole process based on blockchain. It can also be integrated with DSR services. Smart contracts are used to simplify the clearing and settlement process. Under certain conditions, execution can be triggered, and a single node can also trigger execution. In the design concept, it is also considered how to ensure low-cost and efficient DSR market operation.
- The income falls into two parts. First, direct income breaks down into three components. It has successfully deployed new technologies and explored new technologies, which is a very transparent operation mechanism. It greatly reduces the response time of DSR and cuts the labour cost and time cost from this user side. It also improves the efficiency of auditability and traceability, balances the source, network and load storage, and lessens the response time of DSR. Some indirect analysis indicated that it can improve the overall impact of the State Grid Corporation of China, improve the credibility of society and improve the basis of certification and research of new technologies. It can provide an effective platform.

- **Pruk Aggarangsi, PhD, Energy Research Centre, Chiang Mai University, Thailand.**
- Aggarangsi shared a case of blockchain promoting renewable energy development in Thailand.
- Measurement is really important. Blockchain is used for better measurement. He presented a smart city plan formulated in 2015, known as the smart city initiative. Digital collection, multifaceted in style, refers to the collection of intelligent travel data, intelligent energy data, intelligent economic data, intelligent refrigeration data, intelligent life data and intelligent environment data. These data are collected into the blockchain to realize the permanent preservation and traceability of the data.
- Most of the data are big data with no personal privacy information involved. The current status of data collection will be taken into account. It is also needed to collect and save data in the future, including how to improve its future. Through these data, people can

really understand how big the current carbon footprint is, and what aspects and ways to reduce it.

- In 2018, a smart energy initiative was launched, for which very ambitious goals were set. Renewable energy accounts for 35 percent on the one hand, and carbon dioxide emissions are also significantly reduced on the other. Corresponding mechanisms will be built to promote energy trading based on blockchain. This plays an important role in the smart city.
- Great efforts are also made to deploy photovoltaics. It is expected to deploy photovoltaics with a total energy of 9.5 MW on the roof of 250 buildings. Efforts are made to consider how these photovoltaic facilities are connected to the local power grid, including batteries, and how batteries match and coordinate with hot and cold water energy facilities.
- In terms of cross-platform intelligent data collection, efforts are poured into considering which platforms need to collect data. In Thailand, there are many regulations on the installation of solar energy on the roof, it can be said without fear of exaggeration that it is very strict. Sometimes other PV installation methods have to be considered.
- On demand-side management, work is done to introduce equipment with very high management efficiency. Blockchain means everything. On the roofs of buildings, progress is made in deploying solar panels, inverters and smart meters. There will be real-time connection and monitoring between batteries.

■ **Christopher Vagalia, Agri-Tech Organics (ATO), PNG**

■ Vagalia introduced Papua New Guinea's application of blockchain in agriculture. PNG sees various software applications. Considering the potential of how blockchain is used in agriculture, it is bound to propel the development of agriculture. It is not easy for PNG to increase the value of agricultural products. It is hoped that the security of blockchain technology, such as smart contracts and traceability, can be provided to small and scattered farmers, a boon to them. PNG has some local cocoa and agricultural products and farming communities, who are in need of good solutions to sell these products, including outside sales.

■ **Pierre Elias, CEO, ICT Centre, PNG**

- Elias introduced PNG's application of blockchain in forestry carbon sequestration management.
- Elias touched upon some solutions realized by PNG in forestry carbon sequestration management by using blockchain. On 14 December 2021, PNG held a grand event, called Technological Innovation 2021. Such a grand event showed that PNG is very concerned about technological innovation. Information and communication technology (ICT technology) is booming, with ICT clusters being taken initial shape.
- At the same time, women also join the engineering work associations, such as computer training and professional associations. ICT technology, a big push to economic and social development, is bringing people a better life.
- Blockchain can bring us a more credible trading environment. It can be said that the Internet is for information while blockchain is for trusted transactions. Blockchain really builds credibility among people.
- What does the blockchain ecosystem look like? Of numerous start-ups around the world, about 2 million are working on blockchain, so the whole ecosystem is very prosperous.

■ **Nan Li, Shanghai Carbon Information Technology Co Ltd, China.**

- Enterprises are involved to realize carbon neutrality. Enterprises can not only achieve carbon neutrality but encourage employees and more people to benefit from reducing carbon emissions.
- Li briefed on a professional comprehensive solution for carbon neutrality. One is low-carbon and carbon neutrality, and the other is synthetic low-carbon. Blockchain technology is used to bring together employees, employment management systems and other government stakeholders. Carbon neutrality digitization can empower enterprises. This strategy uses information technology, platform technology, SaaS technology and other technologies to quickly complete and manage the traditional steps of carbon neutralization.
- Low carbon technology can quickly help enterprises undertake carbon verification and reduce carbon emissions. In Bangkok, businesses can generate this carbon emission report from the management level and administrative office level by filling in some data tables. In the office scenario, better circular accounting can be carried out. People pay for CCER, and they can pay for the cancellation certificate of carbon emission reduction. This is about the authentication of blockchain.

Topic 5: Blockchain Case Sharing in Innovative Financing

- **Mr Gong Li, Director of Guangfa Securities Innovation Laboratory, China.**

- Li reported some application achievements of Guangfa Securities in blockchain. From the end of 2016 onwards, GF Securities has begun to study blockchain technology. At the same time, it positions itself as an explorer and a builder of blockchain in search of application implementable.
- He introduced two applications: one is the product that has been launched, called trusted ABS cloud, and the other is the ODC trading platform based on blockchain. It handles the role of managers, involving a lot of work, one of which is to prove the authenticity of assets and audit financial data. This workload is very large. In 2018, they used blockchain technology to solve this problem, mainly providing information of assets and putting this information on the chain. The direct advantage is that the data cannot be tampered with, and everyone trusts the data, once it is on the chain.
- He presented an example of the products that actually landed. Zhengjia Plaza, a commercial real estate project in Guangzhou, was the largest CMBS project in the world at that time, with more than 7 billion yuan. GF reported all kinds of cash flows from Zhengjia Plaza, parking lot, tenant, wine shop and museum through this interface every month. The company puts this data on the chain and enables relevant people to understand what they do is not simply to put data itself on the chain, but to protect the privacy of the data.

- **Junlong Li, Shenzhen Qianhai Weizhong Bank Blockchain, China.**

- Li gave a brief report on the recent exploration and practice of Weizhong Bank in the blockchain field. Weizhong Bank lies its strategic focus on the inclusive link of science and technology. It mainly serves micro-enterprises and the general public, specializing in Inclusive Finance.
- Weizhong Bank, incorporated in 2014, became a part of blockchain in 2015. In 2016, Weizhong Bank established a blockchain alliance. In 2017, the self-developed bottom layer of the blockchain was officially opened to the outside world. Since 2017, it has been superimposed on the bottom platform to develop more blockchain-related modular products. So far, they have more than 200 landing application cases.

- **Wei Ronghuan, Carbon Consulting Firm.**

- What does a green supply chain mean on the production side? In the current industrial industry, people need to think about how to build a better and greener supply chain. First, after selecting suppliers, there are a lot of coordination and communications between upstream and downstream. It is hoped that the supply chain has lower carbon emissions in the product life cycle. The whole supply chain comes from different links, the supply chain design should be formulated step by step. From design to production process to transportation to consumption, people should consider how to reduce carbon emissions in an effective way. After the end of the product life cycle, people should also consider whether there is a very good recycling mechanism. On the whole, it can form a cycle, hoping to be a virtuous cycle.
- What is the solution to these problems? How to authenticate each company? The traceability system and decentralization are the characteristics of blockchain. This traceability can be ensured at every step of the green deployment, in the product life cycle, and at every step of the entry into the blockchain.

Workshop Conclusions

Digital innovation is not an end, but a means to enhance the well-being of mankind. Due to the large-scale production of human beings, the current environmental challenges have brought pressure on the Earth and caused stress on raw materials, food, land and energy system. The purpose of this report is to review how blockchain can be used to solve complex business problems in the selected three areas(green development, green supply chain management and innovative financing), and in particular to discuss what policy should be worked out to encourage blockchain applications across APEC region. This report does not focus on Bitcoin or other cryptocurrencies enabled by blockchain; rather, the focus is primarily on enterprise blockchain applications operated by a company or an organization for a specific community of users.

In an increasingly complex international situation, the climate change issue is not only confined to the consensus of the academic community but also has burst into planetary consciousness. Although controlling the temperature rise to 1.5°C faces many difficulties and requires economies to make trade-offs, the low carbon transition brings huge opportunities to mankind. The global transformation will create higher-quality jobs and improve people's health and livelihoods. More governments, enterprises and other social agencies are aware of the benefits of the transition process. Yet the current speed and intensity of transformation are far from enough. People need to take more radical and decisive climate action to respond to systematic problems. The key discovery of this project aims to identify innovative practices that blockchain can complement with existing practices and bring more responsible resource management methods in the context of climate change. The purpose of this project is to create sustainable and inclusive growth in APEC economies that will be enjoyed by future generations.

Blockchain brings the whole value chain on-chain and promotes a circular economy mechanism. Blockchain can fundamentally change how resources are valued and encourage individuals, companies, and governments to develop their economic value from things that are currently abandoned or undervalued, such as garbage recycling and sustainable agriculture products. It is essentially an economic ecosystem built by digital infrastructure. This is also an opportunity for the carbon market. Since the advent of carbon trading, people have been worried that its trading lacks sufficient transparency and traceability. Due to different standards and regulations in various jurisdictions, there is often the possibility of double counting. Using blockchain to manage the carbon trading market has the potential to greatly improve efficiency and avoid many carbon trading restrictions. Especially with the recent elaboration of the Paris Agreement Article 6.4, a transparent, auditable and credible international carbon trading market can be improved by introducing smart contract mechanisms. In addition, the blockchain can also be used to automatically create carbon trading certificates, which can avoid over-issuance or insufficient certificates. This mechanism helps to stabilize the market price within the agreed range of the policy and without emergency response or intervention. The new monitoring, reporting and verification (MRV) methods brought about by the blockchain can help record more company reporting data, including independent procurement reports and company performance evaluation reports. Stakeholders can better understand the company’s performance and engage in the overall carbon neutral action.

Blockchain can provide innovative financing models. Generally, blockchain can create a transparent digital ledger to trace the capital flow in the network. The transaction data can be recorded on the blockchain in an immutable way. Since the data flow can be recorded and cannot be tampered with, blockchain provides clear traceability of funds from the source to the flow. The adoption of a blockchain-based financial platform may completely change the way capital is obtained. Blockchain can bring more new investors to sustainable projects,

from retail-level investments in green infrastructure projects to charitable donations in developing economies. Municipalities, for instance, could issue the proposed blockchain-based project bonds to finance local infrastructure, such as energy utilities, that would generate returns that they could use for payments of coupons and principal. Multiple applications to suit different situations would be possible, including community ownership structures, using the strength of a decentralized governance model with the backing of blockchain. While this approach applies to smaller investments, it would also be possible to aggregate smaller assets into bonds that would also be of interest to larger institutional investors. Development finance institutions could play an important role in implementing such investments. Through their involvement, they could also enhance the confidence of potential investors. Blockchain-enabled financial instruments enlarge the scope of green investment and the amount of total investment may reach trillions of dollars among APEC economies. The blockchain platform offers a flexible structure that can handle more capital flow, manage complex financing transactions, integrate stakeholders, and help SMEs to obtain funds from a large number of different investors. At the same time, the platform reduces the need for third-party processing, which can significantly improve efficiency and reduce time and capital costs.

