

PlastiCoin Green Paper



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Get rewarded for recycling and stimulate the circular economy

Open Circular Network: Data sharing network and distributed ledger

Table of Contents

Introduction	6
Chapter 1 - The Problem and Solution	6
1.1 PlastiCoin.....	7
PlastiCoin Token.....	9
Monetary Value: Why use a weird token? Why not use cash or USD?	9
1.2 Old vs New Systems	9
Plastic Wars: What would it take to incentivize a consumer?	9
Recycling Market Declining.....	11
How does PlastiCoin recycling compare to our current system?	12
Circular Economy = Open Network.....	12
1.3 Recycling Market Outlook	12
1.4 Our Proposal – The Open Circular Network	13
Chapter 2 – The App	15
2.1 Apps	15
App Personas	15
Consumer App	16
Collector App	18
Recycling Center App.....	22
Aggregation Center Inventory App.....	24
Exchange/Market App.....	26
Data Explorer	27
2. 2 App Data Security	28
2.3 App Demo Videos.....	28
Chapter 3 – The Network and the Blockchain	29
3.1 Networks	29
3.2 Services.....	29
Account Service	29
Recycling Service	29
Material Service.....	29

Logistics Service	29
Reputation Service	29
Analytics Service	30
Recycling Center Service	30
Exchange Service	30
Mapping Service	30
3.3 Networks: Consortium Blockchain	30
Why smart contracts and blockchains?	30
(1) Trust (Traceability), Honesty and Longevity	31
(2) Global performance using distributed architecture	31
(3) Openness and Collaboration	31
(4) Right tool for the job with a purpose-built programming language (Smart Contracts)	31
(5) Promote market forces and avoid cartels and monopolies	32
3.4 Open Circular Network Technical Details	32
Smart Contracts	32
Recycling Smart Contract	32
Reputation Smart Contract	32
Reputation Systems	33
Rewards Smart Contract	33
Tracing Smart Contract	33
Escrow Smart Contract	33
Smart Route Matchmaking Protocol	34
Hyperledger	35
Attack Vectors	36
3.5 Modeling Route generation algorithms	37
Problem	37
Goal	37
Mashup of Uber, Waste Management, Amazon Prime Routes, and paper routes	37
Variables	37
Algorithms	38
Chapter 4 – Governance	39
4.1 Governance	39
4.2 InterWork Alliance - Standards Organization	40
Making Multi-Party Agreements Just Work	40
Working Groups	40
Siloed - Single Company Approach	40
Global - Multi Company Approach	41
Token Taxonomy Standard	41
Recyclable Material - Digital Token Taxonomy	41
4.3 Standards	42
Efficiency	44

4.4 Open Governance Network Model.....	44
Chapter 5 – Incentive Models.....	46
5.1 Incentive Models.....	46
5.2 Incentives	46
5.3 Wallet.....	47
Microtransactions	48
Math.....	48
5.5 Gamification	48
Octalysis Framework	48
Core Drives	49
Meaning and Calling.....	49
Social	49
Competition	49
Ownership and Possession	49
Group Quest.....	49
Positive Reinforcements	49
5.6 Recycling System Models - One size does not fit all	49
Third World Model Settings	49
Rural Sub Model.....	49
Urban Sub Model	50
Kenya Model.....	50
First World Country Model.....	50
Chapter 6 – Markets and Economics.....	51
6.1 Markets and Economics	51
Plasti-Nomics: What is 1 PlastiCoin Worth?	51
Bootstrapping the network with funds.....	51
Micro-Transaction-Fees	51
Outstanding Problems: Initial Liquidity - Who is going to pay the first consumer for his material?	52
6.2 The Plastics Exchange.....	53
6.3 New Markets will be created.....	54
6.4 Smart Cities	55
What is a smart city?	55
Chapter 7 – Value Propositions	56
7.1 Value Propositions	56
For material science companies like Dow	56
7.2 Side Effects	56

<i>Outro</i>	<i>56</i>
<i>Glossary</i>	<i>59</i>
<i>Brainstorming Names</i>	<i>59</i>
<i>Research.....</i>	<i>59</i>
<i>Sources.....</i>	<i>60</i>

Introduction

Plastic manufacturers are feeling pressure and seeing a loss in sales due to the negative global sentiment of one-time use plastics, such as straws. New hybrid materials are being invented that are hard to mechanically recycle in our current system. Littering is a huge problem, but there is little incentive for the average consumer to recycle. Existing recycling centers have little incentive to retool and handle new hybrid materials. Third-world countries are causing plastic leakage into the ocean due to lack of municipal recycling programs. A new system needs to be created to solve these global problems.

In opening, here is a quote from the book “The Circular Economy: A wealth of Flows” by Ken Webster:

“Information technology potentially allows the tools of the economy, the medium-and-long-life durable products, to become the basis for a market in the services they provide, rather than just selling the product itself. [...] Information technology allows easy administration and the billing for a thousand small transactions. It even allows the creation of designer currencies to reach the parts of the economy not served by the conventional monocultures.”

This paper discusses an application called “PlastiCoin” and a new network called the “Open Circular Network” in the following chapters:

Chapter 1 – The Problem

Chapter 2 – The Solution and the App

Chapter 3 – The Network and the Blockchain

Chapter 4 – Governance

Chapter 5 – Incentive Models

Chapter 6 – Markets and Economics

Chapter 7 – Value Propositions

Chapter 1 - The Problem and Solution

EPIC FAIL: Recycling Metrics



The current recycling system is a complete failure. 25 – 75% of recycled material ends up in landfills. Consumers don't have an incentive to properly clean the materials. If it's too difficult for cities to run a recycling program effectively, eventually the government will ban those materials, thus putting Dow and other material science companies in a bad position.

Recycling programs are being cancelled due to the lack in value and demand for recycled plastic. WGN Chicago did a great investigative journalism piece about a community that is cancelling its recycling programs due to lack of economic incentives. View the 6-minute video here:

<https://www.google.com/amp/s/wgntv.com/2019/07/01/recycling-in-chicagoland-were-doing-it-wrong-and-soon-itll-cost-more/amp/>

1.1 PlastiCoin

We propose a solution called PlastiCoin*. PlastiCoin solves the recycling and economic incentive problem for both consumers and recycle centers and introduces an Uber-like recycling pickup program fueled by rewards. PlastiCoin embraces the techniques used in Silicon Valley and startups. It also introduces the Open Circular Network to coordinate the global recycling system. (**PlastiCoin is the current working name but will most likely change to include all material*)

To sum it up, the idea is simple, you need to pay people to do the right thing...to clean, sort, and recycle. Economic markets need to be created for recycled plastic to make the material valuable. Companies and entrepreneurs will emerge to create the circular economy for plastic if an open network is available. PlastiCoin and the Open Circular Network aim to create the base data sharing network and applications to enable the circular economy globally. It will be the supply chain, logistics and data network to connect the circular economy. Figure 1 shows a high-level view of what the material circular economy looks like, and the players involved.

Figure 1

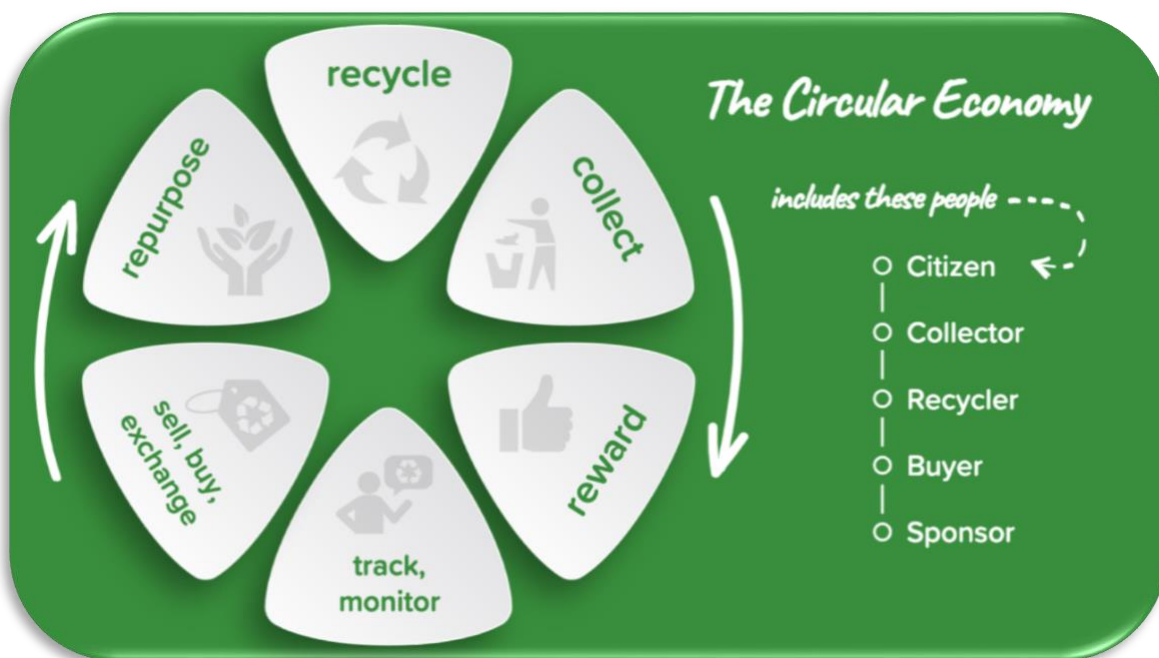


Figure 2 shows an image of the Uber-like consumer app.

