

NAME

- EChain or eChain or E-Chain

DEADLINES

- 1/16 Brainstorming
- 1/19 Get a Prototype Working
- 1/20 Finalize Video Parts + Material
- 1/21 Will Leaves/ Video Finish Editing
- 1/22 7PM Pitch Submissions + Materials

INTRODUCTION

The aim of the project is to utilize IOT and Blockchain technology in order to better track entities' carbon footprints, maintain accountability for the footprint, and therefore incentivize greener techniques.

For example, 29% of emissions come from transportation. If Hoboken wishes to reduce their emissions from vehicles, they must be able to know how much they release in the first place! So by attaching CO₂ sensors near the exhaust, or by some other mechanism such as tracking the engine and oil health, the cumulative public transportation emissions can be tracked. In order to make this data transparent and secure, it would be uploaded to a blockchain. This can be a private blockchain hosted by Hoboken, or even simpler, a public blockchain like Ethereum could be used instead.

Several examples could be construed such as tracking and rewarding smart electricity usage, tracking and rewarding recycling, tracking and rewarding construction practices, tracking and rewarding renewable energy usage, tracking storm water runoff, the list goes on.

In a broader scope, the CO₂ emissions released by public transportation per each state could be stored on a public blockchain. The sensor data would be sent over to smart contracts via ChainLink oracles. If the state breaches an emission ceiling, a smart contract would execute a fee on the state.

In a global sense, if real data is provided across the agricultural, construction, manufacturing, or shipping industries, etc. then it can be analyzed to construct greener processes. Moreover, individual accountability can be maintained through eliminating the threat of corruption of data or spread of misinformation by using blockchain and smart contract technology.

In general, the idea is to utilize a network of sensors to become better aware of the real state of the world and therefore more easily monitor the carbon footprint, whether it be

through vehicle CO2 tracking or through some other mechanism, then to use the blockchain and smart contract infrastructure to uphold accountability, and to incentivize using better and cleaner methodologies/technologies in order to reduce said carbon footprint. (Note that the decentralized structure is currently in its infant stages, but the technology is seeing record growth each passing day. Moreover, while this technology is in its infant/pilot stage, private blockchains could be utilized).

- Big companies don't care and won't act on climate rules
- Enforcing standards on an organization
- Prototype, emissions tracker for public transportation
 - Catch Sensor Data (sensor time limited)
 - 2 Sensor Examples
 - BME680
 - Temp, Hum, AirPsi, Quality
 - Store Data
 - Some Db (mongo maybe)
 - Create Contract
 - GOAL: Get a response from completed Contract
 - Meta (ChainLink) (Sending Data)
 - <https://dl.dropboxusercontent.com/s/x51ugz00lgx5tn2/solutions-diagram-v1.mp4?dl=0>
 - <https://docs.chain.link/docs/beginners-tutorial>
 - <https://docs.chain.link/docs>
 - <https://ethereum.stackexchange.com/questions/2/how-can-an-ethereum-contract-get-data-from-a-website>
 - Send to Eth Test Blockchain
 - No paying fees for proof of concept
 - <https://www.leewayhertz.com/ethereum-smart-contract-tutorial/>
 - <https://medium.com/@iamdefinitelyahuman/an-in-depth-guide-to-testing-ethereum-smart-contracts-2e41b2770297>
 - <https://hackernoon.com/a-step-by-step-guide-to-testing-and-deploying-ethereum-smart-contracts-in-go-9fc34b178d78>
 - https://www.reddit.com/r/ethdev/comments/agz78g/using_raspberry_pi_to_send_data_to_blockchain/
 - <https://docs.soliditylang.org/en/v0.8.0/introduction-to-smart-contracts.html>
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- Data Analysis
 - Is it meeting goals
- Displaying Data To Public
 - Working with blockchain
 - Web or Interface of transactions + data
 - Use a db
 - MongoDB
 - SQL or SQLite3
- Concept > Tech
- Examples
 - Hoboken Contract with State
 - Enforcer or else you lose money
 - Publicity: public marketing
 - Stocks, Affecting company
 - Credit system, Carbon Tax fee
 - Directly incentivising
- Paris Climate
 - Biden rejoining Paris Agreement, carbon taxes (\$40 per ton?)
 - Benefit where carbon tax goes
 - Can confirm with certainty via tech
 - Instead of lobby + politicians

STEPS/MAJOR PARTS

- How to capture CO₂ emissions
 - Say I don't want to get one, what's in it for me?
 - Incentive, tax
 - Are we creating the device?
 - Not for this demo
 - Is there tech out there to get a reliable number
 - What exactly are we measuring
 - Different data for different use cases
 - Exhaust for transportation
 - Fertilizers for agriculture
 - etc.