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APEC Policy Suggestions

Since Bitcoin was invented, blockchain is still in its lifecycle where the internet was perhaps a quarter century ago in the early 1990s. The reasons are partly from technical difficulties, but the main reason is the collision between the digital rules constructed by blockchain and the original industry rules. Since the technology is nascent, policy should be about encouraging blockchain innovation, usage, and scalability. There is no point in rushing to regulate a technology whose applications, benefits, and challenges are only emerging. When carbon neutrality became the highest international consensus, we ushered in the singularity of the integration of industrial rules and digital rules. Responding to climate change has become an important measure of economic transformation to achieve the long-term well-being and sustainable development of the APEC economy. Blockchain will be adopted as a toolkit to link capital and data to build new production relations and business models in the context of carbon neutrality.

Blockchain technology offers potential in building collaborative platforms and network systems in APEC economics, which can help in the achievement of economy investment goals, including for the low-carbon transition. However, several policy actions are needed to facilitate the development of blockchain-based solutions in a safe and equal way. As many of these issues reach across borders, international coordination of policy actions is needed. Some specific policy actions include:

- Promote an openly accessible, standardized “toolbox” that will facilitate further research and development in the field. In this way, economies and their private and public research institutions can be supported in developing or building blockchain solutions. More specifically, the toolbox can provide for the interoperability of blockchain ledgers. Interoperability is critical when blockchains in any industry proliferate to ensure that the ecosystem scales and that businesses and consumers can maximize their opportunities to connect and transact with each other and not just with users of a given ledger (or have to join multiple ledgers). Interoperability standards need to address issues related to governance, data share, and terminology. Toolbox needs to clarify how smart contracts operate and the technical structure to ensure the legality of electronic signatures and on chain data.
- Conduct knowledge transfer between economies. It will be key to generating buy-in from related stakeholders. User case concepts and technologies can be jointly validated through research-based collaborations and partnering with public and private organisations. The creation of spin-offs from the knowledge generated by research organizations has great advantages as a technology transfer mechanism. Technology transfer policy must incorporate specific objectives to promote spin-offs creation. APEC may initiate and govern dedicated working groups of selected technology providers and industry representatives to study the potential benefits and challenges of blockchain. Community platforms created by APEC also help to drive the exchange of information and experiences. APEC needs the develop several initiatives to address the gaps and challenges, such as APEC Blockchain Policy Forum, the APEC Blockchain Policy Centre, and the APEC Sustainable Infrastructure Policy Initiative.Clarify regulatory treatment, particularly in the realm of securities law, tax law, the legal recognition of data stemming from blockchain databases, as well as data privacy and consumer protection. Closer collaboration between government regulators and the wider blockchain ecosystem consisting of actors in the private sector could be considered. Enable innovation through regulatory certainty and flexibility, including via a blockchain sandbox. On the one side, there must be a clear guidance and regulatory certainty so that blockchain initiatives and companies can keep moving forward and work on innovations without having to worry that a new regulation is waiting around the corner that will obliterate their investment. On the other side, the founders of the internet have recognized that they did not pay sufficient attention to online privacy and security, two enormous and critical issues that policymakers and business leaders grapple with today. Blockchain promoters can learn from this and get privacy and security right from the start. At the same time, ledgers managed by public-sector entities that centralize user data, transactions data, and critical information flows—such as in managing a port of a smart city—must invest heavily in managing access and security issues. It is critical to develop blockchain applications like jet airplanes—where there is no single point of failure and the odds of failure are minuscule.
- APEC needs to play a leadership role in providing coordination for the many standards initiatives around the world, in order for them to energize and help scale, rather than fragmenting, the blockchain ecosystem. Several governments including China, Japan, Russia, and intergovernmental organizations are analyzing and developing blockchain standards. We should ensure that many Standards-setting initiatives are complementary

and coordinated, so that disparate standards themselves do not end up fragmenting the ecosystem. This coordinated approach is all the more relevant when blockchains cross borders and impact such issues as revenue collection, data management, and regional security.

Best Practices on Blockchain technology applications

1. Carbon X: A Decentralized Ecosystem Fighting Against Climate Change

1.1 Project description

This project was committed to establish a decentralised low-carbon ecosystem, with sustainable development as the core value, climate issue as the breakthrough, carbon currency as the value circulation medium, and the inter-domestic trust mechanism and multi-party value connection as the means. The project's mission is as follows:

- To lower threshold for ordinary individuals and enterprises and institutions without emission reduction obligation to join the voluntary carbon market. Exhort more parties to work in a common endeavour and build a low-carbon society;
- To improve the safety and efficiency of the traditional carbon market, boost enterprises to save energy, cut emissions, and build a green economy for all;
- To build the trust mechanism among various parties, break down the barriers of the domestic carbon market and bolster the unification of the global carbon market;
- To integrate global forces and build a decentralised low-carbon economy with sustainable development as its core value.

1.2 Project Solutions and results

Carbon X, an open-source blockchain platform, is dedicated to the carbon asset vertical industry. Everyone is entitled to develop and deploy his/her application on top of the Carbon X blockchain. Ethereum is considered and proven to be one of the most secure and stable mainstream public infrastructures and Carbon X will be further developed on the Ethereum fork given the distinct features and needs of the global carbon asset market. All Ethereum community developers who shared the same belief in the sustainable development could join Carbon X with ease by using Solidity to develop apps or smart contracts related to carbon assets.

With smart contracts and blockchain, Carbon X will establish a secure and robust ecosystem specialised in the carbon asset industry. Its provision of varied interfaces for different business scenarios ensures that all players within the scenarios can work side by side under a mutually agreed framework without pre-established trust. By doing so, intermediaries and geographic barriers will be removed, market liquidity and efficiency will be improved, thus creating a better experience for all business participants on an equal footing.

Fig.1: The logic of Carbon X

The carbon X platform falls into three layers:

- Infrastructure blockchain layer based on an Ethereum fork with further development, given the distinct features and needs of the global carbon asset market.

a) Carbon X Blockchain Storage: all transactions related to carbon assets will be stored on chain to achieve full transparency, traceability and tamper-proof.

b) DCASS: Decentralised Content Access Storage System for easier data access and storage.

c) Off-chain private storage: all proprietary data from the issuing authorities will be stored off-chain for privacy protection.

- Smart contract configuration layer to provide standardised smart contract modules for the faster and easier development process in response to real-world carbon asset business scenarios.

a) Contract Negotiation System and Addressing for faster and easier contract settlement and completion.

b) Access policy, dataset manager and user identity system to handle and process on-chain registry.

- Protocol layer to establish keystore, carbon asset registry and audit protocols for easier and faster application development.

a) Carbon asset registry is a standard protocol for carbon asset tokenization. It defines the owner, the transfer permission and the expiry date of the beneath carbon asset.

b) Keystore system for digital asset management

c) Audit module for secure and transparent carbon assets transfer, destruction and transaction.

Source: this case was provided by director Shao shiyang from Gulian Supply Chain Consulting.

2. Blockchain-based Green Bond Consensus System

2.1 Project Description

This project was developed by IGreenbank. Founded in 2015, iGreenBank is a professional provider of green financial services. Proclaimed the first green Fintech service provider in China, the company is under the limelight by establishing the Blockchain-based Green Bond Consensus System.

The Blockchain-based Green Bond Consensus System utilizes blockchain as the technical pillar to achieve the certification process through consensus on the blockchain and multi-party cross-validation. This application reduces the certification cost and changes the traditional third-party certification model.

The key enabling technology is blockchain. The system utilizes blockchain to achieve immutable records, distributive data storage, peer-to-peer transaction, consensus mechanism, encryption files and smart contracts to reshape the relationship between multiple stakeholders. Blockchain, as an institutional governance technology enabling the green bond certification process, can achieve openness and transparency among the participants. By establishing a reliable data sharing mechanism, stakeholders of the green bond visualise the certification process and clearly see the requirements. Investors, one of the nodes, can manage the use of raised funds, and evaluate environmental and climate benefits in a real-time manner. Blockchain lays a technical foundation and creates a governance model for standardising the information flow and automatically set the rule of measurement, reporting and verification (MRV) process. This helps enlarge the scalability of green bond issuance and reduce certification costs.

2.2 ***Project Solutions and results***

One of the successful projects is Sustainability-Linked Bond (“SLB”). SLB could be any type of bond instrument, and its financial and/or structural characteristics may vary depending on whether the issuer achieves the predetermined sustainability/ESG goals. In that sense, issuers are thereby committing explicitly (including in the bond documentation) to future improvements in sustainability outcome(s) within a predefined timeline. SLB is a forward-looking performance-based instrument.

In the case of SLB certification, the issuer will pre-set the Key Performance Indicators (KPIs) and Sustainability Performance Targets (SPTs) in the smart contract. When the issuer meets the requirements, it will enjoy low-interest green bonds, and vice versa, suffer the consequences of an increase in the coupon rate. In the SLB case, the selected KPI by the issuer is "the ratio of increasing the installed capacity of wind power generation." Under this KPI, the issuer has established an SPT, that is, "From 1 January 202 to 31 December 2022, the newly installed wind power capacity shall not be less than the 11.9 percent of issuer’s total installed wind power capacity." The setting of the KPI and SPT of the linked bond is highly relevant to sustainable development goals, the domestic carbon neutrality strategy, and the issuer’s main business and strategic planning.

The Blockchain-based Green Bond Consensus System employs the consortium blockchain as the structure, which is established by permission-based blockchain, only one green bond-related shareholder can be pinpointed as the node for that bond (issuers, underwriters, law firms, green certification agencies, and non-governmental organizations). Participants can perform their duties and verify the compliance of green bonds through virtual data sharing. The verification process contains five aspects: the green attributes of fundraising, environmental benefits, ESG management and information disclosure. The innovation of the system aims to reduce information asymmetry from the system design level. The verification processes can be reorganized based on shared ledgers.

Financial Services Blockchain Consortium (Shenzhen) "FISCO" provides the fundamental technology. FISCO was founded in 2016 by over 20 financial institutions and technology

companies including WeBank, Tencent, Qianhai Financial Holdings, Shenzhen Securities Communication, and SF Holdings. In November 2019, FISCO officially registered as a non-profit organization. To date, FISCO has more than 150 members across six major industries - banks, securities, funds, insurance, regional equity exchanges, and technology companies - making it both China's largest blockchain organisation and one of the most inter-domestic influential.

