

# Inaugural Case Competition: EMISSIONS REDUCTIONS AND DISTRIBUTED-LEDGER TECHNOLOGY

## Intro

Blockchain technology has garnered the attention of countless sectors due to the success of cryptocurrencies like Bitcoin and Ethereum. This poses the question: what does digital currency have to do with the government regulated cap and trade carbon regulating system that is in place in this nation currently? Blockchain ensures that information is immutably secure, and the applications with this level of security are almost endless, especially with the increasing need for privacy protection. Taking these points into consideration, our proposal is that the government should utilize blockchain technology to verify carbon emissions and link carbon emitters, carbon users, and auditors all onto one efficient network.

## Implementation

Government agencies will need to implement a multitiered blockchain network to connect a variety of components. Being multitiered, the blockchain will be able to support offshoots of the parent chain into child chains. The parent chain will be the overarching framework that the entire network runs on, while the child chains can be easily customized to solve scalability problems associated with individual tracking of credit consumption levels for each carbon emitter. Child chains will also be able to handle the generation of smart contracts that designated carbon auditors monitor.

For maximum security, a distributed private ledger will be used to provide the most control over the carbon credit system. A private blockchain as opposed to public blockchain helps maintain integrity of the system such that only those with permission to join the network can access the blockchain. To gain access to the network, equipment must be registered under their designated cryptographic hash, and a newly conceived company will be assigned a hash with its incorporation papers. Companies will be assigned a unique cryptographic hash through the blockchain technology once the government agency validates the company's information. This cryptographic hash will contain all of the company's past transactions and available carbon credit. Mining blocks in this network will not be carried out by the public like many blockchains, instead, mining operations will be set up in the auditors' workplace since they have the incentive to maintain the robustness of the network.

The government will set annual carbon emission targets at the onset and distribute credits to companies that meet the criteria in the form of smart contracts via the blockchain. Annual carbon emission targets set an allowable level of carbon to be emitted overtime while smart contracts enable carbon emitters to receive carbon credits and to carry out transactions on carbon exchanges with those credits. Companies can also be rewarded credits if they help other struggling companies out with minimizing their emissions. Carbon emitting equipment in facilities would all have to be connected to the internet of things (IoT) through a digital twin - an online entity that stores information pertinent to the carbon output of the corresponding machinery based on emissions measurement technology already embedded into the machinery today. Using information from the digital twin in accordance with the limits set out by the smart contract, equipment emitting less carbon will have unused allowance which can be sold as carbon credits. This credit can then be stored to use in the future if the company over-emits the set carbon level. They can also be sold on a carbon exchange where the emitters in the country would have access to via the overarching parent chain. For example, a refinery that consistently produces 90% of the carbon emission cap level can sell the remaining 10% of the smart contract to another emitter on the exchange, retiring the credit when the remaining 10% is emitted in the form of carbon. The cap and trade system operate efficiently to validate carbon credits, and to ensure the security of information relating to the origination of credits is immutably set into the blockchain. By integrating facilities into the IoT via blockchain, this protects against any malicious threats from hackers as the digital twin only monitors information but cannot make any physical changes to the equipment it

monitors. Other operators and government entities connected to the blockchain network will also have access to this information.

### **Protocol for Human Verification**

As mentioned above, auditors can utilize the blockchain's private ledger to look at the history of operations of a facility right back to the adoption of the blockchain. This ledger would be independent of the smart contract system that originates, tracks, and retires carbon credits. A decentralized application (DApp) will be utilized to access both the parent and child chain and to access transaction records of carbon emitting facilities and the credits that were automatically exchanged through smart contracts. The blockchain will be able track all transactions that took place within the system. If a transaction needs to be traced back to the source of origin, auditors can analyze the cryptographic hashes of which these transactions are contained in.

**To maintain the integrity of the blockchain, auditors are also hired as miners by government agencies with salary pay as an incentive.** The federal government would have to set up more than 30 mining locations to verify transactions, credit exchanges and audits that are carried out in the chain itself. Auditors will be able to work off an application rather than travel to each facility to track emission readings. Audit results will be stored inside the new block mined at the time the audit is reported to the network. By using a delegated proof of stake (DPoS) protocol for mining new blocks, computational power will be lower than by using a proof of work verification protocol wherein the mini nodes all must be in consensus before a block is set into the chain. The DPoS system is more efficient since it relies on miners designated by the blockchain's constitution to verify a transaction and allows for greater scalability. The DPoS protocol would serve as a block creating system and automated auditing system in that if it notices any transaction irregularities with carbon emissions, it would alert a human auditor to re-examine those irregularities.