

# **Utilizing Tokenization Platforms For Carbon Trading**

By

THEODORE JOSEPH SIAHAYA  
12002005

The logo of Swiss German University (SGU) is a large, stylized 'SGU' in light blue and purple. The text 'BACHELOR'S DEGREE' is written in black above the 'G', 'in' is written in black below the 'G', and 'INFORMATION TECHNOLOGY' is written in black below the 'U'.  
BACHELOR'S DEGREE  
in  
INFORMATION TECHNOLOGY  
FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY



SWISS GERMAN UNIVERSITY  
The Prominence Tower  
Jalan Jalur Sutera Barat No. 15, Alam Sutera  
Tangerang, Banten 15143 - Indonesia

Revision after the Thesis Defense on 8 July 2025

### STATEMENT BY THE AUTHOR

I hereby declare that this submission is my own work and to the best of my knowledge, it contains no material previously published or written by another person, nor material which to a substantial extent has been accepted for the award of any other degree or diploma at any educational institution, except where due acknowledgement is made in the thesis.



Theodore Joseph Siahaya

Student

18 July - 2025

Date

Approved by:



Dipl. -Inf. I Eng Kho

Thesis Advisor

18 July - 2025

Date



Assoc. Prof. Ir. James Purnama, M.Sc

Thesis Co-Advisor

21 July 2025

Date

Dr Maulahikmah Galinium, S.Kom, M.Sc

Dean

Date

Theodore Joseph Siahaya

## ABSTRACT

### TOKENIZATION OF CARBON CREDIT IN INDONESIA

By

Theodore Joseph Siahaya  
Assoc. Dipl. -Inf. I Eng Kho, Advisor  
Assoc. Prof. Ir. James Purnama, M.Sc , Co-Advisor

SWISS GERMAN UNIVERSITY

The aim of this study is to evaluate different blockchain based carbon trading platforms and analyze the blockchain that the platform uses. The blockchains that are evaluated are KlimaDAO which uses the Polygon blockchain, Toucan Protocol which uses the Base blockchain, and The CarbonX which uses the Ethereum blockchain. The research problem addresses how Indonesia has not implemented a peer-to-peer (P2P) way of trading carbon credits. The methodology is done by using a framework called MF-WDM framework (Multi-Factor Weighted Decision Matrix ), along with using a blockchain analysis platform called Dune Analytics to get the data of the parameters of the analyzed blockchain. The findings confirm that Base blockchain's parameters are the most well rounded and well performed compared to the others, which shows that Toucan Protocol is performed better than the other platforms. This study provides insights for others to develop a blockchain based carbon trading platform, or to use the recommended platform to perform a P2P carbon trading.

*Keywords: Blockchain, Polygon, Ethereum, Base, MF-WDM Framework, Dune Analytics.*

© Copyright 2025  
by Theodore Joseph Siahaya  
All rights reserved



## **DEDICATION**

I dedicate this work to my family, who has supported me throughout my thesis work.

I also dedicate this work to my advisors, Mr I. Eng Kho and Mr James Purnama, for their help and support during my study period.

Lastly, I dedicate this work to the future of the country that I love, which is Indonesia, for its bright future.



## **ACKNOWLEDGEMENTS**

I wish to thank my advisor and co advisor of this research, Dipl. -Inf. I Eng Kho and James Purnama, for their support and guidance throughout this research and writing process for this thesis work.

I would also like to express my thanks to my family for their support and encouragement. My parents love and support my older brother for his advice.

Thank you all for your support and encouragement and giving me the push to finish my studies.



---

## TABLE OF CONTENTS

|                                                                 | Page      |
|-----------------------------------------------------------------|-----------|
| <b>STATEMENT BY THE AUTHOR</b>                                  | <b>2</b>  |
| <b>ABSTRACT</b>                                                 | <b>3</b>  |
| <b>DEDICATION</b>                                               | <b>5</b>  |
| <b>ACKNOWLEDGEMENTS</b>                                         | <b>6</b>  |
| <b>TABLE OF CONTENTS</b>                                        | <b>7</b>  |
| <b>LIST OF FIGURES</b>                                          | <b>9</b>  |
| <b>LIST OF TABLES</b>                                           | <b>11</b> |
| <b>LIST OF FORMULAS</b>                                         | <b>12</b> |
| <b>CHAPTER 1 - INTRODUCTION</b>                                 | <b>13</b> |
| 1.1 Background                                                  | 13        |
| 1.2 Research Problems                                           | 15        |
| 1.3 Research Objective                                          | 15        |
| 1.4 Research Questions                                          | 15        |
| 1.5 Hypothesis                                                  | 16        |
| 1.6 Research Scope and Limitations                              | 16        |
| 1.7 Significance of Study                                       | 16        |
| <b>CHAPTER 2 - Literature Review</b>                            | <b>17</b> |
| 2.1 The Indonesian Carbon Trading System and Its Law            | 17        |
| 2.2 Carbon Trading and Emission Control Systems                 | 18        |
| 2.3 Tokenization and Blockchain Technology                      | 19        |
| 2.4 Related Works                                               | 21        |
| 2.5 KlimaDAO                                                    | 24        |
| 2.6 Toucan Protocol                                             | 25        |
| 2.7 The CarbonX                                                 | 26        |
| 2.8 Dune Analytics                                              | 27        |
| 2.9 Multi-Factor Weighted Decision Matrix (MF-WDM)              | 27        |
| <b>CHAPTER 3 – RESEARCH METHODS</b>                             | <b>28</b> |
| 3.1 Methodology                                                 | 28        |
| 3.2 Data Collection Methods                                     | 29        |
| 3.3 Tools and Techniques                                        | 29        |
| 3.4 Multi-Factor Weighted Decision Matrix Framework Methodology | 29        |