Yet the system can only crack part of the issue in the green bond market. The financial industry's over-reliance on banks has made banks play overly important roles. Green loans or bonds are positioned to use the upper limit of deposit interest rates that will be given priority to large state-owned enterprises and local government investment enterprises because of their low-risk nature. This phenomenon has abandoned emerging entities that have made great contributions to economic growth, such as small and medium-sized enterprises (SMEs) and private companies, which are in urgent need of financing channels. Meanwhile, the disclosure of relevant information on SME corporate bonds is quite limited. Experts argued that blockchain-based project bonds could be a solution to raising finance in a crowdfunding logic, enabling to keep the transparency record, sustainability impacts, and revenue streams of projects. They also emphasized that domestic savers could leverage the chance to invest in local currency assets.

Source: This case was provided by Mr.Zhanghan, director of igreenbank (Beijing) Investment Service Co., Ltd.

3. Blockchain-based P2P Energy Trading in the Brooklyn MicroGrid, USA

3.1 Project description

Brooklyn MicroGrid is a blockchain-based P2P energy trading platform run by Transactive Grid, a partnership between LO3 Energy, Consensys, Siemens and Centrica. Located in the Gowanus and Park Slope communities in Brooklyn, New York, the microgrid has completed a three-month trial run of P2P energy trading among community members. A thorough analysis of the operation of this case study is as follows:

In summary, prosumers can sell their energy surplus directly to their neighbours by use of Ethereum-based smart contracts and PBFT consensus, implemented by Tendermint. The first trial included 5 prosumers and 5 neighbouring consumers, setting the first-ever energy transaction record in blockchains worldwide.

Energy surplus is measured by specially designed smart meters that can handle physical energy measurements and data, and sequentially transformed in equivalent energy tokens tradeable in the local marketplace. Tokens indicate that a certain amount of energy, produced from the solar panels, can be transferred from a prosumer's smart meter wallet to end consumers by the use of blockchain technology. Tokens are deleted by the consumer's smart metering device with purchased energy being used in the house. Microgrid users interact with the platform by specifying their individual price preferences in the form of willingness to pay or sell electricity. The platform can display location-specific and real-time energy prices. In the initial phase of the project, users manually trigger an agreement in the platform, whose terms are recorded in the blockchain. The ledger records contract terms, transacting parties, volumes of energy injected and consumed as measured by metering devices and crucially the chronological order of transactions. In addition, payments are automatically initiated by self-executed contracts. Every member of the community can have access to all historic transactions in the ledger and verify transactions for themselves.

3.2 *Project Solutions and results*

So far, more than 300 houses and small businesses, including 50 or so PV prosumers and a small wind turbine generator, have signed up for the next phase of development, an aim

to achieve fully automated transactions. Microgrid members will be able in the future not only to decide from whom to buy/sell energy tokens based on their price preferences, but also on other criteria that reflect their environmental or social values. For instance, a consumer can specify the maximum price he is willing to spend on locally produced renewable energy but he can also declare other preferences such as percentage of energy he is willing to purchase from local renewable energy or the main grid. Users can even prioritise selling/buying energy from friends, family or a specific neighbour. The market clearance mechanism planned in the future is similar to how stock markets work. The platform will record the interest of buyers and sellers (bids/offers) in an order book. Users will be able to change their price preferences in real time. Locally produced energy will be first allocated to the highest bidders. The lowest allocated bid represents the market clearing price for each time slot, currently set 15 min intervals. Users will be able in the future to collect historic information on prices, and therefore learn and adapt their bidding strategies.

The Brooklyn MicroGrid project aims to serve as a testbed for exploring novel business models that promote consumer engagement in community projects. Localised energy trading taps the potential for energy cost savings, yet numerous research questions are open for debate. First and foremost, the importance and size of local energy trading markets needs to be investigated. Only by implementing large scale projects that represent diverse conditions in energy markets and social groups, will we determine willingness of consumers to participate in similar market architectures. Pricing in customer-sided markets is determined by the laws of demand and supply, resulting potentially in significant price volatility or even higher tariffs than the ones offered by the main grid. As a result, further work in engagement with and protection of the elderly, socially disadvantaged and vulnerable from price volatility is required. In addition, equilibrium prices will not only derived by simple cost functions but by social values and behaviour. As a result, individual preferences and social behaviour of market participants require further investigation in order to develop efficient market designs and pricing mechanisms. Other open research questions include the determination of most appropriate time frame for market clearance and data updates, which is increasingly dependent on the operating protocol rules and consensus.

Another crucial issue is of balancing demand to supply. Currently, the existing network infrastructure is used not only to distribute and supply the energy traded in the marketplace but also to resolve issues caused by RES intermittency and load balancing. In the future, the project aims to explore how blockchain could be used for the active management of the distribution network. In principle, the energy produced by local prosumers can provide additional flexibility for local substation balancing.

This is currently not realised in the Brooklyn microgrid case, although a number of projects have begun exploring the use of techniques from artificial intelligence, machine learning and big data analytics to achieve demand-side flexibility. What blockchains could contribute to these solutions is the potential for decentralised matching between prosumers, enabling them to take real-time control of their own energy generation and supply.

Source: Merlinda Andonia,, Valentin Robu, etc Blockchain technology in the energy sector: A systematic review of challenges and opportunities, Renewable and Sustainable Energy Reviews 100 (2019) 143–174

4. P2P-trading Pilot Project in Urawa Misono, Japan

4.1 Project description

The case includes four consumers and five prosumers as well as one big shopping mall. All prosumers are connected to an embedded private-power lines for P2P-trading. In addition, there is commercial a distribution line connecting other consumers and the mall to the main utility grid. Each prosumer is equipped with a solar PV system, battery, smart meter, Digital grid controllers (DGC), and Digital grid routers (DGR). The DGR records information, such as power supplies and prices, and enables AC-DC-AC conversion for grid interconnectivity. The DGC communicates with the smart meter and DGR, and places bids for power purchases and sales in a blockchain-based P2P network. The bidding is made virtually based on Japan Electric Power Exchange (JEPX) spot market. The bidding results are communicated to the DGR, which carries out the power transactions including PV and battery power control, and thereafter the DGC records the transactions on the blockchain.

4.2 *Project Solutions and results*

There is a series of technological challenges of block-chain which may influence the scalability of the case, discussed as follows. Issues include blockchain throughput (transactions per second: tps), latency (seconds per transaction: spt), data storage, legacy system interoperability, high speed connectivity, and cybersecurity. These issues are influenced by blockchain design and consensus mechanisms. Proof-of-Work (PoW) was introduced as a consensus mechanism in the Bitcoin blockchain and several other blockchain platforms including in the energy sector However, PoW involves high energy intensity, and latency Initially, PoW was mainly carried out using central processing units (CPU). However, due to their higher efficiencies for PoW and cryptocurrency mining, graphics processing units (GPU) and Application Specific Integrated Circuits (ASIC) have been increasingly adopted for such purposes. CPU, GPU and ASIC nonetheless all incur a high energy consumption.

The current case is based on a private Ethereum blockchain, and Proof-of-Authority (PoA) as opposed to PoW consensus mechanisms. PoA adopts an authority node (a known validator) to manage bids, transactions, and completion reports in the P2P network. DGR carry out power and financial transactions based on smart contracts and by leveraging asynchronous grid connections. PoA requires lower computation power, resulting in lower latency and resource consumption. At large, adoption of more energy efficient and scalable consensus mechanisms are expected to increase, such as of PoA and Proof-of-Stake (PoS). Ethereum, for example, maintains plans to standardize PoS on its platform, as opposed to PoW, and integrate sharding. Sharding involves branching one blockchain into several chains, which may reduce latency and increase throughput if the case project is scaled.

A technical issue related to sharding is multi-chain interaction and communication: an area for further research. Ethereum is developing a framework (Plasma) for scalable, autonomous execution of smart contracts leveraging externalized multi-chain, multi-party channels connected to the block-chain root. Multi-chain block-chain infrastructure may also contribute to scalability. If the case is to be scaled up, large-scale block-chain data storage would also be an issue. The Ethereum network, for example, requires high speed large-scale databases such as solid state drives (SSDs) to support node-syncing, data transfer, and multi-tasking Storage issues can be further tackled via cloud computing, side-chains, off-chain storage.

For the case in Japan, identified challenges in the economic dimension include subsidy-dependence, market competition, contract interoperability, and platform market growth. In Japan, smart energy projects have largely been supported by public grants and subsidies, showing a need to mobilize resources and develop business models that do not depend on governmental funding. The case project is mainly funded by the Ministry of the Environment

(MoE) of Japan. Long-term business model innovation and scalability in the event of subsidy independence is an important question. Market barriers built by incumbent companies or monopolies may inhibit decentralized block-chain-based applications.

In a word, a sustainable energy shift requires energy and smart technology advances, as well as new market designs and business models

Source: A.Ahl,M.Yarim, M.Goto, Exploring blockchain for the energy transition: Opportunities and challenges based on a case study in Japan, Renewable and Sustainable Energy Reviews Volume 117, January 2020.

5. State Grid chain, China

5.1 Project Description

“State Grid chain" is the largest public service platform of energy blockchain in China built by State Grid Corporation of China. The platform is led by the Internet Department of the State Grid, and the State Grid e-commerce Limited is responsible for the construction and operation.

5.2 Project Solutions and results

Based on the alliance chain architecture, the energy blockchain platform adopts the "master, side and slave" Multi Chain hybrid mode to build a blockchain public service platform covering various energy business applications such as power, oil and natural gas, so as to provide support for multi-party collaboration and trust transmission across regions and enterprises in the energy industry. The "master, side and slave" Multi Chain hybrid architecture mode can adapt to the energy industry with large volume, complex business and high data concurrency rate, and has good node scalability and reliability. Among them, the main chain covers all enterprises in the energy field and provides cross enterprise data interaction and sharing services based on blockchain; The side chain extends to an industry in the energy field, covers relevant enterprises in the industry, and supports the wider coverage and more comprehensive data interactive application of the main chain; The slave chain is guided by the actual business application requirements, carries out application expansion, supports the master and slave chains, and realizes the full coverage of applications. The grid chain has the following functions:

- Identity authentication service: Aiming at the problems of key management, cumbersome verification and high cost of traditional authentication technology, the chain will take full use of the advantages of blockchain multi-node sharing technology to realize the effective sharing of business data and information among multiple agents, which can effectively optimize the energy business process and improve the flexible, credible and efficient collaborative interaction among multiple agents.
- Certificate storage traceability service: the data certificate storage traceability service based on blockchain is a new distributed infrastructure and computing paradigm. Aiming at the Multi Chain and multi-agent phenomenon of products, users and enterprises in the energy industry chain, it integrates block chain data structure, cryptography and smart contract technology to realize reliable traceability through dynamic certificate storage of digital information in all links.
- Contract management service: combined with blockchain consensus mechanism and smart contract technology, it provides identity recognition, strategy management, smart contract and certificate storage services for energy trading business, and realizes the whole process management of electronic contract from initiation, signing, archiving to certificate storage.
- Transaction matching service: programmable smart contract technology is adopted to

realize transaction security, openness, transparency and data reliability through key technologies such as digital signature, consensus mechanism and asymmetric encryption algorithm, which helps renewable energy supply service providers maximize the benefits of selling electricity and minimize the cost of purchasing electricity.