- Once we have a device (can be from a manufacturer)
 - Have certification for the company to be able to use for tracking
 - Verified
 - What if people tamper with it?
 - Chainlink recognize bad data out of many
 - How will it beam information into the cloud
 - One article has a wifi chip embedded into the device, my question is how that exactly will operate
 - 4g card to comm with cell towers
 - How to construct this blockchain and network
 - What is the main platform coded in
 - Are there examples we can learn from
 - How to add and communicate with the blockchain
 - Making it public access
 - Accountability
 - Will this be a legislative deal as well?
 - How do we enforce this?
 - How will we hold companies accountable
 - Shame/Tax/Certifications
 - I like shame if legislative path goes wrong, ex: twitter bots
 - Why we are doing this and what impact will be seen
 - This is a public issue, so there should be publicly available data
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- Does lowering the emissions lower the amount of business?
 - Revenue Neutral Carbon Tax

BLOCK DIAGRAM

Link Here:

https://docs.google.com/presentation/d/1MQ4lJ6eZ4dQ35OykZeCSczuA8pACu9QfVZiOO_ChJog/edit#slide=id.gae2dc3ac8f_o_423

TESTING

- ETH Blockchain test framework
 - Link

THE DEVICE- Prototype

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- Sensor
- Raspberry Pi
- Comm Card
- Battery

PROFESSORS

- Kevin Lu

Hey Kevin Lu! It's great to see you in this hackathon. I am on a team with William Baltus and we are working towards creating technology to enforce revenue neutral carbon tax through the use of blockchain. Specifically, we want to use the sensor emission data of CO₂ through vehicle exhausts or possibly volumetric recordings of fossil fuel exporters like gas stations or power plants. The plan is to collect that data for a smart contract on a blockchain like Ethereum and use ChainLink to bridge the real world data with the blockchain. This way, we can provide data for analytics while enforcing carbon tax laws (which simultaneously incentivize lowering emissions).

I know you are familiar with blockchain. So far, we were successful in creating smart contracts on an ethereum test network through the use of Solidity and also Metamask wallets. Our test was to transfer ethereum on the test network to and from contracts as well as wallets. Currently we are struggling to provide IOT data to the smart contract. Would you be able to point us in the right direction on how we can bridge IOT devices to the blockchain smart contract?

Hey Professor Snell. It's great to hear from you. Unfortunately I wasn't able to make that cottage, but I'll never forget the photos of you punching your clay wall into shape. In a general sense, our goal is to collect emissions data via sensor network deployments. Said data would be sent to a blockchain for maximal transparency to maintain an entities accountability as well as provide real-time data for analytics. This will allow for enforcement on emissions regulations while incentivizing emissions reduction and regulatory compliance, such that the goals of the Paris Climate Agreement could be met. Often companies make false promises or simply don't meet their claims about emissions reduction. There are countless use cases for IOT/Blockchain systems to provide data about emissions while assisting in regulatory enforcement. For example, we will be collecting CO₂ emission data from vehicles (simulating public transportation), make it available on a blockchain, and create a smart

contract that would simulate a carbon tax being issued. The metric in this case is CO₂, but the metric for other use cases could be different, but will be beyond the scope of our prototype. I hope this answers your question and clarifies the project a little bit. Let me know what you think, any feedback, especially yours, is appreciated.

- Snell
- Guy in slack

We made a global agreement to reduce emissions, but we're not meeting those goals, so how can we meet those goals?

Rather than being reactive using historical data, we can become proactive by using real-time data instead.

Accountability for countries to reduce shady business and dishonesty

SOLIDITY

- https://www.youtube.com/watch?v=NvI-gz-tRs&feature=emb_title
- <https://github.com/willitscale/learning-solidity/blob/master/tutorial-14/EtherTransfer.sol>
- <https://www.youtube.com/watch?v=ELWSKMcJfI8>
- <https://ethereum.org/en/developers/docs/gas/>
- <https://hackernoon.com/how-to-use-remix-and-metamask-to-deploy-smart-contracts-on-the-rsk-testnet-zt393xfz>

SMART CONTRACT CONNECTION TO IOT

- <https://ethereum.stackexchange.com/questions/46741/posting-data-from-raspberry-pi-on-blockchain-and-retrieving-it-back>
- <https://web3js.readthedocs.io/en/v1.2.9/web3-eth-contract.html#eth-contract>
- Making a chainlink node on the Pi
- <https://owocki.com/install-ethereum-geth-raspberry-pi-b/>
- <https://docs.chain.link/docs/running-a-chainlink-node>
- https://www.reddit.com/r/Chainlink/comments/cihd6b/anybody_successfully_got_a_ropsten_node_working/
- <https://thebitcoinstreetjournal.com/chainlink-on-raspberry-pi-leo-vigna/>
- <https://howchoo.com/g/nmrlzmq1ymn/how-to-install-docker-on-your-raspberry-pi>
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SKIT THINK

- There is an unavoidable conflict of interest involved with the idea of taxing an industries' carbon emissions. When a company seeks to maximize profits, it often leads to immoral practices which tend to create issues, one being vast emissions of GHG's. Thus, carbon taxes have been implemented to incentivize the reduction of emissions. However, entities (like Exxon when they lied about Climate Change) often route this issue by making false promises, or even out-right lie, about their initiatives to combat climate change.
- **In order to truly enforce and incentivize the reduction of emissions, a different model of trust must be used.** Rather than relying on the reputation and statements of the entity, what if instead we had the data speak for itself?
- According to Gartner, the next two years will see 30% of blockchain initiatives in supply chain refocus activities towards prioritizing physical product data capture through various mechanisms such as IoT sensors and devices.
- (TEE) Trusted Execution Environments allow for the IOT device to securely execute its implemented code while significantly reducing the risk of tampering. This means that the industry will be able to trust that their data is secure and available, and doubles as a way of guarding the industry itself from tampering with the data so they can't dodge emissions regulations.