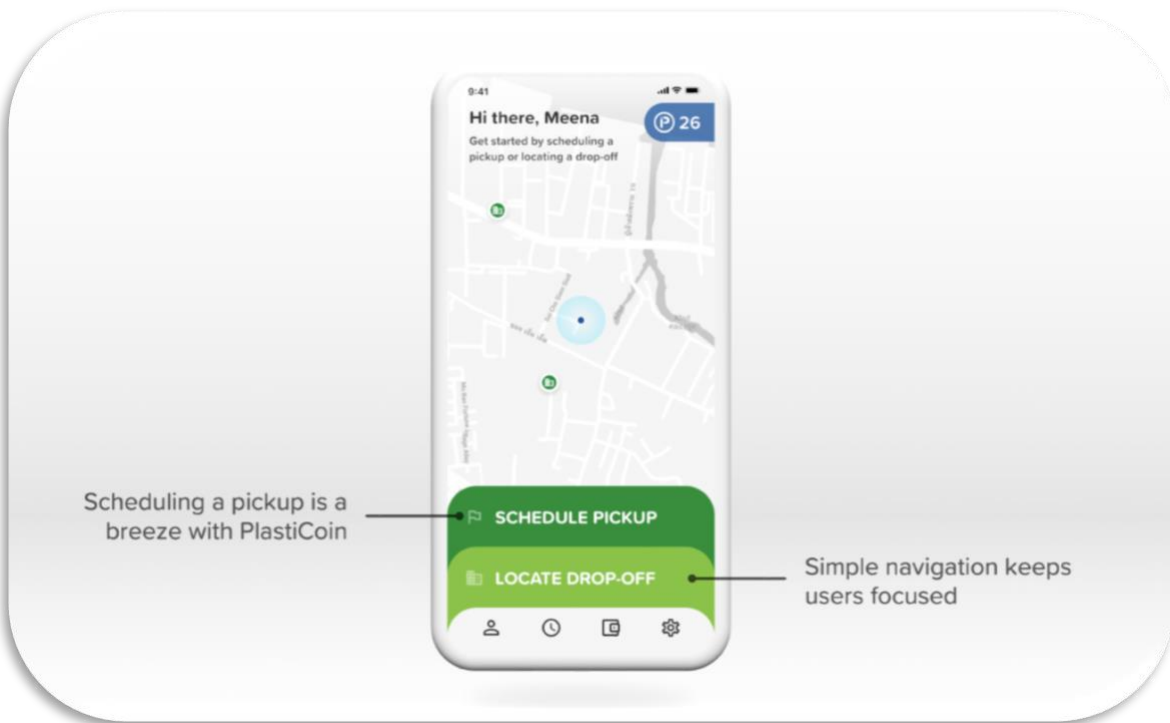
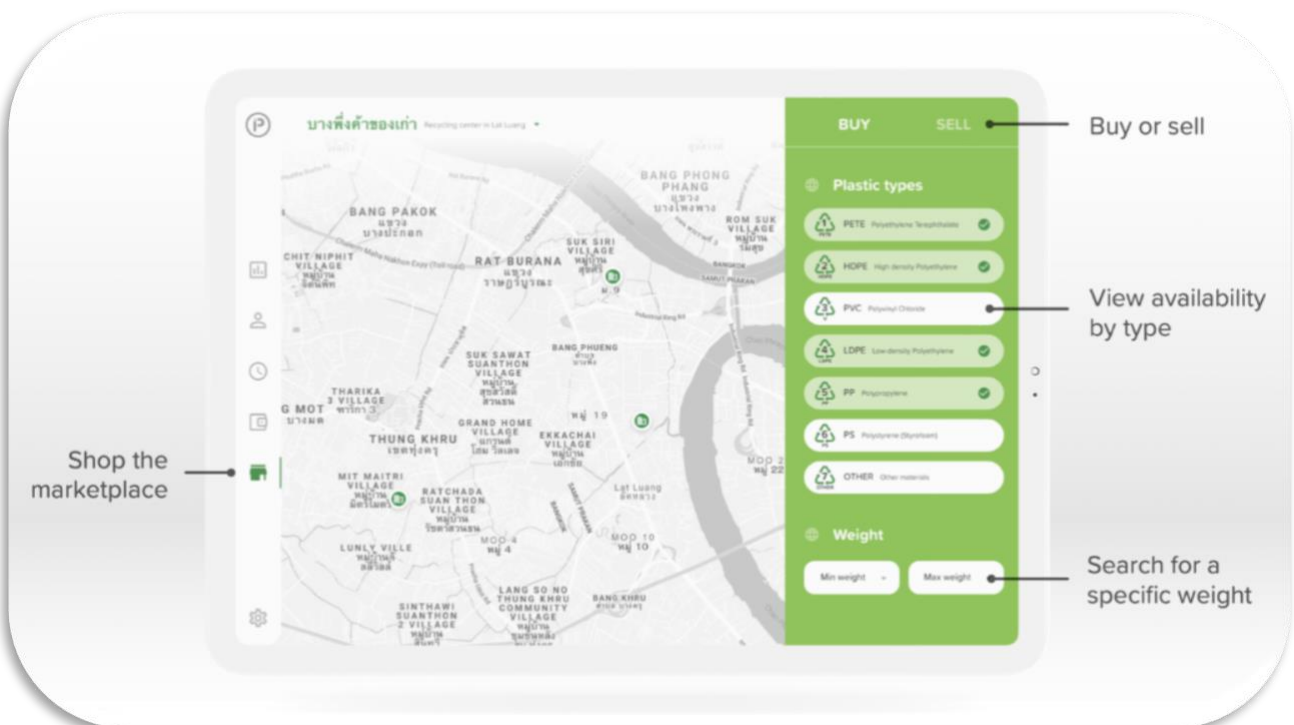


Figure 3 shows an image of the exchange app for the recycled material market.



Next let's explore some of the mechanics of the solution.

PlastiCoin Token

PlastiCoin tokenizes bundles of plastics (in weight) to incentivize recycling behaviors. Each user's bin/bag has an ID associated to it (public key => user id) and acts as the bundle of material identifier. Consumers simply place plastic in the bin/bag and get rewarded when it reaches a recycling center. Web of Trust, claims, attestations, blockchain, smart contracts and game theory fuel the network.

Monetary Value: Why use a weird token? Why not use cash or USD?

A token is used because it would be impossible to support every currency in the world and to scale globally. We don't have a true global digital currency...yet. Kenya uses Shillings and M-Pesa to transact on mobile. It utilizes SMS/text messaging technology. Thailand uses the baht and a lot of its citizens pay in cash. The United States use USD and services like Venmo to transact on mobile. The idea is to leave the payment processing to the local region and their currency of choice. The only monetary fact that exists on the network is that 1 PlastiCoin is universally and globally worth 1 unit of weight.

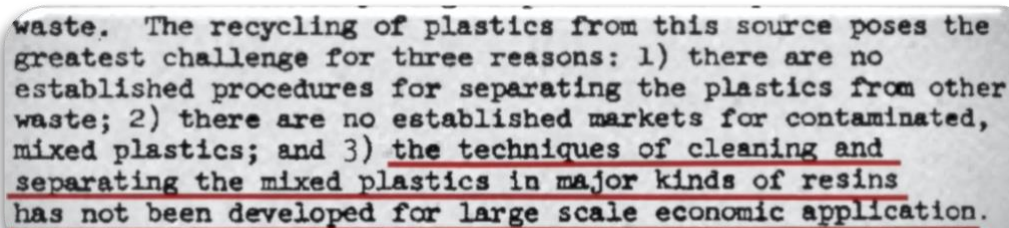
Micropayment technology is becoming more globally adopted with the recent announcement of El Salvador adopting Bitcoin as legal tender [1]. This can be thought of as the "Open Monetary System" or the "Internet of Programmable" money. The underlying technology enabling this new innovation is the Lightning network built on top of Bitcoin. The lightning network allows global micropayment transactions to occur with little to no fees. It is game changing technology! People and machines will be able to pay for things in increments of fractions of a penny. Imagine being able to stream a song and pay per second. This is possible NOW! New layers are being built on top of this base technology. Layer 1 – Global Settlement, Layer 2 – payment routing and micropayments, Layer 3 – open global markets. The network fueling PlastiCoin and the Open Plastics Network can be built on layer 3.

Next let's talk about old legacy systems, what is broken with them, and new systems.

1.2 Old vs New Systems

Plastic Wars: What would it take to incentivize a consumer?

PBS has a documentary called Plastic Wars. <https://www.pbs.org/wgbh/frontline/film/plastic-wars/>. In it they are critical of the current recycling system in the US. They surface questions from 1973:



waste. The recycling of plastics from this source poses the greatest challenge for three reasons: 1) there are no established procedures for separating the plastics from other waste; 2) there are no established markets for contaminated, mixed plastics; and 3) the techniques of cleaning and separating the mixed plastics in major kinds of resins has not been developed for large scale economic application.

They were right when you see images of modern collection systems like this:



How are they ever going to sort all that material efficiently?

PlastiCoin believes this can be done at the source, specifically at the consumer's home. Technology and smart phones did not exist back then. We did not have mobile payment systems. But now we do! Why not incentivize the consumer to clean, sort, and crush the material at the source? You don't need a big fancy expensive mechanical sorting and bundling facility. Just pay the consumer a cut of the plastic value for doing this task.

To prove this theory, we did an experiment to see how much effort it took to clean, sort, and crush a garbage bag of materials. Here are some images

Before vs After (sorting and crushing)



The volume of the material in the bag was reduced 50% after crushing. The crushing process only took 5 minutes.



A citizen with a small incentive would be happy to put in a little bit of effort. The bag above weighs 5 pounds and was collected at my house over 1 week. Here is the breakdown of material:

- 1.1 pounds mixed plastic (mostly water bottles LDPE) worth about 50 cents (*as of 5/15/2020 at 50 cents per pound*)
- 0.2 pounds aluminum worth about 5 cents (*assuming 25 cents a pound*)
- 3.8 pounds glass worth 38 cents (*assuming 10 cents per pound*)

Therefore, this bag of mixed recycling has a value of 1 dollar. The value of this recycling could spawn a lot of different business models. Why do we pay somebody to pick up our recycling in a big truck when it has so much value? The consumer should get a cut!

Recycling Market Declining



China does not buy as much recycled raw materials. The market for some recyclables is rapidly declining. Chicago's Republic services used to sell cardboard for \$180/ton now it's only worth \$35/ton. Nobody is buying recycled mixed paper. We do not want the same fate for plastic recycling. We need to help build the market for recycled plastic.

How does PlastiCoin recycling compare to our current system?

A PlastiCoin bin sits right next to your expensive legacy recycling bin but has an app associated to it. Traditionally you pay high fees to own a recycling bin. You have no incentive to actually place plastic items in the bin besides being a good citizen to the earth. The recycling program is owned by a private entity and rules mandated by government regulation. This constrains what plastic items you can place in the bin. You must follow certain rules, like cleaning plastic bottles, no greasy pizza boxes etc... Why is this? It is because there is no free market of recycling centers and transport contractors. You are constrained by legacy technology of government/private ran recycling centers. What if recycling was an open system and treated more like an app with incentives/gamification to entice people to participate? What if entrepreneurs could participate in the open system and create a new business if a problem arose on the network that needed to be solved?

Circular Economy = Open Network

Why does the Circular Economy not work today? Here are some of the reasons

- Data monopolies or just no public data at all
- Inefficient matchmaking
- Inefficient logistics
- Lack of economic incentive

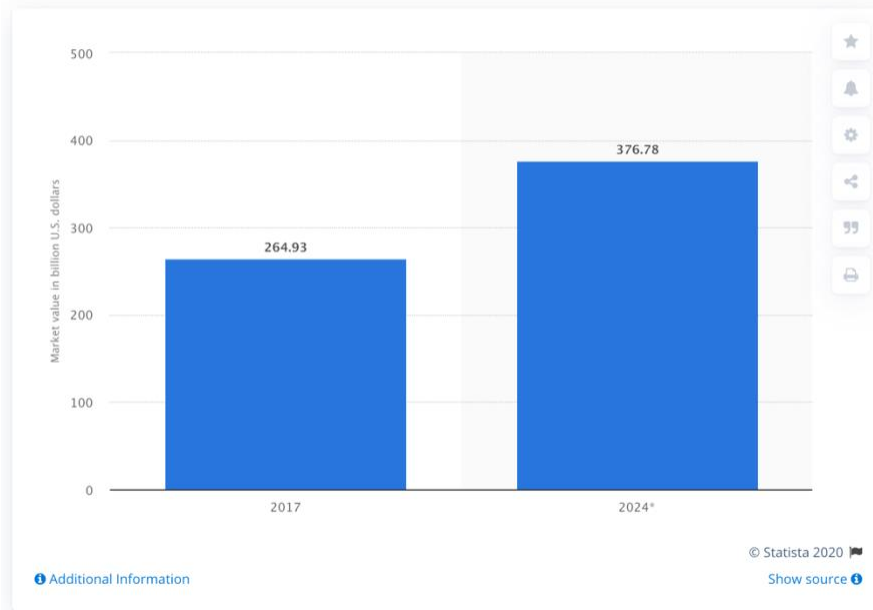
We need to stimulate a circular economy and create new markets for recycled materials. This can be accomplished when economic incentives are in equilibrium and a free market of entrepreneurs (local and global) are enabled with cheap raw materials. Items that were previously un-recyclable may find a new market. The Open Circular Network will enable this.

1.3 Recycling Market Outlook

Despite the recent decline in market value of recycled material it still has a positive outlook. It's projected to grow over 100 billion dollars in the next few years.

