



School of Computer Science and Engineering

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Blockchain-based Carbon Market

by

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Abstract

Emissions trading schemes (ETS) are a policy tool at the forefront of the fight against climate change. In this thesis, I will present a blockchain-based approach for creating a carbon market driven by hydrogen certificates. By using carbon tokens, an effective price can be placed on the use of carbon removing a market failure existing in the production of natural resources. I will use a high-throughput permissioned blockchain to motivate how trust can be placed in a market made volatile by inconsistent government policy and scepticism on the behalf of participants.

Abbreviations

BE Bachelor of Engineering

L^AT_EX A document preparation computer program

PhD Doctor of Philosophy

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Chapter 1

Introduction

A blockchain can be defined as an immutable ledger maintained by a network of mutually untrusting peers. Since the creation of Bitcoin (BTC) in January 2009 by the maverick Satoshi Nakamoto there has been an explosion of interest in the underlying technology behind blockchains. Specifically, the immutability and openness of the distributed ledger makes blockchain an attractive option for markets with untrusting participants exposed to information asymmetry. The market for carbon is particularly well suited to the blockchain due to inconsistent government policy - for example the ill-fated outcome of the Carbon Pollution Reduction Scheme in Australia.

Recent attempts to create blockchain-based carbon markets have been met with some success - but have been held back by technicalities or innovations that disrupt the fundamental goal of using the blockchain as a ‘trust machine’. I will outline how hydrogen certificates on the blockchain can be used to automatically spend carbon tokens and add extra validation before being sold on the commodity market. Hydrogen is particularly well-suited as an example for certificate-based carbon markets due to hydrogen producers attaching a carbon footprint to certificates.

I will outline how permissioned blockchains are principally useful for carbon markets due to support for high-throughput transactions. A carbon market would have to scale to a large number of distributed producers with scalability matching hydrogen energy

production - an industry expected to be worth USD155 billion by 2022. I will propose Hyperledger Fabric as a blockchain framework - chiefly due to its support for up to 3500 transactions per second (TPS) and a plugable consensus algorithm. Moreover, my proposed solution will accommodate an optional carbon ‘reputation’ as part of the price for exchanging carbon tokens between producers.

In Chapter 1 an overview of the thesis and its novel approach to certificate-based carbon markets is presented. In Chapter 2 I outline the background to the project and important literature for markets on a blockchain. In Chapter 3 I provide methodology for the blockchain architecture. In Chapter 4 I outline some preliminary results with creating smart contracts (programs on the blockchain) for auctions on a public blockchain. In Chapter 5 I conclude with some remarks on the future potential for the thesis topic.

Chapter 2

Literature Review

Chapter 3

Project Plan

Chapter 4

Project Dependent Preparations

Chapter 5

Conclusion

Bibliography

Appendix 1

Appendix 2