- Trusted access service: facing the access needs of diversified terminals and diversified services in the energy industry, combined with 5g, Internet of things identification and artificial intelligence technology, develop a trusted access terminal device supporting the blockchain to meet the ability requirements of diversified service terminal access mode, service security isolation, supporting service data trusted identification, authentication and verification of data trusted access and so on.
- Data sharing service: Aiming at the problems of centralized deployment, limited access, non-unique identification, easy to be stolen or tampered among energy enterprises, the decentralized data sharing protocol module is designed with the help of blockchain technology, distributed storage, tamper proof and Traceability Technology, so as to carry out the whole process of data traceability protection from data screening, storage, transmission and download, and build a data security and trusted network to realize data sharing.

Based on the mixed architecture mode of "master, side and slave", the largest public service platform of energy blockchain in China - "State Grid chain", built by State Grid Corporation of China, has been applied in 25 business scenarios, with more than 100 million uplink data and remarkable application results.

6. Zhengtai Carbon Monitoring, Reporting and Verification Platform

6.1 Project Description

The project is a carbon monitoring, reporting and verification demonstration platform for Zhejiang Zhengtai Internet of things Industrial Park, which is committed to building a carbon data monitoring and analysis platform connecting "government, enterprises, verification institutions, consulting institutions and regulatory institutions". Through the monitoring, summary, analysis and report of carbon emission data, the project helps the government master the carbon emission data and carbon emission structure of the park, and provides quantitative decision-making basis and management measures for realizing low-carbon development strategy in the region. By providing carbon asset trading services, the system helps to revitalize the carbon assets of enterprises in the park and help realize carbon neutralization in the park.

6.2 Project solutions and results

The platform provides data access, data encryption, data cleaning, data uplink, data statistical analysis and other functions. it will support the cleaning, processing and mining of carbon asset data, highlight important indicator data and form a leadership cockpit. The blockchain-based carbon management industrial manufacturing carbon emission solution reconstructs the underlying trust foundation based on the distributed network, gathers the carbon emission data of the whole process of factory, monitors the carbon emission in real time and accurately automatically completes various data declaration, opens up a more intuitive and comprehensive display of the progress and achievements of carbon trading.

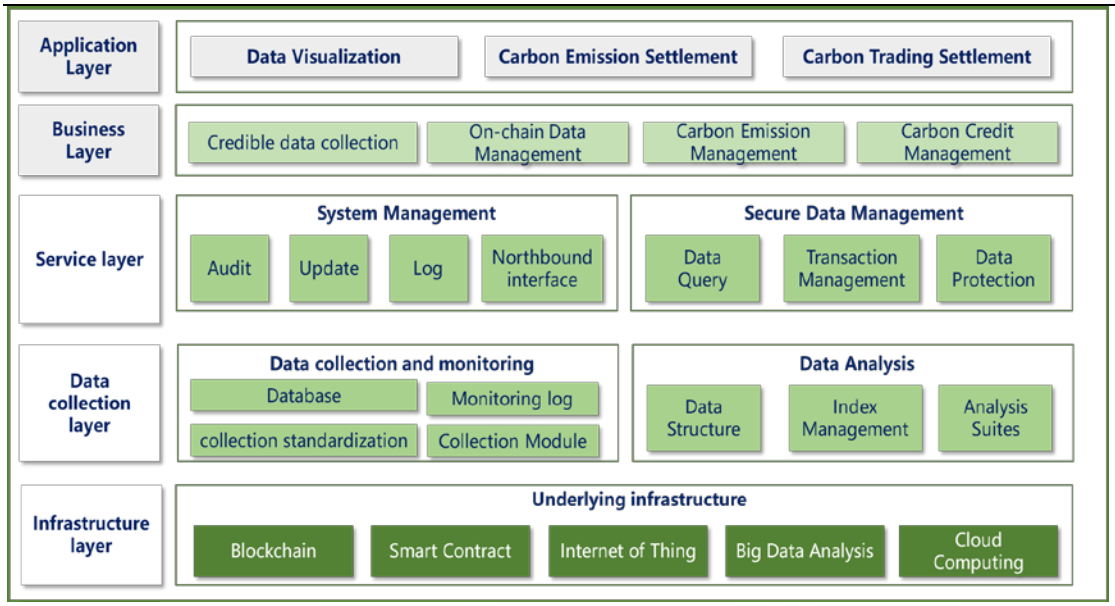

Fig. 2: The five layers of the platform

Data collection

To collect emission data, the system first define clearly accounting boundary and emission sources in the industrial park. Emissions from production facilities involved in carbon emission in the production and manufacturing process of factories and production lines are collected automatically with help of industrial equipment, Internet of things equipment and other hardware equipment as well as operation equipment.

Carbon emissions include emissions from fossil fuel combustion, emissions from industrial production processes, and emissions from net purchases of electricity and heat. The system help to support the carbon emission data collection of production facilities in different scenarios of industrial manufacturing industry and provide a variety of data collection methods.

The main functions include collecting emission data at the edge in real time through the blockchain module; collecting emission data by connecting blockchain client with existing system interface; carrying out multi-channel data collection for a single emission source according to the business scenario.

System services

The system provides one-stop carbon emission data service, calculate carbon emission data in real time, and track the completion of enterprise carbon emission reduction projects Completion schedule, target completion and cost utilization, so as to realize fine process control and production operation.Control. Introducing blockchain technology to improve data authenticity and security helps to meet regulatory needs and support carbon trading.

Business application.

In all, the system is designed to help those manufacturing firms to participate in carbon asset trading. The solution reconstructs the trust mechanism for all participants in the manufacturing industry chain. Manufacturing enterprises and processing enterprises can count the carbon emission data in the actual production process, formulate emission reduction control plans, and uniformly carry out production management and supply management; Regulatory authorities can conduct real-time supervision of carbon emission behavior and checking the carbon emission allowance of enterprises. The carbon trading platform can query the whole life of carbon assets Life cycle data to support asset due diligence.

So far, 10 manufacturing enterprises have been installed with the system and it is under good operation.

Source: Zhengtai industrial park

7. Blockchain + Distributed PV Generation

7.1 Project Description

This project is about blockchain + distributive PV Generation, listing distributive PV generation powerbase as a kind of reliable digital asset on-chain. The blockchain plays a part in generating a reliable and unchangeable history of the powerbase's power generation number (production history) and the power sales to the Domestic Grid (income history).

This reliable on-chain data is supposed to support due delegation and ongoing asst monitoring for the investigation to PV generation powerbase by law firms, financial institutions and other personal investors.

7.2 Project solutions and results

Not only did the project write the Hash of source data on chain but it devoted to executing a close-loop and lifecycle management of digital asset on the chain, allowing future business scalable to carbon neutrality, sharing PV generation with personal and institute investors, traditional due delegation and post-investment management.

All PV generation powerbase is projected as a unique Non-fungible token that can be pledged/transacted/frozen/transferred directly on chain. The NFT technology allows every single PV generation base to have a unique income and asset valuation history, which is a bud for future investment and valuation.

To make sure the digital asset is one-to-one mapping to the real-world physical asset (PV generation in this case), the IoT and wireless communication, which is vital, need to combine into the blockchain-based solution.

The PV generation itself has blockchain account and can act as a counterparty. With a smart contract, this project can support an array of financial investment arrangements from traditional leasing to a shared economy. The production & sale data is on-chain, while the income can be a token distributed first from the power buyer to the PV generation account and then to all investors via a blockchain account system and smart contract. So all financial history is close-looped on-chain with the transact while clearing feature.

The power generation from PV is cleaner than the traditional one, carbon coupon token can be therefore generated from the digital PV generation based on the production and sales data, as another new income. With the regulation's permit, this coupon is promisingly be used as a carbon neutrality method by those enterprises in need of aligning with carbon limit.

The project has finished all technological research and development, currently, corporation with a power generation company is in full swing. And the carbon coupon should be another driving factor.

Source: this case was presented by Mr.Zhang xinyu, director of Yumo Blockchain company, Shanghai.

8. Green Food Trace System Using Blockchain Technology

8.1 Project Description

The system is committed to providing a fully decentralised green food trading and tracing system using blockchain technology, allowing the producers and consumers to communicate on a premise of guaranteed security, privacy, and fairness. Specifically, the system considers that one of the biggest challenges to realizing a credible trace system is to capture the footprint of foods during the procedures from production to table. Further, the opaque upstream-downstream financial relationship has impeded the healthy growth of the supply chain. The system, therefore, utilizes blockchain technology and a sensing network to collect and store evidence of food footprints. Blockchain can be utilized to strengthen the trust between the individual consumer and producer. Meanwhile, it can be applied in the process of metering, billing, and settlement in the food trading market (financial supply chain), endowing consumers with a high degree of autonomy in the food trace system directly. The underlying cryptographic algorithms are used to protect the security and privacy of consumers' and producers' personal data and food trading records. The architecture of the system can be depicted as follows:

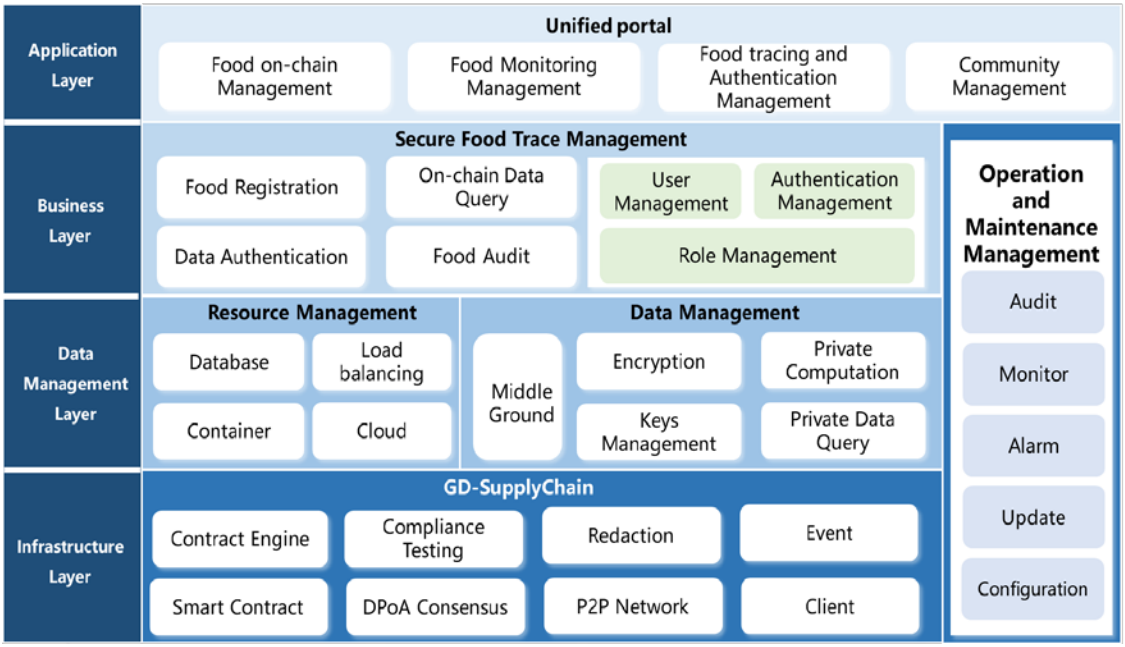

Fig. 3: The architecture of system

8.2 Project Solutions and results

To ensure that the producers and consumers can communicate on a premise of guaranteed security, privacy, and fairness, the project solutions include the following key elements: Data authentication, aggregating user authentication, footprint authentication.