Size of the waste recycling services market worldwide in 2017 and 2024

(in billion U.S. dollars)

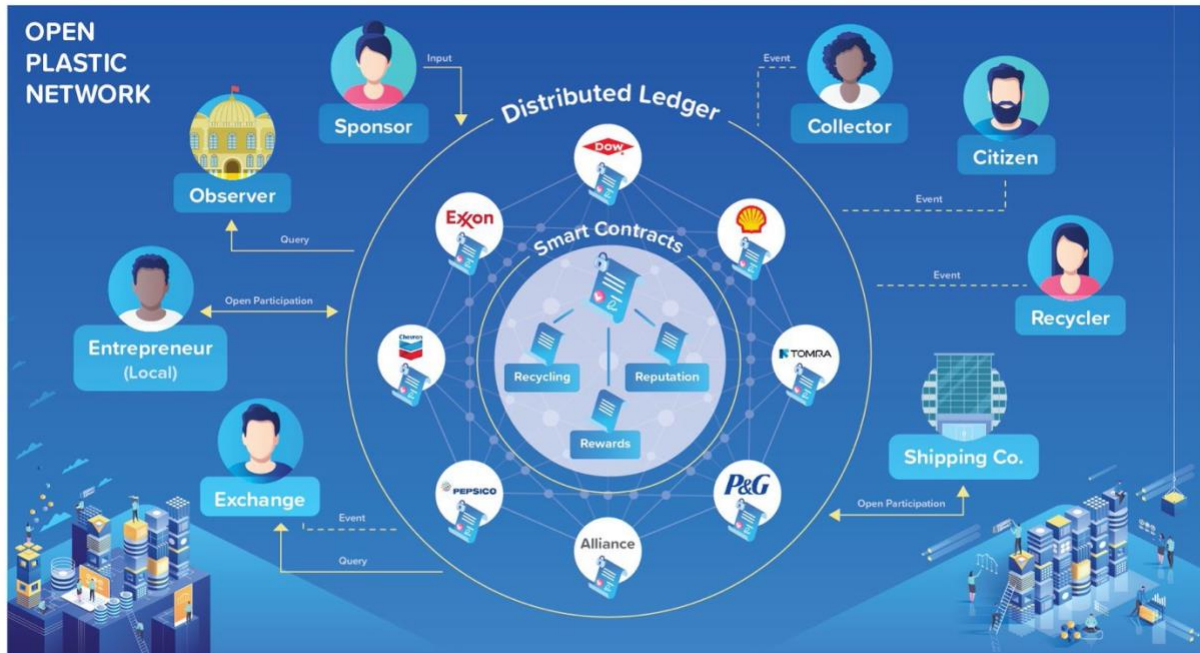


<https://www.statista.com/statistics/239662/size-of-the-global-recycling-market/>

There is clearly an emerging market for plastic and other high value materials. Let's talk about how a global network can be built to feed the new demand.

1.4 Our Proposal – The Open Circular Network

The Open Circular Network enables the circular economy by using distributed ledger technology to share data and run smart contracts. The network should be ran by a diverse set of companies and organizations across the globe. The founding members could be companies in the "Alliance to end plastic waste". Companies like Dow and Exxon. Companies that need this system to work for their "License to operate". The diagram below depicts the multiple parties on the network and the role they might play in creating data and moving material.



The system will consist of 4 core components

1. Apps
2. Networks
3. Governance
4. Incentive Models

Let's start off by talking about the App in chapter 2.

Chapter 2 – The App

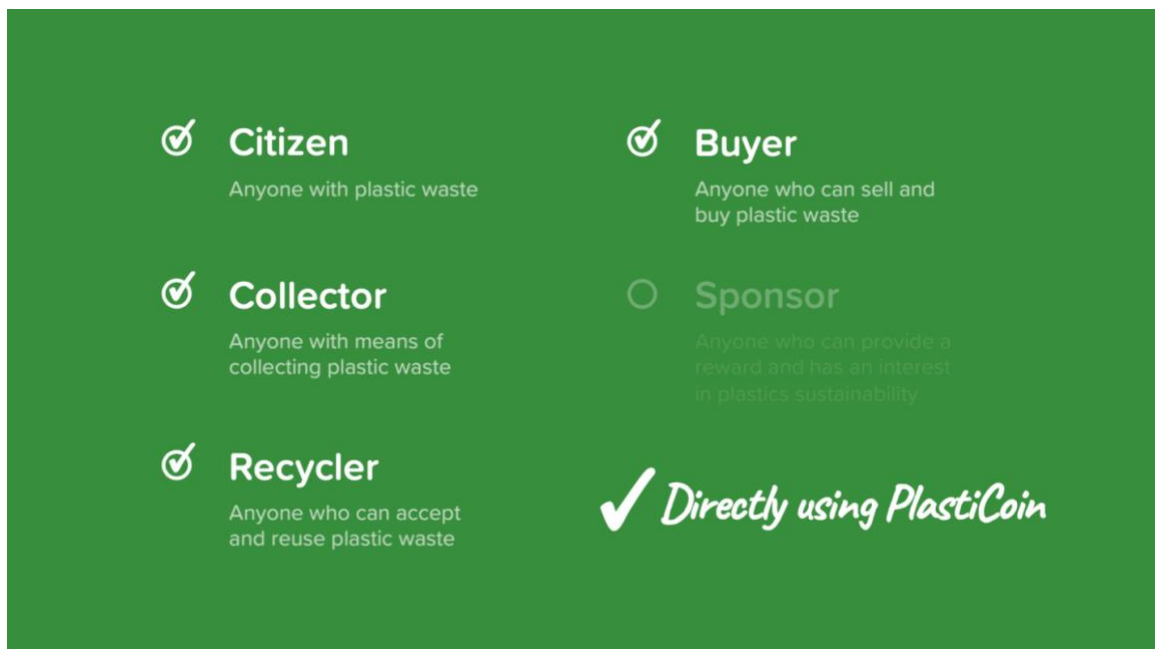
2.1 Apps



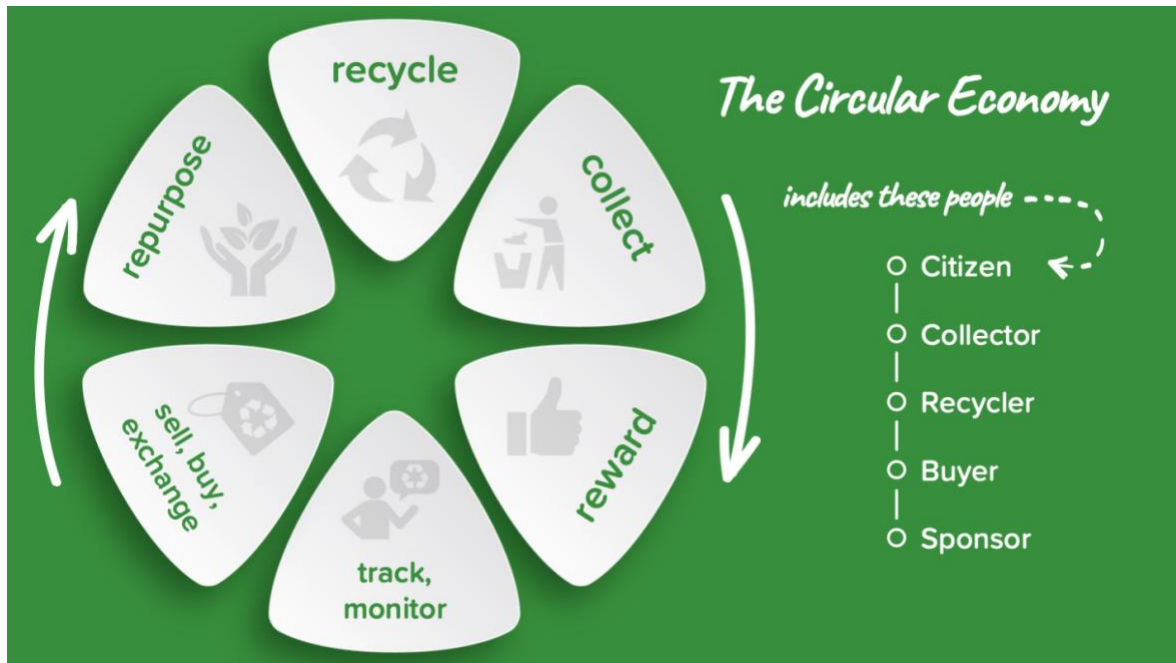
There will be several apps built on top of the network. These are all reference implementations and can be customized by any developer since its built on an open network and is open-source software.

App Personas

The app has several roles. Consumers, Collectors, Recyclers and Buyers.



Everyone in these roles come together to form the circular economy.



Let's talk each app and give a high-level overview and what the app does.

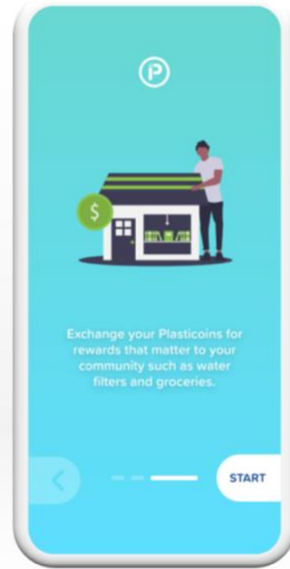
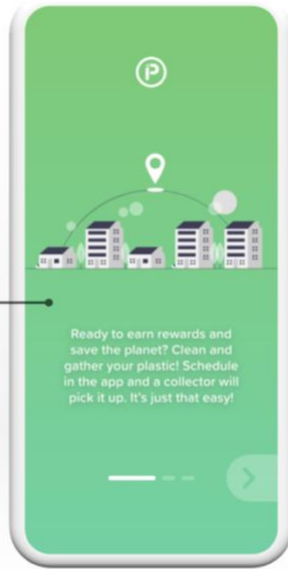
Consumer App

- Used by owners of plastic to request a material pickup or to locate drop centers
- Rewards Wallet

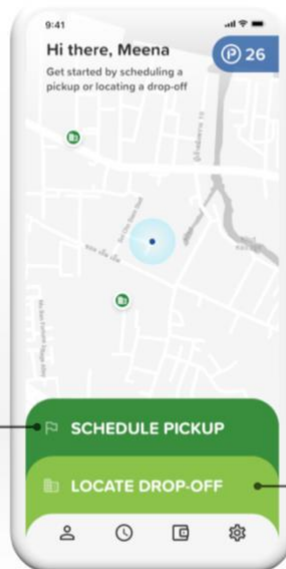
The images below show a walk thru of the consumer app



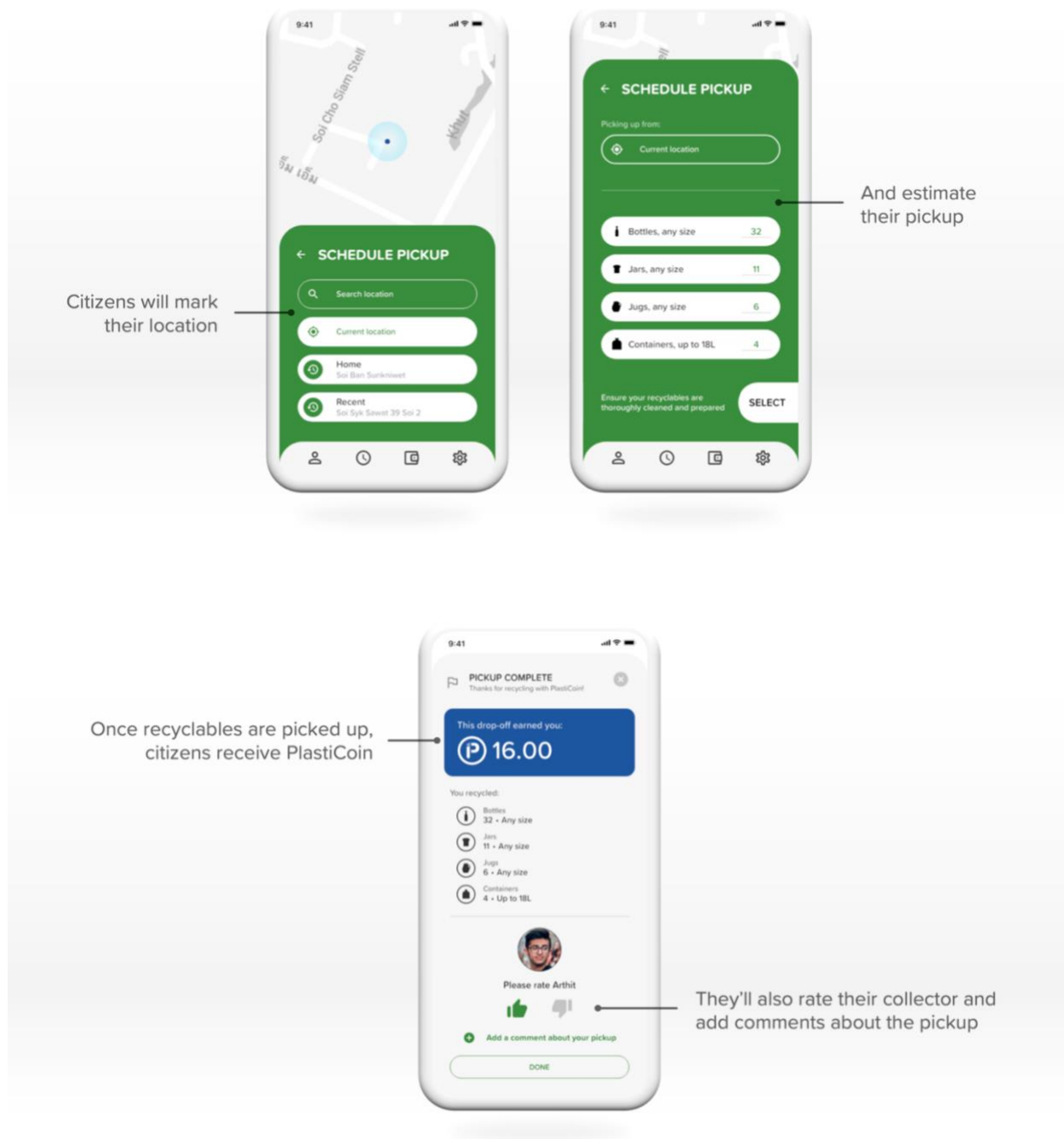
We'll welcome users with a pleasant onboarding