The focus is definitely on the software side as we are meshing the hardware (sensors) with distributed ledger technology (blockchain + smart contracts) in order to eliminate misinformation regarding emissions reporting/statements and to enforce carbon tax laws. The carbon tax is our prototypes way of representing emissions enforcement, but regulations are up to legislative bodies and the software can easily adapt. The advantage here lies in the fact that the data speaks for itself instead of relying on a company's statement about their initiatives. By nature of blockchain technology, data recorded would be fully transparent and secure, which would allow for even the public to view. (Of course this aspect could be changed easily, but we value the aspects of a public blockchain more than those of a private blockchain).

We understand that the project's integrity is highly influenced by the physical system and have spent some time delving into current protocols for tracking CO₂ emissions. Through some research into data collection of emissions, we discovered case studies that were able to track emissions by placing sensors in the exhaust of vehicles. There are products in place that can be attached to vehicles easily to monitor emissions. For our use, that would require the product to be accurate, reliable, and re-engineered to accommodate communication with the blockchain.

One of our concerns is how can one bring these physical systems to private industries. It is intuitively easier to bring them into public industries, however monitoring a private industry that does not want to be involved or share its data would prove to be a challenge. While IOT devices have proliferated throughout the world, another hurdle would be figuring out how to mass deploy these sensors onto vehicles and have them

simple enough to be easily attached to said vehicle. This is similar to the case of public v. private adoption of data collection.

A solution we have in mind is monitoring the flow of fossil fuels and gasoline. By using a volumetric sensor to capture how much fuel is being used, we can safely assume the amount of emissions being released. For example, by placing sensors at gas stations and monitoring how much goes out to consumers, we can estimate the amount of emissions produced. More research would be helpful but based on chemical reactions, 19.60 lbs of CO₂ is released per gallon of gasoline. By knowing the amount of emissions a fuel outputs, we can then possibly use the volume of fuel as a data monitoring point. This volumetric fuel sensor can be applied and mandated to all exporters of fossil fuels.

Enforcement

- Why? - Climate Change, provide
 - Paris Agreement,
 - Biden rejoins, market for US
 -
 - Enables Enforcement of emissions and makes carbon taxes more feasible
- **Requiring aggressive methane pollution limits for new and existing oil and gas operations.**
- Carbon Tax
 - Benefits both
 - We investigate the current use of public revenues which are generated through both carbon taxes and cap-and-trade systems. More than \$28.3 billion in government “carbon revenues” are currently collected each year in 40 countries and another 16 states or provinces around the world. Of those revenues, 27% (\$7.8 billion) are used to subsidize “green” spending in energy efficiency or [renewable energy](#); 26% (\$7.4 billion) go toward state general funds; and 36% (\$10.1 billion) are returned to corporate or individual taxpayers through paired tax cuts or direct rebates. Cap-and-trade systems (\$6.57 billion in total public revenue) earmark a larger share of revenues for “green” spending (70%), while carbon tax systems (\$21.7 billion) more commonly refund revenues or otherwise direct them towards government general funds (72% of revenues). Drawing from an empirical dataset, we also identify various trends in systems’ use of “carbon revenues” in terms of the total revenues collected annually per capita in each jurisdiction and offer commensurate qualitative observations on carbon policy design choices.
 - <https://www.sciencedirect.com/science/article/pii/S0301421516302531#~:text=Of%20those%20revenues%2C%2027%25%20of%24,tax%20cuts%20or%20direct%20rebates.>
 - Estimation
 - Not approximate, based off equations
 - Dishonesty in company data provided
 - Secure Sensors to provide Data (Trusted Execution Environment)
- ### Company Interest
- Lowering Energy Waste
 - Increases Revenue
 - Easily Adapting Carbon Tax Legislature

- Requiring public companies to disclose climate risks and the greenhouse gas emissions in their operations and supply chains.

- Eases pressure for enforcement
- Backup w/ studies
- Enabling Companies

Business Proposal

- Demographic
 - Public Companies: 3,671
 - Industries looking to reduce energy waste and OPEX
 - Data analysis
 - Regulatory entities looking to implement and enforce carbon laws
 - Reliable sensor, tamper proof collection, tamper proof storage, transparency
- Costs to run and maintain
 - Overhead
- Investor Interest

HOBOKEN:

- Empowering local communities to develop transportation solutions. Communities across the country are experiencing a growing need for alternative and cleaner transportation options, including transit, dedicated bicycle and pedestrian thoroughfares, and first- and last-mile connections. The Biden Administration will transform the way we fund local transportation, giving state and local governments, with input from community stakeholders, more flexibility to use any new transportation funds to build safer, cleaner, and more accessible transportation ecosystem.