Key technologies involve private computation, the customized secure multiple computation, private set interoperation, non-interactive zero-knowledge proof, key-policy attribution-based encryption. Moreover DPoA consensus protocol, the decentralized proof-of-authority consensus protocol, is designed to improve the throughput of transactions and decrease the cost of consensus. To improve the efficiency of data query from the underlying blockchain, the system also use efficient On-chain Transaction Query, the on-chain commits (index) and off-chain label.

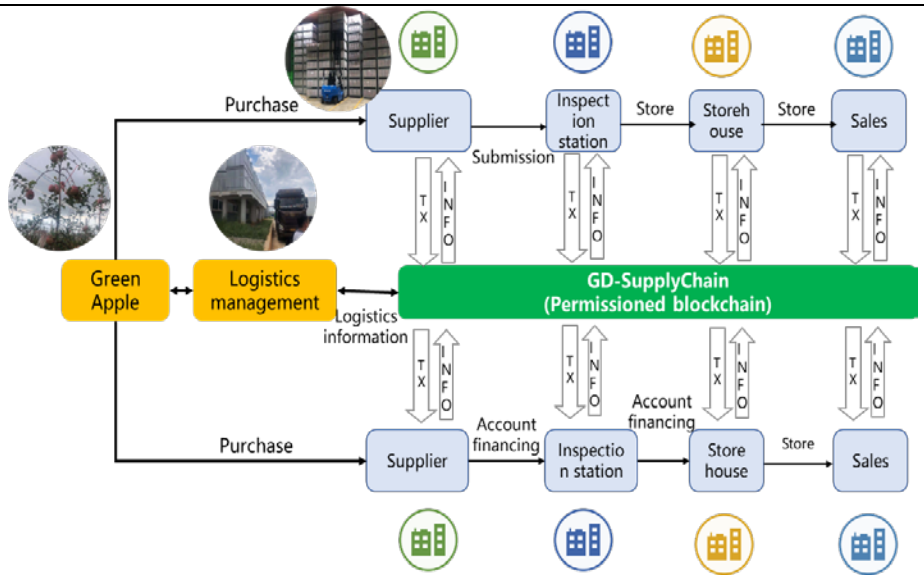

Fig. 4: The architecture of GD-Supply Chain

This system is also suitable for fairness trading, fair food trading with fairly trading on smart contract. It has been adopted by some decision makers to manage the sensing data in the Internet of Things (IoT). Specifically, the data collected by the sensors are encrypted and sent to the distributed blockchain for further processing. This system has been utilized for digital assets trading, such as music, book, and video. It achieves secure traceability and trading in the digital right management.

Source: This case was presented by director Wang Zhihong, Guangzhou Blockchain Co.Ltd.

9.Blockchain-based Platform for Green Winter Olympic Games

9.1 Project Description

Under the joint guidance of the State Grid Corporation of China and the Beijing Organizing Committee for the Winter Olympics, the system is a visual green power traceability system built by the Beijing electric power trading center and the State Grid blockchain technology company affiliated to the State Grid Beijing Electric Power United Nations network e-commerce company, The platform was established as the largest public service platform of energy blockchain in China. It was oriented to relevant government departments, regulators and relevant enterprises to effectively support the green power generation of the Beijing Winter Olympics.

The system can issue green power consumption certificate based on blockchain for Winter Olympic venues, so that 100% green power supply commitment of Winter Olympic venues can be traced, checked and proved. During the 2022 Beijing Winter Olympic Games, the blockchain based green electricity traceability system will help the Winter Olympic venues to absorb 100% of green electricity, so that every 1 kwh of green electricity can be traced and verified.

9.2 Project solutions and results

The project monitored the key process chain from production to consumption, mitigated the risk of data loss in transmission and of data tampering, and provided a hundred services for the Winter Olympic venues.

Full coverage of 100 percent green power provides credible proof to realize the real-time, visual and multi-dimensional perception of green Winter Olympics, a testament to the world for the low-carbon Winter Olympics.

The whole platform included the foundation layer, platform layer, data layer, service layer and display layer.

The integration completed the acquisition of business data, carries out data calculation through algorithm analysis, and uses graphics and real-time data.

The platform layer was based on the State Grid chain service and encapsulates the data exchange service. The State Grid chain mainly provided basic link Interface calls and online certificate storage services for green power data at the Beijing Winter Olympic; In the data exchange platform, it completed integration, extraction and quality management of the green power data for the games.

The data layer included the modelling and cleaning of data and the formation of data assets, and transmits standard data to the service layer.

The service layer mainly contained data uplink, data statistics, data analysis, data development, data interface and other services.

The display layer showed the whole process of green power generation, transmission, transaction settlement and consumption at the Winter Olympic Games.

10. BF Anti-Counterfeit DApp Solution System

10.1 Project Description

Many organizations and enterprises in China or around the world have been plagued by counterfeit products. The huge losses due to counterfeit products forced them to invest tremendous resources in product anti-counterfeiting and IPR-related production, yet its effect is not evident. The raging epidemic in the past years has developed awareness of the majority of consumers of the safety of food supplies. A low-cost and effective anti-counterfeiting technology, tool and means for traceability is like a magnet to businesses, organisations and even consumers. The company initiated the "BF Anti-Counterfeit DApp Solution System" project to provide specific traceability and anti-counterfeiting solutions with technical support and services for different products of users with low-cost but efficient traceability and anti-counterfeiting technology.

Based on the application concept of blockchain technology, the project design team of "BF Anti-Counterfeit" from Beifu New Technology Ltd (initial BF), with an emphasis on the application research of blockchain, develops the technology with practical value, implementing blockchain technology in tracking and tracing in supply chain management with a tool of anti-counterfeit DApp solution system. The "BF Anti-Counterfeit DApp Solution System" project is an application in the area of traceability and anti-counterfeiting, expecting to provide users with low-cost but efficient and practical traceability and anti-counterfeiting products and services by using the creative functions of blockchain technology applied in the project.

10.2 Project solutions and results

The “BF Anti-Counterfeit DAPP Solution System” project includes a software system and the application of matching hardware products, applying the special design of blockchain system combined with software and hardware to record and ensure the accuracy, timeliness, and credibility that the system is monitoring, tracking and managing the traceability information in all steps of supply chain including production, circulation and even sales process, whether it be online or offline.

(1). Application Scenarios:

The project “BF Anti-Counterfeit DAPP Solution System” is composed of a blockchain software system and application hardware products. The blockchain software system endows the products with a unique "product ID" and "passage record" , in combination with IoT technology, recording the data of the whole process of product circulation, providing information for tracking, and enhancing consumers' trust in product safety. Enterprises can manage their products online through the software system as well. The blockchain hardware product "RFID+NFC" developed and utilized together with the blockchain software system can help users to operate skilfully with the software system to reduce the operation and management cost, improve operational efficiency, empower the actual production and marketing, and thus create new values.

Far cry from traditional traceability and tracking means, the project uses blockchain patented technology to achieve real traceability at a lower cost, increase the credibility of traceability information, make it more convenient and effective to operate especially in supply chain management, and boost consumers’ confidence in product safety, the current online and offline sales in particular. It brings greater added value at a small cost to the producers, transporters, sellers and end users (consumers). On the other hand, marketing managers can apply this project to controling product safety and operating the supply chain more effectively.

The project is a blockchain ecosystem of tracking security. The software system provides each product a unique "product ID card" and "traffic record", in combination with the function of Internet technology, to record the exact information of production, logistics and other links

and to provide empirical evidence for tracing and tracking, so that it can build consumers' trust in the product. Together with the blockchain software system, the blockchain hardware product "RFID+NFC" is also developed and used to trace, track, supervise and manage the whole process of supply chain especially in production and logistics.

(2). Blockchain Bottom Layer

“BF Anti-Counterfeit DAPP Solution System” is a blockchain anti-counterfeiting tracing and tracking platform that combines blockchain with Internet and other technologies. Its blockchain bottom layer includes:

Hyperledger Fabric is generally applied while the concept of a combination of centralisation, multi-centralisation and decentralisation is applied as well for the efficiency purpose.

Gossip Protocol, the core technology of the P2P network, is applied in the system. Gossip is a distributed protocol with the decentralised method, tackling the problems of data propagation and state consistency in a cluster.

The subject project also applies Protobuf (Google Protocol Buffers), a serialization technology. Serialization is a technology for distributed systems, involving network transmission.

The project realizes authentication and data encryption through asymmetric encryption technology and a PKI system. PKI (Public Key Infrastructure) is implemented in this project as follows:

A CA (Certificate Authority) Authority is implemented to provide digital certificates, including public and private keys, to users (including service providers and consumers). Meanwhile, the CA Authority also needs to provide a CRL (Certificate Revocation List).

Blockchain achieves security authentication through the PKI system. Public and private keys are designed as: The CA issues two certificates: public and private keys, where the private key is held only by the service provider and the public one is held by the owner (the service consumer).

Trust between certificate and blockchain: CA certificates are divided into two categories: RCA (Root CA) Root certificate and ICA (Intermediate CA) Intermediate certificate. These certificates start with the RCA and form a certain trust between the certificate and blockchain.

(3). Technical Architecture, Functional Features and Business Processes

The project has the following characteristics:

I: Patent: Blockchain technology

“BF Anti-Counterfeit DAPP Solution System” combines the blockchain patent technology with Hyperledger Fabric in anti-counterfeiting of cryptography technology and digital segmentation design. Blockchain technology with its characteristics such as "uniqueness", "non-tamper" and "timestamp" can be well applied to anti-counterfeiting of product traceability, leading to credible traceability of data and information.

“BF Anti-Counterfeit DApp Solution System” implements our Block-chain patents, involving the innovation points as follows:

Technological innovation A: Patent technology with the innovative blockchain parallel application of multi-centralisation and decentralisation: The combination of multi-centralisation and decentralisation makes the traceability anti-counterfeiting system more efficient and effective, while the public and private information can coexist selectively. In this sense, public information used for traceability security can be displayed to the public, while private data can be reasonably protected from being released.

Technological innovation B: Digital segmentation encryption patent technology for the segmentation of data processing: The data address of the traceability of information shall

be processed in stages, with each stage corresponding to the tracing and tracking steps of supply chain management including production and processing, customs, logistics, storage, sales and other links of the product respectively. The traceability of information shall be verified through the special encryption processing of the data address. The digital segmentation technology is also embedded in the product's tracing and tracking history of non-tamper timestamp automatically added.