Scheduling a pickup is a breeze with PlastiCoin



Simple navigation keeps users focused

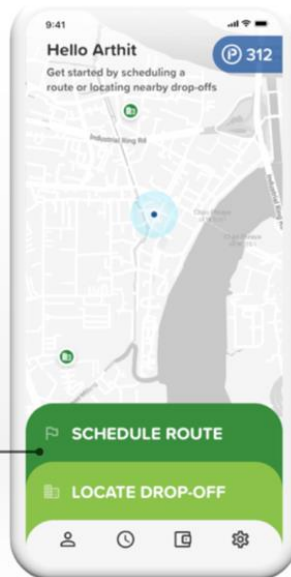
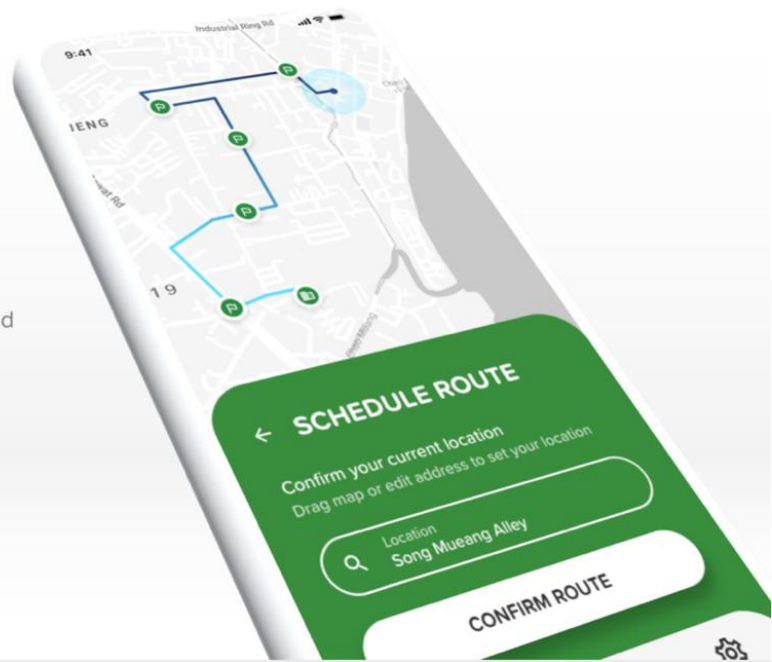


Collector App

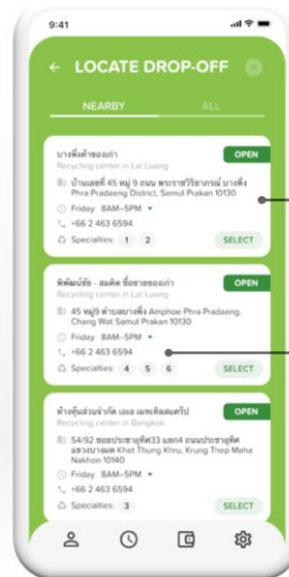
- Used by a collector to obtain a route and to schedule hours available
- Collector rewards wallet
- Route Map Navigation

Collector

will locate available pickups and drop-off at recycling centers

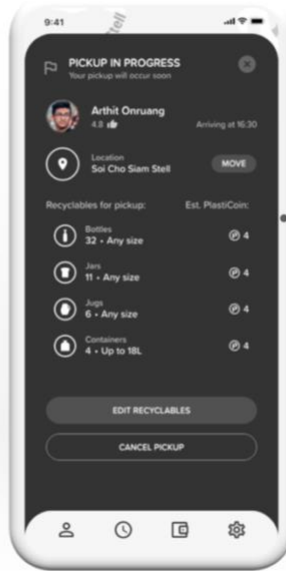
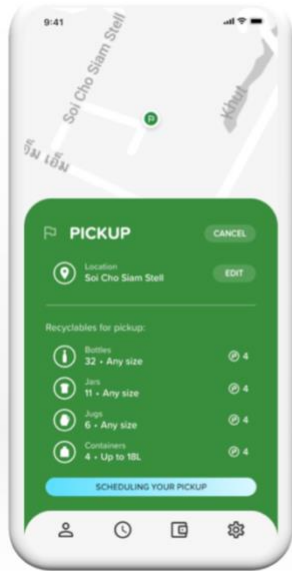


Schedule a collection route in just a few clicks

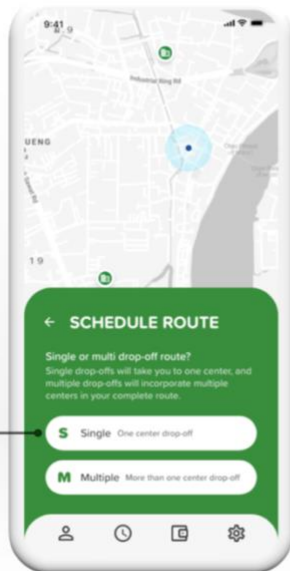


Nearby, participating recycling centers are easily accessible

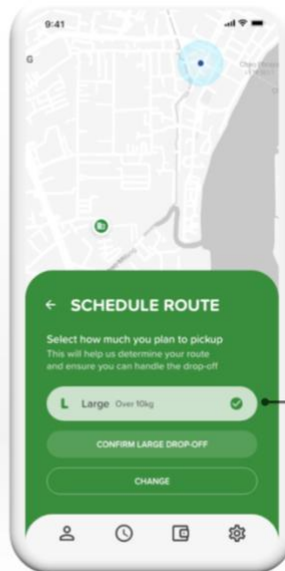
Center specialties are noted for each location



And their recyclables will be picked up that same day

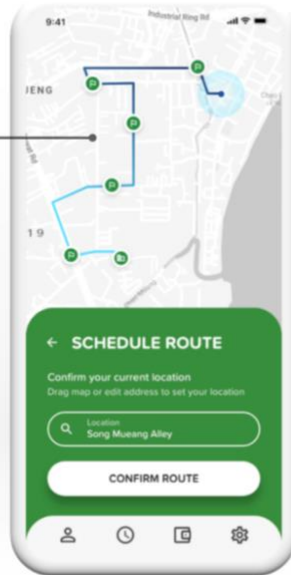


Collectors will select the number of recycling centers they'll visit

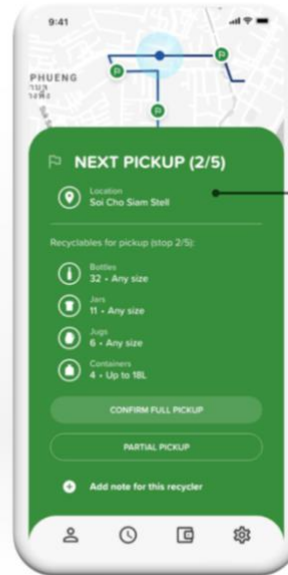


And they'll determine a pickup size they can handle this trip

They'll be matched to a route considering all selected factors



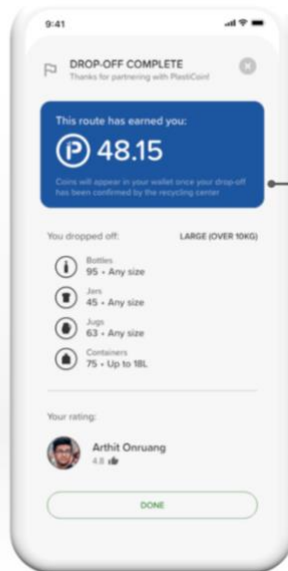
The app will guide collectors as they pickup recyclables



As collectors reach the center, they'll simply drop-off all pickups

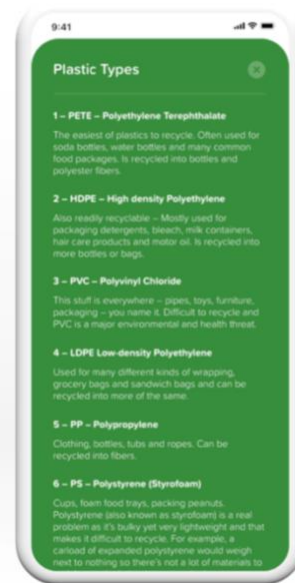


Once the center confirms the drop-off, collectors earn PlastiCoin

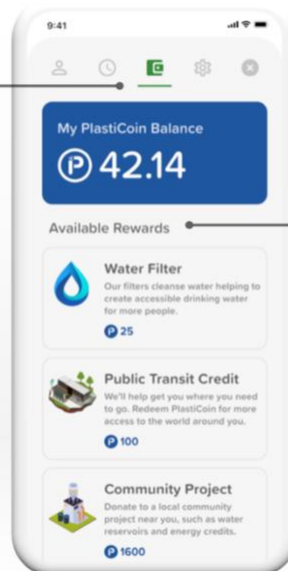


Each collector can also manage their collection preferences such as travel and accepted plastics

A quick reference guide is also available for our collectors



PlastiCoin will collect in a wallet



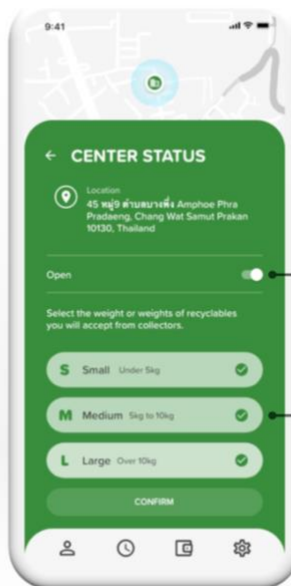
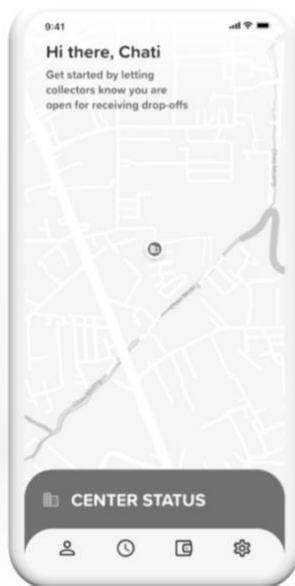
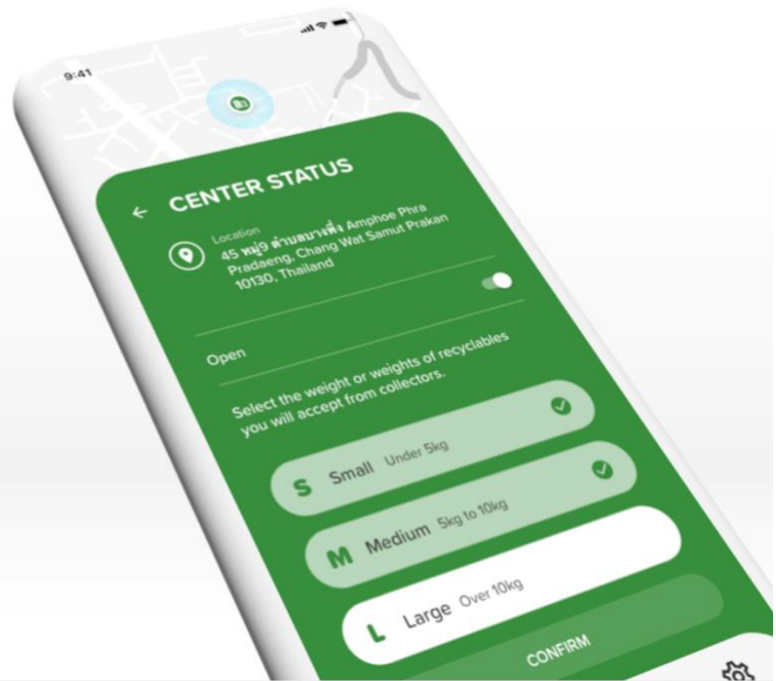
And is redeemable right in the app