---

---

|                                                   |           |
|---------------------------------------------------|-----------|
| <b>CHAPTER 4 – RESULTS AND DISCUSSIONS</b>        | <b>31</b> |
| 4.1 P2P Carbon Trading Platform                   | 31        |
| 4.2 KlimaDAO and Polygon Blockchain               | 31        |
| 4.3 Toucan Protocol and Base Blockchain           | 35        |
| 4.4 The CarbonX and Ethereum Blockchain           | 39        |
| 4.5 Comparison of All Blockchain                  | 43        |
| 4.6 Parameter Rating Evaluation                   | 48        |
| 4.7 Weighted Scoring                              | 51        |
| <b>CHAPTER 5 – CONCLUSION AND RECOMMENDATIONS</b> | <b>52</b> |
| 5.1 Conclusion                                    | 52        |
| 5.2 Recommendations                               | 52        |
| <b>REFERENCES</b>                                 | <b>53</b> |
| <b>CURRICULUM VITAE</b>                           | <b>59</b> |



## LIST OF FIGURES

| Figures                                                                            | Page |
|------------------------------------------------------------------------------------|------|
| Figure 1. Methodology                                                              | 28   |
| Figure 2. The P2P Carbon Trading Platform                                          | 31   |
| Figure 3. Polygon's transaction volume in the last 30 days (Apr 2 - May 2)         | 31   |
| Figure 4. Polygon's transaction size in the last 30 days (Apr 2 - May 2)           | 32   |
| Figure 5. Polygon's transaction speed                                              | 32   |
| Figure 6. Polygon's transaction fee in the last 30 days (Apr 2 - May 2)            | 33   |
| Figure 7. Polygon's block time in the last 30 days (Apr 2 - May 2)                 | 33   |
| Figure 8. Polygon's block size in the last 30 days (Apr 2 - May 2)                 | 34   |
| Figure 9. Polygon's smart contract                                                 | 34   |
| Figure 10. Polygon's smart contract distribution shape                             | 35   |
| Figure 11. Base's transaction volume in the last 30 days (Apr 2 - May 2)           | 35   |
| Figure 12. Base's transaction size 30 days (Apr 2 - May 2)                         | 36   |
| Figure 13. Base's transaction speed                                                | 36   |
| Figure 14. Base's transaction Fee in the last 30 days (Apr 2 - May 2)              | 37   |
| Figure 15. Base's block time in the last 30 days (Apr 2 - May 2)                   | 37   |
| Figure 16. Base's block size in the last 30 days (Apr 2 - May 2)                   | 38   |
| Figure 17. Base's smart contract                                                   | 38   |
| Figure 18. Base's smart contract distribution shape                                | 39   |
| Figure 19. Ethereum's transaction volume in the last 30 days (Apr 2 - May 2)       | 39   |
| Figure 20. Ethereum's transaction size in the last 30 days (Apr 2 - May 2)         | 40   |
| Figure 21. Base's transaction speed                                                | 40   |
| Figure 22. Ethereum's transaction Fee in the last 30 days (Apr 2 - May 2)          | 41   |
| Figure 23. Ethereum's block time in the last 30 days (Apr 2 - May 2)               | 41   |
| Figure 24. Ethereum's block size in the last 30 days (Apr 2 - May 2)               | 42   |
| Figure 25. Ethereum's smart Contracts                                              | 42   |
| Figure 26. Ethereum's smart contract distribution shape                            | 43   |
| Figure 27. All blockchain's transaction volume in the last 30 days (Apr 2 - May 2) | 43   |
| Figure 28. All blockchain's transaction size in the last 30 days (Apr 2 - May 2)   | 44   |
| Figure 29. All blockchain's transaction speed                                      | 44   |
| Figure 30. All blockchain's transaction fee in the last 30 days (Apr 2 - May 2)    | 45   |

|                                                                                 |    |
|---------------------------------------------------------------------------------|----|
| Figure 31. All blockchain's block time in the last 30 days (Apr 2 - May 2)      | 46 |
| Figure 32. All blockchain's block size in the last 30 days (Apr 2 - May 2)      | 46 |
| Figure 33. All Blockchain's smart contracts in the last 30 days (Apr 2 - May 2) | 47 |



## LIST OF TABLES

| Tables                                                       | Page |
|--------------------------------------------------------------|------|
| Table 1. Parameter ratings table example                     | 30   |
| Table 2. Weighted score table example                        | 30   |
| Table 3. All blockchain's smart contract distribution shape  | 47   |
| Table 4. Parameter comparison table                          | 48   |
| Table 5. Parameter ratings table                             | 50   |
| Table 6. Scoring Method based on the developer's perspective | 51   |



## LIST OF FORMULAS

| Formulas                     | Page |
|------------------------------|------|
| Formula 1. Formula of MF-WDM | 27   |