II: Unique design of RFID + NFC + Internet + Block-chain traceability for anti-counterfeiting: The project applies the “RFID+NFC” method, in combination with the unique design of blockchain anti-counterfeiting based on the decentralised software system, to implementing the supply chain management, in which it automatically and timely traces, tracks, and records information, and reports to the management or even customer side. The unique method combining different frequency band "RFID + NFC" hardware chips and other means (such as RFID + QR code), with a single code for each item through such means as smart contracts, some specially designed code (QR Code etc.), scanning RFID or contacting NFC, traces and tracks the whole steps of the supply chain including product manufacturing, warehousing, logistics, sales, after-sales service and so on. The design also can help users(management) to establish management and circulation based on data or information that can be trusted, so that it can achieve a higher level of management by sharing resources, management information, and even achievement.

III: Unique software system and hardware configuration: The "RFID+NFC" hardware chip specially designed and other means as well as hardware devices in the project help scan code or contact the source of the NFC to upload data to the chain through the smart contract so that the whole process of supply chain management in tracing and tracking of the real-time interaction, transmission and storage of information can be applied to big data analysis and management, leading to more efficiency.

IV: High-level performance at low cost: “BF Anti-Counterfeit DAPP Solution System” with the combination of software and hardware equipment can perform well at low cost when adopting the unique design of sub-master code mixed-using high and low costs devices allocating technology, so that it enhances the competitiveness of the product. The design of multi-level codes, the mixed use of chips of different frequency bands, and the clever cooperation of software and hardware, can help us in tracing and tracking and reduce the cost of anti-counterfeiting hardware. The subject mature system and products of the project perform anti-counterfeiting traceability and bring the value added by the great improvement of management efficiency to the users in supply chain management.

Presently blockchain application is a new technology and a new type of solution in the market as well. The present market for a general application of blockchain technology and products is not yet formed in China or in the world, yet the future of market is expected, whether it be better technology or a faster-growing market. “BF Anti-Counterfeit DAPP Solution System” can by far technically support the simultaneous operation of multiple nodes, with the initial operation of transaction number per second (TPS) around 15000 and query rate per second (QPS) up to 45000, leading to a result that a block can be completed every second with the trading capacity up to 99M. “BF Anti-Counterfeit DAPP Solution System” is now providing 84 users with their 487 products with supply chain management services. The company still needs to jostle for more market shares by improving the technology and increasing the number of users and products as well.

Source: This case was presented by Jason Jiang, director of Beifu blockchain company.

11. A Non-Intrusive Deep Learning Based Lift Monitoring System

11.1 Project desciptions

At the end of 2020, there are about 70,000 lifts in Hong Kong, China, among which

about one-third of them are aged more than 30 years old. In general, these lifts have relatively more frequent breakdown due to aging components. Equipping them with remote monitoring systems could instantly check the operating condition, and send alerts in the early stage of failure or upon detection of fault symptoms so as to carry out timely maintenance, reduce breakdown time and even prevent accidents.

11.2 Project solutions and results

The rapid advancement of Artificial Intelligence (AI) in recent years is now driving forward the innovation and technology in the world. While the use of AI on lift monitoring is still at the initial stage as of today, the EMSD in collaboration with practitioners from industries, academic and research sectors started developing a smart lift monitoring system (hereafter referred to as “the system”) in 2018 by applying AI and remote monitoring technology.

The system facilitates lift owners, building management offices, lift manufacturers and lift maintenance contractors to have collaborative analysis and diagnosis of the operating condition of the lifts. The data of real-time lift operation status and alerts can be viewed and downloaded from a common platform (Fig. 1). The system is designed for keeping aging lifts as well as modern lifts away from breakdowns and accidents, by informing relevant maintenance parties via the common platform to take immediate corrective actions and conduct corresponding predictive maintenance with higher efficiency and performance prognosis.

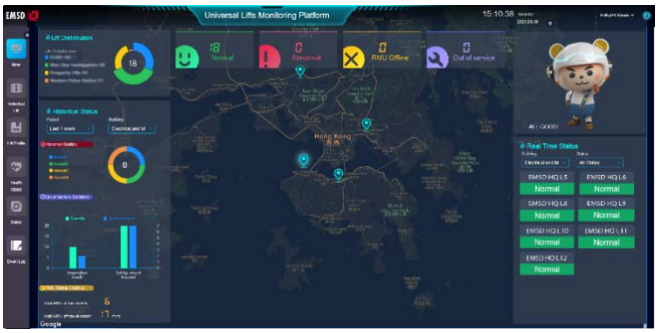

Fig. 5 Common Platform for Lift Monitoring

The system plans to develop a non-intrusive blockchain monitoring platform for lifts, which enables the operation data to be stored in many nodes in the block-chain network, thus ensuring the data integrity. With cyber security in mind, the project developer plans to develop an IEEE standard for data acquisition of the operation of lifts by using different Data Acquisition Devices (DADs) to ensure the data accuracy of the said platform without sharing operation details to each others, the block-chain based framework enables different stakeholders (e.g. facilities managements) to input operation data to enhance the fault prediction of the common monitoring system for lifts .

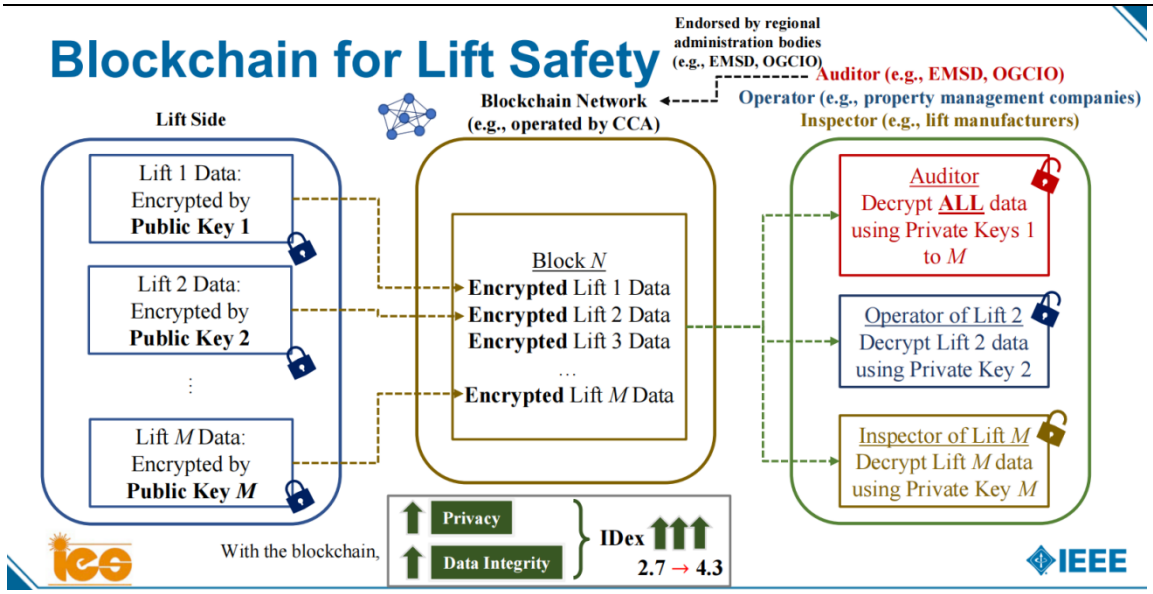

Fig. 6 Block-chain for lift Safety

Project Value and Benefit

The benefits of the System include enabling early fault detection and predictive maintenance, increasing lift availability and reducing possibility of accidents. By commercialising the System, the following benefits will also be achieved:

Enhancing EMSTF's client satisfaction on lift maintenance services;

Enabling EMSTF to be a trade model on the application of AI and big data for lift monitoring;

Displaying the big role of AI for lift monitoring as mentioned in Best Practices for O&M Service of Lift & Escalator Installations;

EXhibiting a successful I&T project in collaboration with governments, industries, academic and research sectors, speeding up the stages of concept formulation, proof of concept (PoC), research and development (R&D), measurement and verification (M&V) and commercialisation.

Source: this case was presented by Ivan Li ,honorary secretary of the Association of Energy Service Companies of Hong Kong, China

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Annex 1: Workshop Agenda

16 Dec 2021	Opening Ceremony
Moderator: Prof. Yu Bai, Director of Science and Technology Division, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences	
09:00-09:05	**Background Introduction** Prof. Yu Bai, Director of Science and Technology Division, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences
09:05-09:10	**Welcome Message** Prof. Jiancheng Lv, President of Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences
09:10-09:15	**Greetings** Ms Xuemei Yang, Division Director, Department of International Cooperation, Ministry of Science and Technology, People's Republic of China
16 Dec 2021	**Topic 1: Blockchain Capacity Building**
Moderator: Mr Zhigang Luo, APEC Project Coordinator, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences	
09:15-09:35	**Blockchain Principles, Development Trends and Applications in Energy and Low Carbon** Prof Yongdong Wu , College of Cyber Security , Jinan University / Chief Expert of Block-chain New Technology (Guangzhou) Company, Ltd.
09:35-09:55	**Blockchain Industry Development Trend and Supporting Policies of Guangzhou** Mr Anso Luo, Vice Secretary General, Guangzhou Block-chain Industry Association.
09:55-10:15	**Climate-friendly Cooling Through Digitization and Block-chain** Dr Bo Shen, Research Scientist, the Lawrence Berkeley Laboratory (Berkeley Lab), U.S. Department of Energy laboratory
10:15-10:35	**Blockchain Powers Digitization Forward** Mr Li Zhu, Ecological Marketing Director, Intelligent Technology Business Group of Ant Group
10:35-10:45	Q&A
10:45-11:05	**Blockchain Development in Papua New Guinea** Ms Christopher Vagalia, Agri-Tech Organics (ATO),PNG
11:05-11:25	**Blockchain Development and Policy in Hong Kong, China** Dr Ivan Li, Association of Energy Service Companies of Hong Kong, China
11:25-11:45	**Blockchain Development and Policy in Thailand** Dr Junwei Wang, Executive Director, Bangkok Centre of shanghai

	Institute of CAS
11:45-12:00	Q&A
16 Dec 2021 Field	**Topic 2: Blockchain Case Sharing in Green Supply and Finance**
Moderator: Prof Guotian Cai, Deputy Director of Energy Strategy Research Center, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences	
14:00-14:30	**Blockchain Application in Supply Chain Management** Mr Nicolas de Loisy, President , Supply Chain Management Outsource - SCMO
14:30-15:00	**Block-chain in Food Traceability** Dr Suporn Pongnumkul, Member Economy Government Electronics and Computer Technology Center, Thailand
15:00-15:20	Q&A
15:20-15:30	Tea Break
16 Dec 2021	**Topic 3: Blockchain Case Sharing in Energy Transition**
Moderator: Dr Pruk Aggarangsi, Director of Energy Research and Development Institute Nakornping Chiang Mai University	
15:30-15:50	**Application of Blockchain in the Development of Carbon Assets in the Construction of the Whole Photovoltaic County** Mr Zhigang Luo, Senior Engineer, APEC PO, Guangzhou Institute of Energy Conversion, CAS.
15:50-16:10	**Potentials of Block-Chain Technology Application in Livestock and Poultry Production for Full Traceability of Milk and Meat and Ensuring Environmental Safety and Safe Food Supply in Bangladesh** Prof. AKM Ahsan Kabir, Department of Animal Science, Bangladesh Agricultural University
16:10-16:30	**Carbon X: A Blockchain-based Decentralized Carbon Economy** Ms Shiyang Shao, Executive Director, Gulian Supply Chain Management Company, Ltd.
16:30-16:50	**Application Exploration of Block-chain Technology in Carbon Trading** Mr Xuedu Lv, Former Vice Director of Member Economy Government Centre for Climate Change Strategy and International Cooperation
16:50-17:00	Summary
17 Dec 2021	**Topic 4: Block-chain Case Sharing in Carbon Neutral**