Recycling Center App

- Scan in material
- Disperse rewards
- Materials Accepted Database

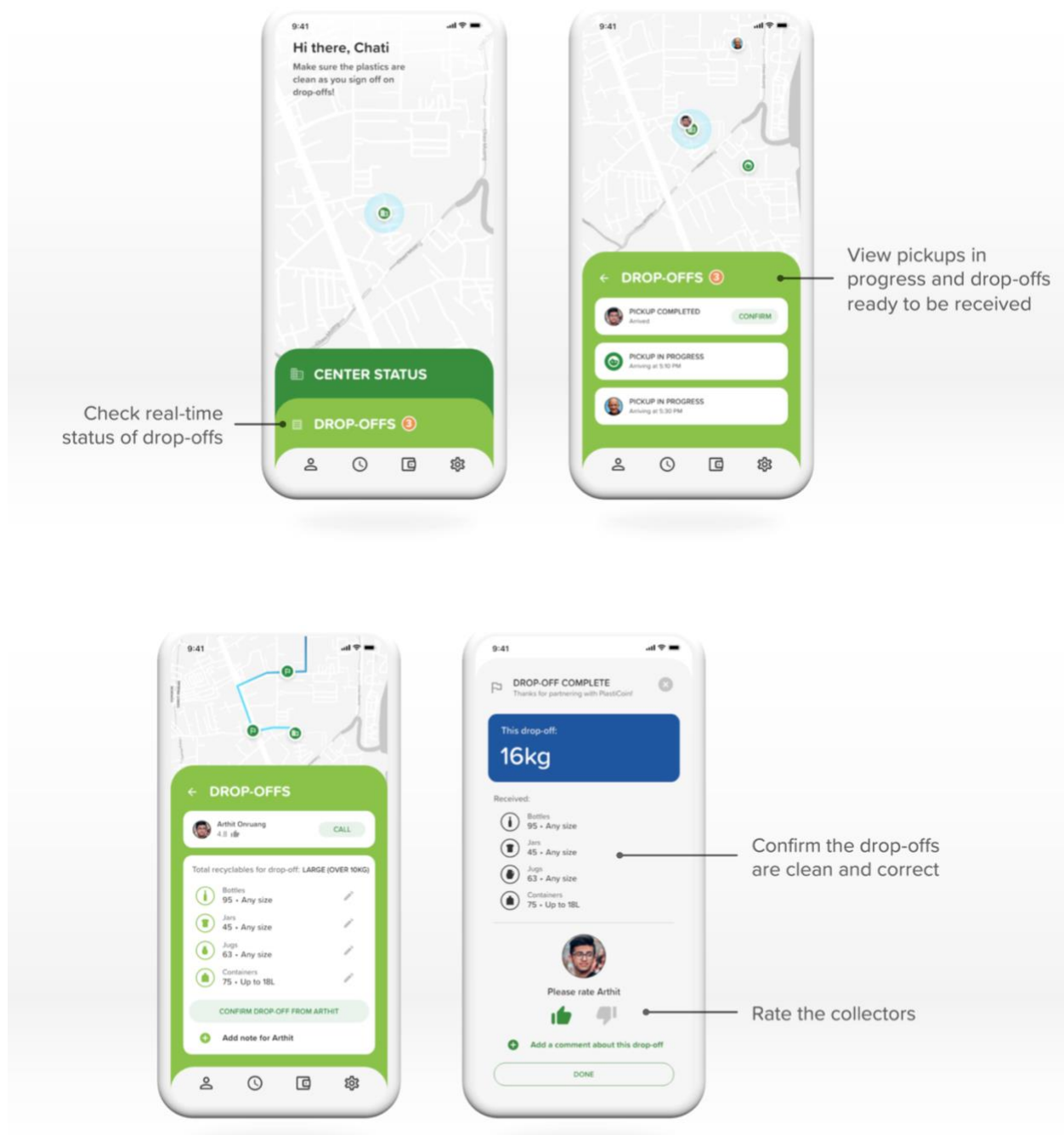
Recycler

will collect recyclables from
our mobile collectors



Centers will indicate
receiving status

And the weights of
plastic they'll accept



Aggregation Center Inventory App

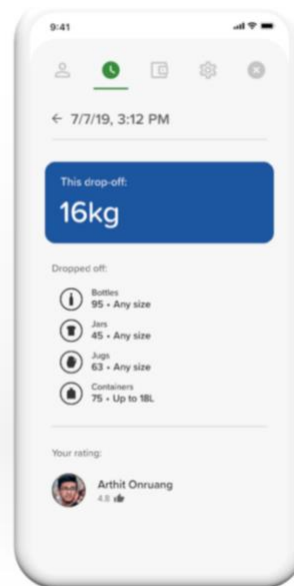
- Inventory system
- Exchange interface
- Quantity and material database

Recycler

can also monitor intake and buy or sell plastic



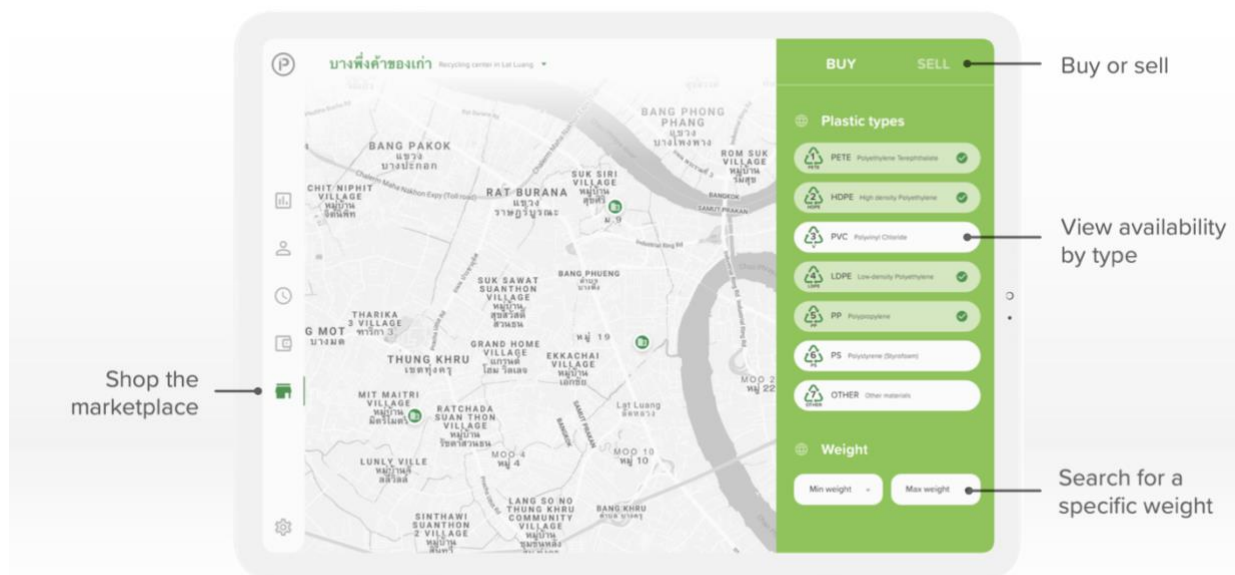
And view center intake history for records and discrepancies





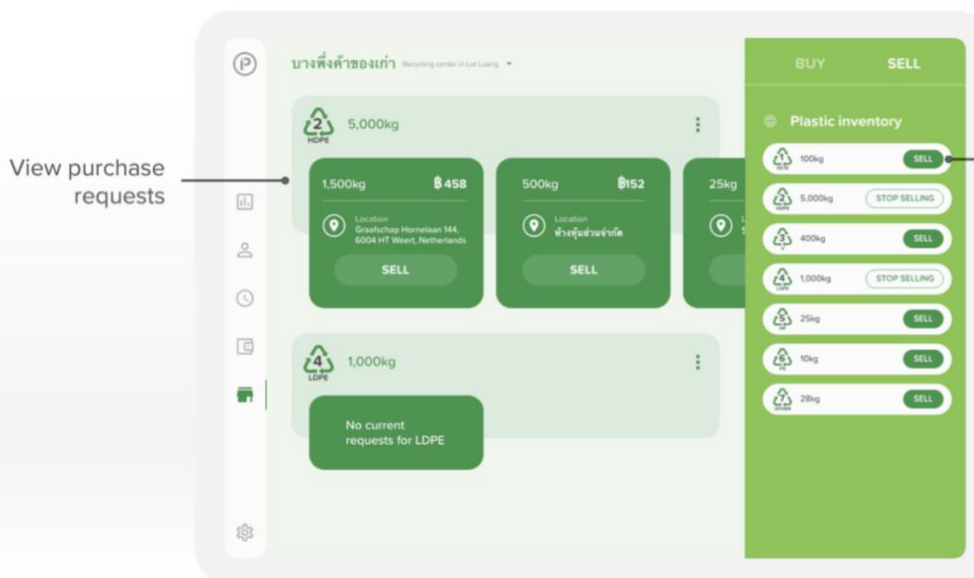
Exchange/Market App

- Robinhood-like exchange for buyer and sellers of materials
- Import and export material pricing (ask/bid)





Location-based availability



Determine what you'd like to sell

Data Explorer

- Index all the material on the network
- Public data about recycling centers
- Public aggregate data about material and type collected by regions (weight, rewards etc...)
- Can be queried by anyone and used as a public data source

2.2 App Data Security

The open data system has several levels of access control using cryptography. Private data is encrypted and cannot be seen by anybody except the owner. Regional specific data can only be seen by a regional consortium members. Public regional aggregate data can be seen all. This is explained in more details in the “Networks” section and uses the concept of “channels”.

2.3 App Demo Videos

Here is video demo of an early version of the PlastiCoin branded consumer and collection app that was built for Mr. Green Africa in 2020.

- 3-min app demo:
<https://www.youtube.com/watch?v=Z7pa2h9yl7M>
- 12-minute detailed walkthrough commentary app demo:
<https://www.youtube.com/watch?v=F4EY7GAqyhE>

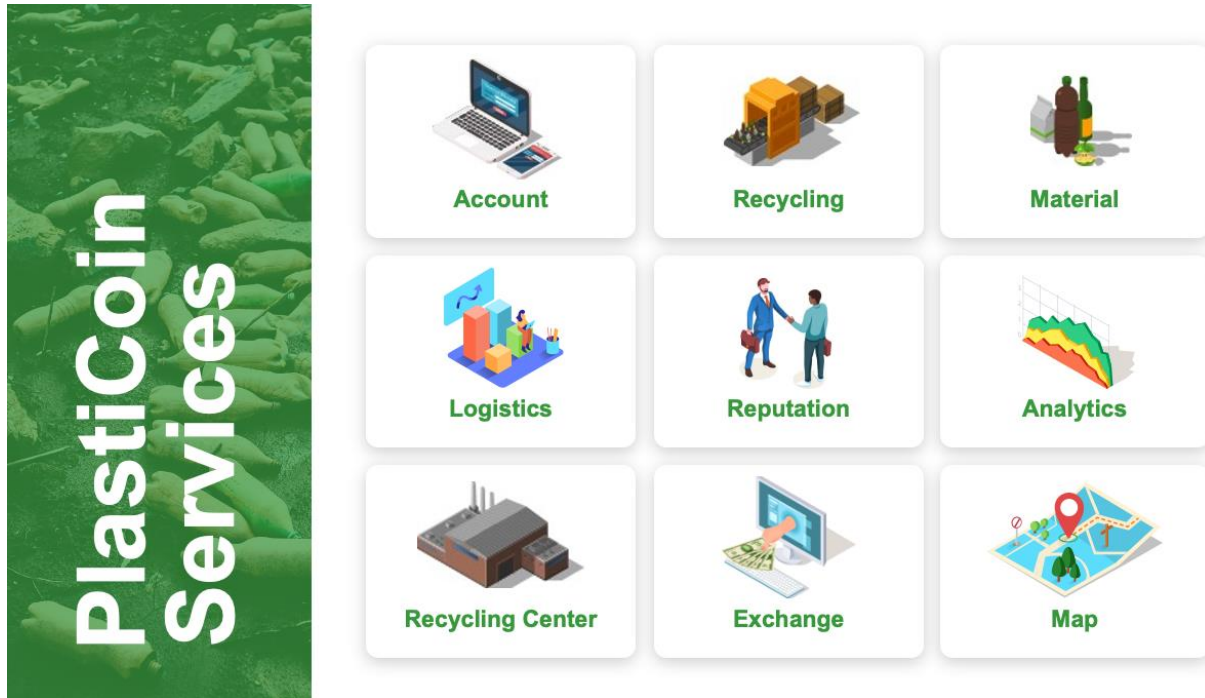
The next section will touch on networks. This part of the paper tends to get a bit more technical.

Chapter 3 – The Network and the Blockchain

3.1 Networks

The network is the underlying fabric the apps run on top of. It consists of several services.

3.2 Services



Account Service

The account service manages the user identities on the network. They can be decentralized identities or provided by a member service provider.

Recycling Service

The recycling service manages the workflow of the consumer and collector and information and the material to be picked up.

Material Service

The material service indexes all the material in the system including raw material, type, properties, etc...

Logistics Service

The logistics service manages information about the route, supply chain and logistics

Reputation Service

The reputation service manages the points awarded to consumers for recycling properly (cleaning sorting etc..) and the collectors score of how well they picked up the material.

Analytics Service

The analytics service collects aggregates in the system and computes them to provide better data analytics. This data can support better AI and system generated routes and improves efficiencies with time.

Recycling Center Service

The recycling center service handles all the data about a recycling center including hours of operation, materials accepted and inventory.

Exchange Service

The exchange service handles asks and bids for the market exchange in an orderbook.

Mapping Service

The mapping service provides GPS, directions, geocoding, and address lookup for the system.

The next major component of the network is the consortium blockchain. This can be thought of as the shared database that syncs data between different organizations.

3.3 Networks: Consortium Blockchain

The network should not be run by one company or one government. It should be a consortium of key players and open to all. It should be supportive of an open free market. All transactions are ordered and confirmed by consortium members on the distributed ledger (blockchain). Anyone can use the network.

Why smart contracts and blockchains?

The Alliance to End Plastic Waste was setup as an alliance, or consortium, to solve the global plastic waste problem. It was not setup as a for-profit corporation, so then why would you run the technology like a for-profit corporation? Why would you outsource it to a third-party intermediary with conflicting incentives – “to provide an expensive solution and profit”. The answer is you DO NOT! Certainly, there will be components built using normal database technologies and APIs, but the core logic and smart contracts must be saved to a distributed ledger. This system should be created by the companies and individuals with the most to lose if this system did not exist! Wouldn't you trust 31 diverse companies over one for-profit entity, or even one non-profit entity? Wouldn't you trust a ledger that was audited and meticulously verified by more eyes?

Solving the global plastics waste problem is not a one entity problem, therefore, the technology needs to be, created by, and ran by, many diverse entities. It is a lot like open source software, hence the name of the network, Open Circular Network. Blockchains and distributed ledger technologies (DLT's) have evolved over the past 10 years and is mature technology. It is already being used to solve real world problem by large, trusted companies.

There are 5 main reason to use a consortium blockchain:

1. Trust (Traceability), Honesty and Longevity of the network
2. Global performance using distributed architecture
3. Openness and Collaboration
4. Right tool for the job with a purpose-built programming language (Smart Contracts)
5. Promote market forces and avoid cartels and monopolies

(1) Trust (Traceability), Honesty and Longevity

Hyperledger Fabric is one of the technologies that has evolved over the years. It is an enabling technology that makes it very easy to create a consortium blockchain that can be ran by members of the Alliance. If one member drops out of the consortium the network still lives on! The network can be bootstrapped (within hours!) and can be operated with only one member at the start. The goal is to get multiple parties running the distributed ledger and core components, but this is certainly not a requirement up front. They can be added on demand when the right time comes. There are many benefits to this design, the obvious one being trust and longevity. It's better to trust multiple companies and non-profits instead of just one. Especially when solving a global problem. This also enables traceability of assets (such as plastics) on the network.

(2) Global performance using distributed architecture

The non-obvious benefit of a blockchain is increased regional performance. For example, if a cement company in Thailand ran their own node in Thailand, the client apps in that region could submit their transactions to that server. The system would be fast and would scale globally to any region because the nodes will be located near the clients. The ledger from that region would asynchronously replicate around the world with an eventual consistency.

(3) Openness and Collaboration

Independent companies and non-profits/individuals can run bolt-on components that do not have to be in the core layer. This simple design principle will make solving the global plastics waste problem a truly global collaboration where there are many problems unique to a specific region.

(4) Right tool for the job with a purpose-built programming language (Smart Contracts)

Blockchains have a purpose-built programming language called smart contracts. This language makes it easy for a developer to codify contracts. I like to compare it to using the right tool for the job. I would not use a microcontroller or low-level C language to make a web app. I would use HTML and JavaScript. Therefore, use a smart contract language for the job of multi-party workflows. They excel in value transfer and storing shared state. A popular smart contract programming language is Solidity made popular by Ethereum. Another one is chaincode in Hyperledger.

Here is a formal definition: A smart contract is a computer protocol intended to digitally facilitate, verify, or enforce the negotiation or performance of a contract. Smart contracts allow the performance of credible transactions without one central authority. These transactions are trackable and irreversible. Smart contracts are perfect for handling multiple party workflows and smart contracts that transfer value. Here is how it maps to our context of a global plastic recycling program:

Multi-party = consumer, collector, recycler, seller, buyer, transporter, observer

Workflow = pickup, sort, transfer, sell, buy, exchange

Value Transfer = counterparty handling of plastic asset value transfer and PlastiCoin rewards

This purpose-built technology abstracts away many complexities of traditional systems. The workflow can also be easily changed and iterated on. When used in conjunction with a tool like Hyperledger Fabric the following are abstracted away:

- *User Account Management* – abstracted away by Public/Private keypairs for authentication/verification/signing
- *Databases* – abstracted away by state variables (columns in a database) by creating an instance of a smart contract (similar to a row of data or new class)

(5) Promote market forces and avoid cartels and monopolies

We want the system to promote market forces and avoid cartels and monopolies. It would be tragic if one company ran the whole system. We want the network to remain open and competitive for anyone to join. If a neutral blockchain is used a single company will not be able to control the data or lock it in a “walled garden”. The open data can then be available for all to build companies on top of. Walled gardens of data lead to monopolies and no competition. If an open market is created with open data than better more competitive companies can be formed on equal ground.

3.4 Open Circular Network Technical Details

The Open Circular network (“OCN”) is built upon a multi-party database (blockchain/distributed ledger) and workflow system. The “core” of the network can be run by the consortium (or an individual if a consortium does not exist in a region yet). This architecture will allow third parties to integrate with it and write their own client applications. The consortium will create client reference implementations such as the PlastiCoin mobile app. This can be compared to Bitcoin. In Bitcoin, the miners run the “core” of the network and many third party can create client wallet applications.

The OCN uses Blockchain technology to optimize multi-party workflows using smart contracts. This enables the network to scale globally because we are automating **tedious human verification tasks**. The network will not scale to all corners of the earth, from tiny villages to huge cities, unless we automate verification tasks with smart contracts.

The OCN can unlock global value never thought of before! It can enable global statistics on how much material the system is moving and where it is located. Currently only 9% of the plastic ever produced has been recycled. This number is most likely not very accurate because it was gathered by a polyglot of disparate systems. What if we could increase this number to 20% or 50%? What if feedstock for plastic pellets were created from recycled plastic instead of oil? What if this system was fine-tuned, efficient, and global? What if recycled plastic feedstock was cheaper than cracking oil from the ground? This is all possible!

Smart Contracts

The Open Circular Network’s core will be comprised of several smart contracts: Smart contracts are simply logic that run on top of a distributed ledger and the transactions are timestamped, ordered and verified.

At a high level, the basic logic of the smart contracts on the Open Circular Network are:

Recycling Smart Contract

This smart contract tracks the material from the consumers house to the recycling center. It is like a typical supply chain provenance use case.

Reputation Smart Contract

This smart contract tracks your reputation on the network. It tracks reputation for consumers, collectors, and recycling centers. This helps keeps the network secure and helps detect collusion and corruption. It will enable a web-of-trust and eventually make it easier, more efficient, and cheaper to

run the network as it onboards more users. The system actually gets better and more secure as the number of users grow. Let's touch on a note about reputations systems:

Reputation Systems

How does Twitter, Facebook and Uber operate at scale with millions of users and maintain a safe(ish) online experience? The answer is Reputation Systems. There is a good book on how to build healthy online communities <https://www.amazon.com/Building-Reputation-Systems-Randy-Farmer/dp/059615979X> Here is an example of a reputation system smart contract <https://medium.com/coinmonks/how-to-build-a-reputation-system-on-blockchain-957bd9ec1ab2>

Rewards Smart Contract

This smart contract tracks the tokens for each users balance.

Tracing Smart Contract

This smart contract facilitates the transfer of product from one party to another.

Escrow Smart Contract

To make a scalable global recycling program you need to automate everything...specifically reputation and trust. The best comparison is an Escrow account. Escrow is the use of a third party, which holds an asset or funds before they are transferred from one party to another. The third-party holds the funds until both parties have fulfilled their contractual requirements. If you've ever bought a house, you notice the middleman is taking a huge cut! It's a very slow, inefficient and expensive legacy system. The same is true of property taxes. A company, like wells Fargo, is the moderator between you and your city. Again, they take a huge cut in the form of the interest on your mortgage. Escrow is associated with real estate transactions, but it can apply to any situation where funds will pass from one party to another. It can apply to a global recycling program!

A legacy escrow system will never scale for a global recycling program...but we have SMART CONTRACTS! A smart contract automates the moderator's job! Instead of having a company moderate, you use a network, in our case a permissioned blockchain (Hyperledger fabric) to be the trusted third party. The escrow contract is codified as a smart contract. This system can scale globally because we do NOT need humans or companies in the middle. The network handles this! Here's the business logic:

Party A (user recycling) does not trust party B (collector) so they have a moderator (recycling center). Party A puts the weight of plastic into the escrow account smart contract. When the collector picks it up, he is now the owning counterparty B. The moderator is the recycling center. Once the weight in plastic is delivered to the recycling center the funds are released in the form of PlastiCoin. This is an over-simplification and there are a few more models we discuss later in the paper about initial liquidity to bootstrap the network.

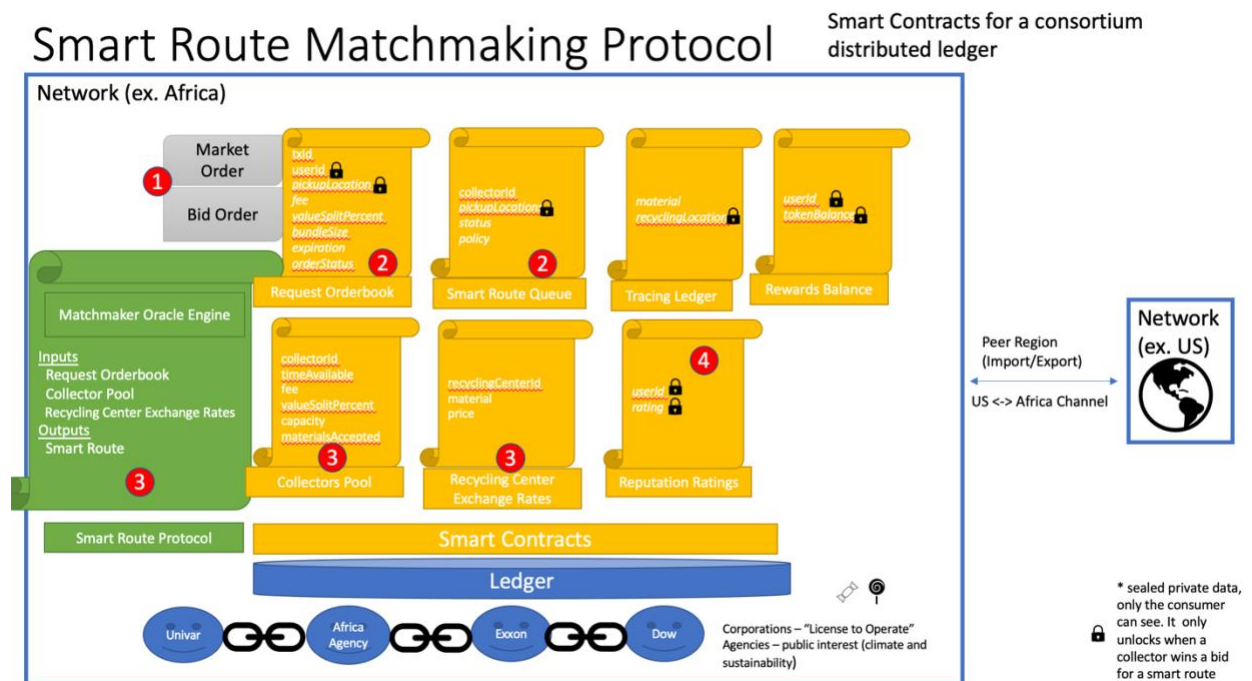
A similar system is being used in the real world by an open global marketplace called Open Bazaar. This article explains how it works <https://openbazaar.org/blog/Escrow-Smart-Contract-Specification-in-OpenBazaar>. The smart contract code is available open source here: <https://github.com/OpenBazaar/smart-contracts/tree/master/contracts/escrow>

All of these smart contracts are components that make up the "Smart Route Matchmaking Protocol".