Moderator: Ms Shiyang Shao, Executive Director, Gulian Supply Chain Management Company, Ltd.	
09:00-09:20	**Blockchain-based Green Bond Issuance** Dr Yushi Chen, Chief Researcher, Hengqing Digital Block-chain Institute
09:20-09:40	**Blockchain-baseed Carbon Neutrality Business Model** Mr Xinyu Zhang, President, Shenzhen Moke Node Network Technology Company, Ltd.
09:40-09:50	Q&A
09:50-10:10	**Blockchain Technologies to Support Renewable Energy Deployment** Prof Benoit Couraud, Heriot Watt University, UK
10:10-10:30	**Energy Demand-Side Management-Using Block-chain Technology** Dr PengFei Li, China Communications Service Corporation Limited
10:30-10:50	**Blockchain Technology to Precisely Account for Renewable Energy Produced on Site Setting a Goal to Achieve Carbon Neutrality** Dr Pruk Aggarangsi, Director of Energy Research and Development Institute Nakornping Chiang Mai University
10:50-11:00	Q&A
11:00-11:20	**PNG cases: BC for Agriculture** Ms Christopher Vagalia, Agri-Tech Organics (ATO), PNG
11:20-11:40	**PNG as an APEC Startup and Blockchain for Forest** Ms Pierre Elias, CEO, ICT Centre, PNG
11:40-11:50	**Carbon Didi--linking Human and Nature** Ms Nan Li, Shanghai Carbon Information Technology Company, Ltd.
11:50-12:00	Q&A
12:00-14:00	Lunch
17 Dec 2021	**Topic 5 – Blockchain Case Sharing in Green Financing**
Moderator: Mr Zhigang Luo, APEC Project Coordinator, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences	
14:00-14:15	**Innovative Financing Solutions Using Blockchain** Lin Junlong, Webank Blockchain Strategy Department, Shenzhen Webank Company
14:15-14:30	**ABS Solutions Based Bloc-chain** Gong Li, Director, Guangfa Securities Innovative Lab

14:30-14:45	**Green Supply Chain+Supply Financing System** Wei Ronghuan, Division Director of Green supply, Carbon Fin-tech Consulting Limited
14:45-15:15	Q&A
	Topic 6 Project discussion **Moderator:** Mr Zhigang Luo, APEC Project Coordinator, Guangzhou Institute of Energy Conversion, Chinese Academy of Sciences
15:15-15:30:	**Discussion on the Overall Outline of the APEC Project Report (Case Writing, Policy suggestions)**
15:30-16:30	**Case Discussion**
16:30-16:50	**Policy Suggestions Discussion**
16:50-17:00	**Conference Summary**

Annex 2: Speakers Biography

1. Mr Anso Luo

CIO, Guangzhou ZTLM technology Co.,Ltd, chief specialist of the Guangzhou Blockchain Industry Association, and has been working as a blockchain specialist for over 3 years. Luo has over 15 years of Fintech experience in various sectors such as fund management, corporate banking, investment banking, security exchange, financial risk management. Luo has extensive experience in application design development and technical project management in blockchain technologies.

2. Dr Bo Shen

Dr Shen is an energy/environment research scientist in the energy technology area of the Lawrence Berkeley Domestic Laboratory (Berkeley Lab), a U.S. Department of Energy domestic laboratory managed by the University of California. Dr Shen's work covers a wide range of areas, including energy efficiency policy and governance, tech-economic analysis of efficiency improvement and pollution reduction measures, clean energy transition, distributed energy resources, demand response, power market reform, green financing, carbon pricing, and emissions trading based on block-chain technology application.

Dr Shen has over 25 years of experience working in the energy field. Prior to his employment at Berkeley Lab in 2010, Dr Shen led the China Energy Efficiency and Demand-Side Management (DSM) Project at the Natural Resources Defence Council (NRDC) and worked as a senior public utilities analyst for the State of Delaware, respectively. Dr Shen also served as an inter-domestic consultant in various technical assistance projects of the World Bank and the Asian Development Bank.

Dr Shen has authored or co-authored over 50 papers in peer-reviewed journals and dozens of technical reports and peer-reviewed conference papers. Dr Shen holds a doctorate in energy and environmental policy, an MBA in finance, a master's degree in environmental studies, and a bachelor's degree in mechanical engineering.

3. Mr Li Zhu

Li Zhu works for Ant Group Smart Technology Group for ecological market construction, leading the development of Ant Group's smart technology business and ecological cooperation development, and working with ecological partners to build a win-win business development system. He is exploring the research and application promotion of cutting-edge technologies such as 4G, 5G, IoT, cloud computing, artificial intelligence and chain, and has implemented business transformation and upgrading. He

had worked for Huawei and Ericsson for many years and has obtained more than 30 authorized patents and basic patents.

4. **Ms Christopher Vagalia**

Vagalia is a financial accounting and IT professional. Vagalia graduated with a bachelor's degree in business studies & accounting at Divine Word University. She manages her own consultancy, Agri-Tech Organics (PNG) Limited. Well versed in the areas of Financial Accounting, Audit, Taxation, Administration, Payroll, Human Resources and Information Technology. Vagalia leads her team of vibrant trailblazers in the development and research into blockchain/DLT, e-commerce, cloud solutions, web development, digital marketing and other emerging technologies. She was sponsored by Deloitte Touche' Tohmatsu (DTT) and later worked with the firm for three years upon completion of her studies. She later worked as the Financial Controller for the Hekari Group of Companies in the Southern Highlands, Mineral Resources Authority as Senior Account and Nestle as Management Accountant before pursuing her passion in ICT. She is the CEO of Agri-Tech Organics (PNG) Limited, an ICT/Software Development company, which she founded and manages. Agri-Tech specialized in the following services: Research & Development of blockchain & Distributed Ledger Technology; E-Commerce Solutions & Internet Payment Gateway Integration; Cloud Based Solutions (Linux & Windows); Decentralized Application Development; Mobile App Development (for Android & iOS); Web Development; Digital Marketing; and Financial Risk Management.

5. **Dr Ivan Li**

Dr Li is the honorary secretary of the Association of Energy Service Companies of Hong Kong, China. Dr Li is an expert in carbon, AIOT and smart grid, with 12-year experience in the carbon and energy industry. Dr Li, a pioneer and researcher of the carbon market, has extensive experience in carbon innovation areas, including global climate change, society response, low carbon consulting, carbon asset management, and carbon fintech innovation. Of more than 10 SCI papers Dr Li published, 4 won essay contests. Dr Li founded and managed a team in Hong Kong, China for the building of a platform for the trade of emission reduction products, also known as the first of this kind in Hong Kong, China. He was a member of the task force "study on emission trading in the mainland: option for Hong Kong, China" which was funded by the Central Policy Unit (CPU). The team under his management developed and invested to the first batch of CCER projects, which was also pledged as collateral for loans in the China carbon sink project.

Dr Li once led an innovation team in the Electrical and Mechanical Services Department (EMSD) of the Government of Hong Kong, China. Dr Li's key

responsibility was to manage and administer innovation and technology projects. Dr Li successfully invented, developed and brought the AIOT project "Non-Intrusive Data Analytics System for Adaptive Intelligent Condition Monitoring of Lifts" from 0 to 1, which has filed a patent in Hong Kong, China (Patent No.: HK30012023), US patent (Application No. 17/098,562) and PCT patent (Application No.: PCT/CN2020/128946), and won lots of awards from Hong Kong, China, and International arena.

6. Dr JunWei Wang

PhD, SN ENGR of the Chinese Academy of Sciences (CAS) and the Executive Director, CAS Innovation Cooperation Centre (Bangkok).

Dr Wang received his PhD at the University of Bristol, the United Kingdom in 2008. After his British time, Dr Wang, upon being acknowledged for his academic background, was involved in a few of China's domestic projects in policy research and international cooperation in science, technology and innovation. Dr Wang is now working for "CAS Innovation Cooperation Centre (Bangkok)", which faces the multilateral STI collaborations between China and ASEAN. This centre serves as a platform of the CAS in the ASEAN region and covers many collaborative aspects such as talent, start-ups, technology commercialization, strategy consultation, scholar scheme (under the support of CAS-TWAS).

7. Mr Nicolas de Loisy

Nicolas de Loisy is the President of Supply Chain Management Outsource, a global network of professional firms providing advisory in logistics, transportation, and supply chain management. The network's experts help transform supply chain challenges into a strategic and competitive advantage through 40 offices in 25 economies. He is also co-founder of The Belt and Road Blockchain Consortium – BRBC; and the Vice-Chairman Blockchain Committee / Independent Power Producers Forum – IPPF.

With 25 years of experience in the logistics industry and 20 years of experience in providing supply chain advisory services, his experience includes the development of corporate and operational strategies, profit enhancement and cost reduction, as well as marketing & operational management. He, a blockchain expert, frequently gives speeches at events on subjects related to blockchain technology. He is a co-founder of The Belt and Road Blockchain Consortium (BRBC - www.beltandroadblockchain.org), and a Vice-Chairman of the Blockchain Committee at the Independent Power Producers Forum (IPPF - www.ippfpowerasia.com).

Loisy is the author of *Transportation and the Belt and Road Initiative*, a book

that contains the first-time-ever-published list of all BRI projects.

8. **Dr Suporn Pongnumkul**

PhD, Senior Researcher, Human Behaviour Analytics Research Team, Data Science and Analytics Research Group, Member Economy Government Electronics and Computer Technology Centre (NECTEC), Thailand. Dr Pongnumkul has profound knowledge of blockchain development in Thailand and implements some cases about blockchain in food traceability.

9. **Mr Zhigang Luo**

Luo is an associate researcher of Energy Strategy and Low Carbon Development Research Centre of Guangzhou Institute of Energy, Chinese Academy of Sciences, a graduate of the senior president class of Blockchain EMB of Sun Yat-Sen University, and holds a master's degree in business administration at Guangdong University of Foreign Studies. His research interests include low-carbon economy, carbon market system design, green finance, low-carbon blockchain, ecological compensation mechanism design, and low-carbon business model innovation. He has successfully provided several policy-consulting studies for the World Bank, the Asian Development Bank, the British Foreign Office, APEC, domestic ministries and commissions, and Guangdong Development and Reform Commission. As a key researcher, he is in charge of the designs of the Guangdong Carbon Market System, domestic carbon trading system, and domestic comprehensive ecological compensation pilot scheme, and acts as the coordinator of the Asia Pacific Economic Cooperation Low-carbon Blockchain Project. He is also liable for the design of Guangzhou's Energy Right Trading System, and has provided business consultancy for Jinan Iron and steel, Guangdong Electric Power Group, Domestic Energy Group, Guangzhou Development, Guangdong Nuclear Power and other enterprises, such as Energy Strategic Planning, Carbon Asset Management and Carbon Finance. At present, he is exploring the combination of carbon finance and blockchain to promote enterprises in a common endeavour to formulate carbon neutrality strategies.