Smart Route Matchmaking Protocol

The Smart Route Matching making Protocol is the most important component on the network. Here we can get into the details of the smart contracts we started to talk about above. The protocol consists of a few smart contracts, a matchmaking engine, and a distributed ledger to make sure routes are fairly created and distributed to collectors on the network. The routes must be efficient and economical. The routes cannot be created by one central party to enforce a fair open system without bias. The only way to achieve this with an open non-custodial market.

The figure below shows a high-level step by step process flow of the protocol:



1. A pickup request is entered into the "Request Orderbook" by the consumer with recyclables as either a *Market* order or *Bid* order. A market order simply takes the average fee and value split created by the *matchmaker oracle*. For instance, you might live in a region that has 2 service providers, (1) Mr. Green, who charges a fee of 300 shillings and gives you a value split of 0%; or (2) Company B who charges no fee and gives a 1% split to the consumer. An entrepreneur in the region might see a market opportunity to undercut the competition and create a better cheaper company than Mr. Green and Company B. Since it's an open market, they have the choice to create Company C and cut the pickup fees to 0 and offer a value split of 5% to the consumer. Market theory suggests the consumer would pick the better deal! Also, imagine if competition grows and there are many collectors on the network. In this situation a *Bid* order might offer a better return for the consumer. A consumer could place a bid to be paid 6% with no pickup fees to the Recycling Orderbook. For our example, let's assume this is the happy path and the pickup request is placed in orderbook (depicted by the red (1) in the figure above). This would update the *orderStatus* to "offer" with an expiration date of 2 weeks for example. Any collector on the network can accept this offer if it is economically feasible and time permitting for them.

2. When the *orderStatus* is updated to “offer” the *pickupLocation*, *txID*, and *expiration* is added to the “Smart Route Queue”. This does not mean it is assigned to a specific collector yet, any collector can swoop in and offer a better deal. The status does not change until the expiration date is met in this offer round. It is pending until the “Smart Route Protocol” adds it to a route. The smart route protocol uses a combination of the MATCH matchmaking protocol and traveling salesman’s algorithms to efficiently add *pickupLocations* to a Smart route based on a policy. The policy contains constraints such as collector capacity, vehicle, regional constraints, price and reputation score* (**reputation score can get complex and biased, so more research needs to be done*). The “Smart Route Protocol” also uses input data from the “Collector Fee Chart” and “Recycling Center Exchange Rates” to help calculate the most efficient route.
3. When all the constraints are met, the Smart Route is given to the collector by the Matchmaker Oracle Engine and the status of the pickup in the Orderbook is changed to “Reserved”.
4. The collector receives a notification that he has a new route. He should accept (or take a reputation hit reverting the status of the route). When accepted, the status of the request in the Orderbook changes to “Accepted”. At this point the private data fields, *pickupLocation* and *userId* are revealed to the only the collector using public key cryptography. The collector goes along his route and the Tracing Ledger is updated after each pickup using the collector’s digital signature.
5. Rewards are given based on the pre-agreed upon *Collector fee chart*. The token balance is updated in the *Rewards Balance ledger*. (a cryptocurrency like Bitcoin could be used instead of a worthless token or proprietary points system)
6. At the end, each party in the process is awarded *Reputation points* based on rating and computed fields, like route completions.

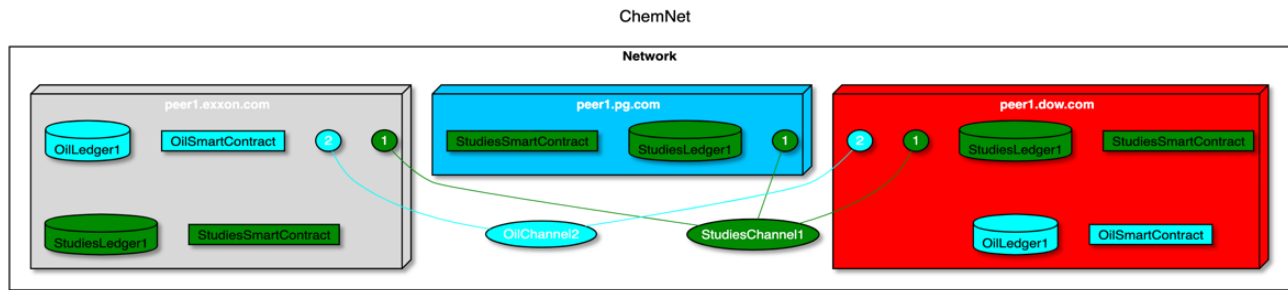
The above process flow is an over-simplification of the protocol. It needs to be tweaked and tested in the real life in many regions around the world. There are a few attack vectors that are talked about later in the paper and many more to be discovered along the journey!

Now let’s talk about some of the technology components that are being used to build the smart route protocol, specifically the Linux Foundation and IBM’s open source blockchain called Hyperledger.

Hyperledger

Another term for a blockchain is called a “Multi-Party Distributed Ledger”. For example, if you have two separate companies that “sort-of” trust each, but don’t want to rely on each other’s API’s to query shared data, then, blockchain could be a nice solution for a synchronized shared database. Smart contracts are the logic akin to stored procedures in the traditional database world. Each company can automate business logic “on-chain” and help speed up tedious business processes. This could lead to more sales and less operating expenses between B2B partners. In Hyperledger, state can be broken down by channel...i.e data specific to a certain subset of companies or regions or business units (unlike Ethereum, which only has 1 global state for all nodes on the network).

B2B sub-networks can organically grow in time as relationships blossom. Here is an example of a fictitious network called ChemNet:



This model can be applied to the circular economy and all the parties involved to make it work globally.

In this example above each organization runs a node in the network on their own hardware. Exxon, P&G and Dow. They can securely share and synchronize data using “Channels”. For example, maybe Dow and Exxon want to open a channel and share data about Oil, they can create a channel called “OilChannel2” and share data via the “OilSmartContract”. Notice we did not open a channel with P&G because we do not want to share the data with them. Maybe we want to all share data about Studies. All three companies can create a channel called “StudiesChannel1” and share data from the “StudiesSmartContract” and saved to each companies copy of the “StudiesLedger1”.

Next let’s talk about what can go wrong! 😈

Attack Vectors

Anytime money or rewards is involved people are going to collude, cheat, steal, and try to game and hack the system. Here is a list of ways the system will tried to be gamed. The intention is to list as many threats as possible so we can mitigate them in the design of the system.

“The Seinfeld” - In one model of the system we can introduce the initial liquidity to bootstrap the network by having a rewards sponsor mint rewards. If a rewards sponsor mints 1 million USD rewards and converts them into 1 million PlastiCoins for redemption in, let say Thailand, then somebody from, let’s say the UK, will try to ship in bulk plastic to the Thailand and take the rewards. This is like an episode of Seinfeld where Kramer and Newman drive a truckload of bottle returns from New York (0 cent deposit) to Michigan with the hopes to redeem them for a 10-cent deposit. The fraud can be mitigated by tracking the plastic from origin to destination and requiring the citizen to be in a certain region to redeem the reward. If the citizen, collector and recycler collude then a Data analytics detection system (AI/ML) can be in place to look for anomalies or weird behaviors, such as weird plastic amount coming from certain regions and inventory weights not matching up.



This is just one example of how the system needs to be resilient and automated but also scale. On the contrary if there is too much human administration, the system will be too expensive to operate and will never grow to any meaningful size. That is why we need to model many different ways to build the system. In the next section we talk about different route generation algorithms.

3.5 Modeling Route generation algorithms

Problem

A city has many bins and many collectors. You want to fairly distribute routes among the collectors. You have two types of Collector, (1) casual and (2) serious. Casual collectors only collect a small number of bins on occasion (similar to a part time worker). Serious collectors collect a lot of bins and spend a lot of time on the network (similar to a full-time worker). In general, time sensitivity is not that important because it's just recycling. Some collectors have a higher collecting capacity (i.e they have a large truck). How do you fairly distribute routes?

Goal

The goal is to come up with a generic model and region-specific models. One model does not fit all.

Mashup of Uber, Waste Management, Amazon Prime Routes, and paper routes

Possibly mashup waste management (Once a week scheduled routes) and uber (on demand random routes)

Variables

Below are the variables that are used to determine the region-specific recycling route models.

Collector Variables:

- Capacity: 1 car | 1 truck | 1 bike | 1 wagon | 1 dump truck | 1 body
- Availability: 1 hr/week | 8 hours today | 40hrs/week | etc..
- Region: 1 mi | 10 mi | etc...

Citizen Bin Variables:

- Time Sensitive: None | 1 day between 5-6 PM (fee)
- Location Sensitive: if you live in the boondock's vs populated city

System Variables:

- How often do you hand out the routes: 1 day
- How many bins/per hour on average does a collector collect? For example, 40 bins per hour in Urban Thailand
- Local specific variables:

Reputation Variables:

- Performance: bins per hour
- Reliable: do you show up and finish a route you are assigned?

Recycling Center Variables:

- Capacity: 1 ton of PET and 300 pounds HDPE | No glass | We accept everything because we are creative!

- Materials Accepted: PET | HDPE | etc...
- Type: State run | Local Business Ran | Garage Startup | Corporate Sponsored

Economic/Market Variables:

- Material Price:
- Material Demand:
- Nearby Buying Corporations
- Regulations on Virgin Plastic: Gov only allows corps to buy 75% virgin plastic, hence higher demand for recycled plastic

Incentive Variables:

- Recycling Stimulus: In Thailand you get \$25 for joining PlastiCoin | No stimulus because we are at scale in your region | No stimulus because we have no money and you don't live in a high risk region (like a landfill near a major river that dumps to the ocean)

Educational Variables:

- Materials Accepted in your area: [PET, HDPE]
- Not Accepted: [Glass, Cardboard, Food Waste, Yard Waste, Styrofoam, Light bulbs, ceramics, motor oil, electronic] * *How do we log this, so we know the demand or find a special one-off buyer/recycler?*
- How to clean?

Algorithms

How do you we fairly give out recycling routes to the best people without excluding new collectors?

Scenario 1: First Come

First Collector Advantage

If you drop a pin and the first person in the area accepts the pickup then you will never get an efficient route with many bins. This will incentive casual users with low capacity and low availability. It will drive serious collectors away from the network. If the casual collector quits you risk there being no collectors on the network.

Scenario 2: Ranking

Best Collector Advantage

This model generates a route based on a user's reputation. The serious collectors will benefit. High availability and high-capacity collectors will benefit. Casual collector may never get a route. This will be bad because one-off areas might never get touched or a casual collector may never have the opportunity to graduate to a serious collector.