10. **Prof AKM Ahsan Kabir**

Ahsan Kabir is a professor in Animal Science Department at Bangladesh Agricultural University, Bangladesh. He holds a bachelor's degree in animal husbandry, a master's degree in animal science at Bangladesh Agricultural University, and a PhD in animal resource sciences at the University of Tokyo, Japan. Prof Kabir has participated in multiple post-doctoral training courses

abroad in the fields of eco-friendly animal production; innovation and technology for quality of life and sustainable society; discussion and project planning on biomass energy research works; renewable energy technology and industry development in BRI economies; and quality management along organic agri-value chains in developing economies. Prof Kabir is a member of the DAAD Alumni Association, the Japan Student Alumni Association, and Asia-Pacific Forum of Renewable Energy along with the general secretary of the Bangladesh Society for Animal Production, Education and Research. Prof Kabir has more than 19 years of teaching experience in a public university. In the Department of Animal Science, Bangladesh Agricultural University, Prof Kabir, an ex-head of the department, wrote more than 40 articles for leading journals. Moreover, he wrote two books about animal science which were published in Bangladesh and a book entitled *Organic Animal Husbandry (Organic Farming: New Advances Towards Sustainable Agricultural Systems)* was published by Springer in 2019. Prof Kabir has proactively presented more than 20 research findings at inter-domestic conferences/seminars mostly in Australia, Germany, Brazil, Japan, Thailand, India and China. Prof Kabir is currently using blockchain technology in the animal sciences.

11. Ms Shiyang Shao

Shao is the co-founder of Carbon X, managing director of Goolun Capital, an angel investor of Energy Block-chain Lab, co-chair of Renewable Committee / China Outreach Committee of Independent Power Producers Forum, and a member of the Energy Investment Committee of Investment Association of China and Beijing Green Finance Association. Shao has held various positions related to climate change, green finance, and investment at China Beijing Environmental Exchange (CBEEX), Crystal Vision Energy Limited (CVE), and Goolun Capital. Shao has led the investment in both tech start-ups like Energy Blockchain Lab and the alternative emissions trading market. Shao has also taken advisory roles for both government and private sectors, including participating in policy research of China’s pilot carbon trade program in selected regions and sectors, carbon finance scheme design and application of blockchain technologies in green energy, and relevant policy study. She graduated from Wuhan University in environmental sciences in 2003, then Peking University with a master’s degree in environmental management in 2007, and University of Inter-domestic Business & Economics with a master’s degree in applied finance in 2017. Shao is also an alumna of Galilee Inter-domestic Management Institute (2007 summer school on Inter-domestic Agriculture Business Management in Israel) and International Carbon Action Partnership (2011 summer school on Emissions Trading for Emerging Economies and Developing Economies in Madrid).

12. Dr Xuedu Lv

Dr Lv is a lead climate change specialist at East Asia Department, Asian Development Bank (ADB). Dr Lv joined ADB in 2010, working on low carbon development, carbon market, climate finance, and low carbon technology. Prior to joining ADB, Dr Lv took different positions including deputy director-general of Climate Centre of China, Member of the Executive Board of Clean Development Mechanism under the Kyoto Protocol to UNFCCC, and deputy head of Global Environment Office, Ministry of Science and Technology of China. Dr Lv used to be an adjunct professor at Tianjin University and Tongji University.

13. Dr Yushi Chen

Dr Chen is the chief researcher of the Digital Alliance Institute for Digital Finance Research (DAIDFR), a doctorial researcher at the Science Policy Research Unit (ranked third in the world among science and technology think tanks, first in the UK), Climate FinTech Advisor at FinTech4Good, member of Financial Technology Committee of Guangzhou Digital Finance Association, and visiting scholar of Tsinghua University Science and Technology Policy Research Centre. Dr Chen previously worked as a researcher for the United Nations High-Level Panel on Digital Cooperation. Dr Chen served as digital technology director at the iGreenBank, blockchain analyst at the Digital Innovation Department of EDF Energy, and a senior researcher in the Energy Blockchain Labs. Dr Chen was a co-founder of Bytes R&D in Zug, Switzerland.

14. Mr Xinyu Zhang

Zhang graduated from Shanghai Jiao Tong University, holds a bachelor's degree in automation and a second bachelor's degree in technical economics, a master's degree in engineering at Shanghai Jiao Tong University, and a certificate of the financial risk manager and CFA charter holder. He has long been engaged in risk management solutions in the financial industry and, among the first batch of risk consultants in China, fully served the implementation of Basel II and Basel III. He is engaged in the measurement and implementation of credit process management, credit risk, market risk, regulatory capital, and economic capital. He has served as a risk consultant, financial engineer, project manager, business analyst, key account manager, and other roles.

Zhang has 15 years of work experience in consulting companies and product companies and has served companies including BearingPoint, IBM Global Business Services (GBS), Capgemini Consulting, Sungard, IBM Algo, and Moody's Analytics. At the same time, he has long paid attention to the development of fintech. Since 2016, he has served as a blockchain solution design consultant in Jin Tong Technology, participated in the preliminary sales and design of several blockchain projects, provided lectures and

training on the blockchain, and participated in the writing of blockchain and big data.

At present, he is the CEO of Shenzhen Moke Node Network Technology Co Ltd and serves as a consultant in many blockchain entrepreneurship projects.

15. Prof. Benoit Couraud

Prof Couraud earned an engineering degree at Ecole Centrale de Lyon, France, in 2009, and a M.Sc. degree in electronic and electrical engineering at Shanghai Jiao Tong University, China, in 2009. His doctoral research focused on power transfer optimization for IoT solutions at the University of Aix Marseille, Marseille, France.

He is currently leading the data science team at IMREDD, university Cote d'Azur, and is a research associate at Heriot-Watt University, working on artificial intelligence, local electricity market solutions and optimization tools for renewable energy integration, and smart grids solutions.

16. Dr PengFei Li

Dr Li is currently an energy expert of the China Communications Service Corporation Limited. He earned his PhD degree at the Energy Technology department of Aalborg University. He was a visiting scholar at the ETH in Switzerland and the University of Victoria in Canada. He has participated in many EU projects such as the smart grid of the EU’s "Horizon 2020" project, the project of Integration of the Nordic Regional Energy System, the project of Science Foundation of China, and varied wind power generation projects in China. He is a reviewer for many internationally renowned journals and top international conferences in the field of power and energy. He has published a number of SCI papers and international conference papers and has taken part in many high-level international academic conferences to give lectures.

17. Dr Pruk Aggarangsi

Dr Pruk Aggarangsi is currently the director of Energy Research and Development Institute- Nakornping, Chiang Mai University, and an assistant professor at Mechanical Engineering Chiang Mai University, Thailand. He has a wide scope of expertise in renewable energy, wastewater treatment, numerical modelling, simulation and analysis, and smart city environment management. For the past 14 years, he has overseen more than 200 biogas/biomethane projects supported by the Thailand Ministry of Energy and private sectors. Dr Aggarangsi has had crucial roles in engineering many biogas constructions projects and conducted more than 40 clean energy technical training workshops. Dr Aggarangsi is the co-author of the book *Biomethane: Production and Applications* and many renewable energy

publications. He also plays an important role in driving Chiang Mai University's Smart City-Clean Energy Project, with an aim to initiate sustainable development for communities around the world. He employed blockchain technology to precisely account for renewable energy produced on-site setting a goal to achieve carbon neutrality in his economy.

18. Ms Christopher Vagalia

Vagalia is a financial accounting and IT professional. Vagalia graduated with a bachelor's degree in business studies & accounting at Divine Word University. Vagalia manages her own consultancy, Agri-Tech Organics (PNG) Limited. Well versed in the areas of financial accounting, audit, taxation, administration, payroll, HR and IT. Vagalia leads her team of vibrant trailblazers in the development and research into blockchain/DLT, e-commerce, cloud solutions, web development, digital marketing and other emerging Technologies. Vagalia was sponsored by Deloitte Touche' Tohmatsu (DTT) and later worked with the firm for three years upon completion of her studies. She later worked as the Financial Controller for the Hekari Group of Companies in the Southern Highlands, Mineral Resources Authority as Senior Account and Nestle as Management Accountant before pursuing her passion in ICT. She is the CEO of Agri-Tech Organics (PNG) Limited, an ICT/Software Development company, which she founded and manages. Agri-Tech specialized in the following services: Research & Development of blockchain & Distributed Ledger Technology; E-Commerce Solutions & Internet Payment Gateway Integration; Cloud Based Solutions (Linux & Windows); Decentralized Application Development; Mobile App Development (for Android & iOS); Web Development; Digital Marketing; and Financial Risk Management.

19. Nan Li

LI Nan, BD director of Tandidi. Over 14 years of experience in enterprise operation and management. Li is mainly engaged in crossover marketing with innovation. Li has served several financial companies such as Zhongan insurance and CCIC.

20. Ms Pierre Elias

Source Pacifique Co-Founder fair-grade.com. Global Business Services Executive. She held a succession of leadership positions in a mix of multinational assignments, and industries. She is passionate for how private blockchain can transfer forest governance.

21. Junlong Lin

Weizhong Bank blockchain, head of strategic cooperation of FISCO bcos open source community. Lin's responsibilities include leading the formulation of FISCO bcos related training and certification standards and participating in the editing and planning of blockchain courses; planning several FISCO bcos tour meetups and other activities, and jointly building FISCO bcos open source ecosystem with individual developers and institutional partners; Lin is committed to giving full play to the cluster advantages of FISCO bcos open source community, building a community ecology of win-win cooperation and complementary advantages, and promoting the healthy development of safe and controllable blockchain underlying platform and the implementation of blockchain scenario applications in multiple industries and fields.

22. Gong Li

Currently the director of the Innovation Laboratory of the Information Technology Department of GF Securities, Li has been responsible for the research and development of block-chain projects since 2017, including the research topics "blockchain financial product trading platform" and "blockchain-based forecast market trading platform", as well as the product "trusted ABS cloud" released in 2018. Li was granted a blockchain-related patent.

23. Ronghuan Wei

As a chief consultant of Carbon Fin-tech Consulting Limited (CFC), Wei has multi-working experience in serval types of international enterprises. From China's renowned company to the world's top 500 and automotive top 10 company. Wei has a wide range of experience in industries such as papermaking, plastic injection and moulding, metal stamping, and electronic devices. Functionally Wei has 6 years of experience in supply chain management, four years in lean manufacturing production systems, three years in quality systems, and two years in marketing. With a focus on practical ideas, Lean, and creative operational thinking logic, Wei serves as a chief consultant of manufacturing for Carbon Fintech Consulting company.