Scenario 3: Weighted Random Lottery

Fair Advantage (I think I like this one! 😊)

If you fairly disturbed routes between casual and serious collectors based on reputation weight, then all will benefit. Outlying areas can be collected by casual one-off collector and serious collectors will have large routes and a steady schedule. This is similar to the lottery for first round draft pick

https://en.wikipedia.org/wiki/NBA_draft_lottery

- <https://www.nba.com/nba-draft-lottery-explainer>

- <https://math.stackexchange.com/questions/2782566/in-a-lottery-game-with-differing-weighted-probabilities-among-players-how-to-ca>
- <https://stats.stackexchange.com/questions/210073/weighted-lottery>

*Note, we should have a Statistician come with the details on how this would work...right now it's just a high-level concept

Lottery Process

In one particular model, a Lottery can run every night for each region and determines the schedule for tomorrow. It takes into consideration the number of bins, who is available, and the collector's capacity.

Lottery Variables:

Runs per day: 1

Route Reserved Limit: 1 day

Lottery Math

User	Type	Capacity	Availability	Reputation	Region	Weight
Nick	Serious	1 truck	M 8 hrs	.99	10 mi radius	50%
Alex	Casual	1 Bike	M 4 hrs	.85	2 mi radius	30%
Jesse	Casual	1 wagon	M 2 hrs	.84	1 mi radius	20%

Nick = .0 to .5 (weight \geq .0 and weight $<$.5)

Alex = .5 to .8 (weight \geq .5 and weight $<$.8)

Jesse = .8 to 1 (weight \geq .8 and weight $<$ 1)

Rand(1) = .38

Nick Wins the route today!

This is just one simple example of how to model the system. There are many more real-world examples to take this to the next level with non-custodial marketplaces. But I will leave that topic for you to research on your own for now!

Next let's talk about how to govern the system.

Chapter 4 – Governance

4.1 Governance

We want the system to promote market forces and avoid cartels and monopolies. It would be tragic if one company ran the whole system. One case study is the New York city and the history of garbage racketeering <https://www.nytimes.com/1995/07/30/business/the-garbage-wars-cracking-the-cartel.html> New York city has a nasty history of the mafia running the trash collection. When one company or group controls a monopoly on a service for a region the consumer loses. They get less

efficiency and a higher price service. Small companies cannot thrive or even have to chance to start a company.

We want the network to remain open and competitive for anyone to join.

4.2 InterWork Alliance - Standards Organization

The InterWork Alliance is an independent, technology-neutral, cross-industry association determined to tear down these siloes by simplifying and standardizing how multi-party interchanges are accomplished amongst disparate technology platforms across use cases such as global sustainability, supply chains, healthcare and more. In short, they are a standard organization.

The InterWork Alliance is one of many missing links to solve the ocean plastic leakage problem...at least from the digital perspective. I recommend watching this webinar about the InterWork Alliance.

<https://www.youtube.com/watch?v=Oer4-6awtis&t=4s> . Its members include big partners like Microsoft, Accenture, and IBM. <https://interwork.org/>

Making Multi-Party Agreements Just Work

Multi-party digital interchanges require a trusted, agreed-to representation of value, and correlating contractual agreements. Unfortunately, technological disparity across platforms creates roadblocks that inhibit the level of interworking necessary for web-scale adoption. There needs to be a unified approach where all parties work together to build out an ecosystem that is global.

PlastiCoin could help define, at the global standards body level, what it means for a bundle of plastic (tokenized asset) to be Recyclable (behavior). Much the same way a financial token is defined as fungible or transferable. We already have a standard way to label a product as a recyclable material type, but now we have the opportunity to digitize this globally as a standard! When this global definition is agreed upon it will be easier for multiple organizations to work together for a common goal.

Working Groups

The InterWork Alliance, from a neutral third-party perspective, could help form business working groups of companies to implement the larger circular economy vision. The working body hierarchy could be *“sustainability/circular economy/recycling/plastic”* and Dow could contribute the standard definition of what it means for an asset to be Recyclable, as well as the PlastiCoin implementation. Another company in the working group could define *“sustainability/circular economy/recycling/paper”* standards. More industries could get involved as the standard grows.

Siloed - Single Company Approach

Many companies are working on different separate components that make up the total circular economy. One of those companies is “Circularise”. They help certify textiles as recycled per European Union law. Right now, the certification process is slow, paper based and largely defined by a textile exchange in Europe. The legacy standard is called GRS (Global Recycled Standard). See <https://textileexchange.org/wp-content/uploads/2017/06/Global-Recycled-Standard-v4.0.pdf> Circularize is trying to digitize it using a public blockchain and a proprietary peer to peer layer 2 network. Right now there is little adoption of this technology as it only solve on small problem. A similar project led by BASF is called reciChain. <https://www.basf.com/ca/en/who-we-are/sustainability/Sustainability->

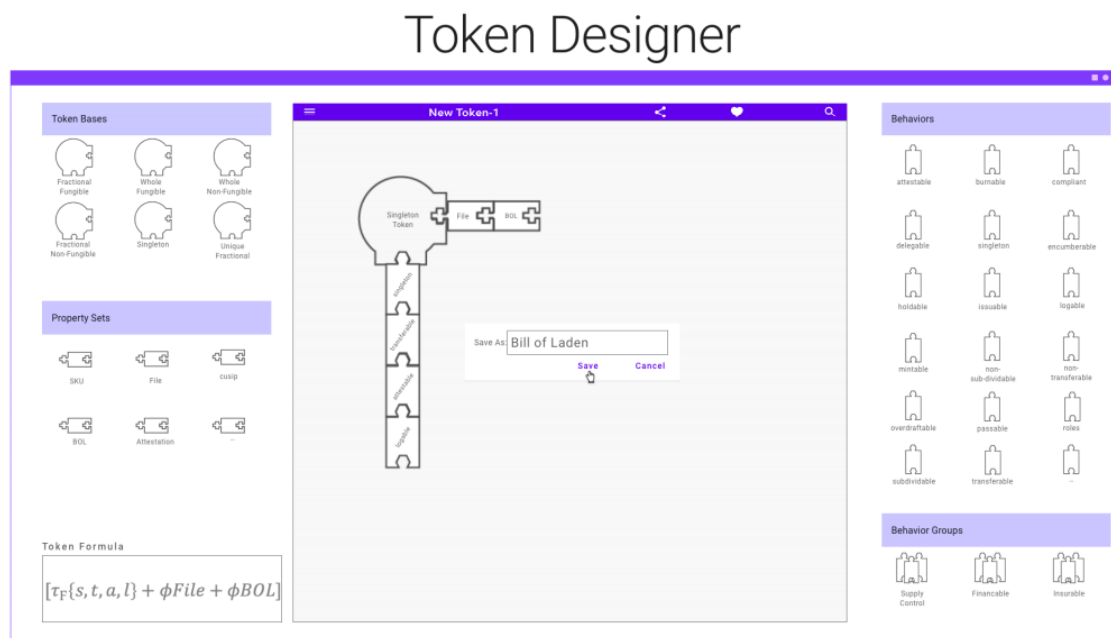
in-Canada/reciChain.html . Again it will receive little adoption because its being developer in a silo and only help solve one small piece of the puzzle.

Global - Multi Company Approach

This is a big problem and trying to accomplish it in a silo will not succeed globally. A Global standard should be abstracted from GRS/Circularise/ReciChain standards and certified by a standard body. If you dissect this idea...the token behavior could be called Recycled, in the past tense, meaning its certified. This differs from PlastiCoin's implementation in the present tense as Recyclable. This is all aligned with the Token Taxonomy Framework's initiative to create simple business definitions for these types of tokens and to make them pluggable. <https://medium.com/tokenhall/ttf-1-0-released-6bcc13b18fae> .

Token Taxonomy Standard



Imagine if the token designer below had the Recyclable and Recycled standard behaviors that any company in the world could implement. (by dissecting it from ReciChain, Circularise, and PlastiCoin)



Below is what the taxonomy of a Recyclable Token could look like:

Recyclable Material - Digital Token Taxonomy

- Token Base
 - Non-Fungible (Digital twin representing Physical Asset - tokenize weight of recycled mixed material)
- Standard Behaviors (plug these open standards into our token taxonomy)
 - Attestable/Certifiable (ex. contains 20% recycled material)
 - Transferable (consumer => collector => recycling center => exchange => re-user)
 - Origin Location (consumers bin location)
 - Counterparty (is in in-transit, or stored at a recycling sorting center...etc.)
 - Ownable
 - Sub-dividable/bundable (bundle of mixed material)

- Burnable (burn token when reused in a new product)
 - Traceable/Locatable (assetId => GPS coords)
 - Reputable (reputation system, could feed into attestable)
 - Roles
 - Custom Behaviors
 - Recyclable (We can help define this new standard)
 - Property Set
 - IsMixedMaterialBundle
 - Bundle ID
 - Material Types
 - Rigid
 - PET (Type 1 , ex. water bottle)
 - HDPE (Type 2 , ex. Detergent container)
 - Flexible/Mixed
 - Polyethylene Mixed Food Packaging (ex. Dow RetainStandUpPouch => Is there a standard typing system yet?)
 - Cleanable
 - MeetsMaterialCleaningStandard
 - Sortable
 - IsSorted
 - Weight
 - IsReused/IsRecycled
 - Recycling Company Code (person who reuses the material into a new product)
- Behavior Groups
 - Supply Control
 - Recyclable (Plastic vs Paper vs Electronics vs Mixed N Product ...business working groups create this for their respective domain)

4.3 Standards

After we have an industry standard designed by all, the companies can work together to achieve the Circular North Star! The theory of network effects states that data by itself is not very important, but when combined at scale it can become very valuable.



To achieve the circular north star companies can implement the “Recyclable Standard” to interoperate and create multi-party ecosystems [as depicted above].

It would be impossible for all the companies involved in the circular economy to coordinate, schedule meetings and integrate business processes and systems. That's why we must create the Global Recyclable Standard.

1. If we start at the bottom of the diagram, “the foundation”, we have the Global Standard supported by the standards bodies.
2. The next layer up we have the core implementations with apps such as, “PlastiCoin”. The apps can plug into the standard, for example, PlastiCoin implements the recyclable standard and material transfer.
3. Next Layer up each independent system can interoperate, so long as they implement the Recyclable Standard. For example, PlastiCoin can now interoperate with a collection agency in Africa, “Mr. Green” because they implement the “Collectable” standard.
4. Next, to the right the material can transfer to waste management because the material needs to be "Sorted" and "Cleaned".
5. Lastly the material could be certified as recyclable by Circularise to meet EU regulations and go into textiles because they implement the Certifiable standard.

Efficiency

Now that all parties involved share a common standard, doing multi-party business will be more efficient. The cost savings could fund new innovative business models. I predict that most companies in the next decade will have teams dedicated to “Multi-Party Engineering”.

Inter-working could stimulate “Network Effects” because data is not useful on its own but becomes valuable when aggregated in a network.

This standard could help create a real Circular Economy!

4.4 Open Governance Network Model

After the standard is agreed upon by the core parties the hard part is building an implementation with the newly formed consortium. How do competing companies work together for a common goal? The Linux Foundation has a brand-new effort called the “Open Governance Network Model”. They help consortiums turn from vaporware to production governed networks. The effort is based on a repeatable model that has been used in open-source projects and Linux for decades. See:

<https://www.linuxfoundation.org/blog/2020/10/introducing-the-open-governance-network-model/> and <https://bert.substack.com/p/the-linux-foundations-open-governance>

Brian Behlendorf, who is executive director of the Linux Foundation’s umbrella blockchain organization Hyperledger, opened with this:

“The Linux Foundation has long served as the home for many of the world’s most important open source software projects. We act as the vendor-neutral steward of the collaborative processes that developers engage in to create high quality and trustworthy code.”

In contrast to the InterWork Alliance, who specialize in the business standard, taxonomy, and vocabulary, the Linux Foundation focus is on the actual implementation and coordination of developers. Bootstrapping these networks can be difficult.

An example is IBM’s “Food Trust network”. IBM helped food retailers, farmers, suppliers and distributors join together to form a “Food Supply Chain” tracking network. They helped coordinate the effort with large players like Walmart. A lot was learned along the way and the learnings are being formed into an “Open Governance Network Model”, a repeatable model for any network. Their core activities will include:

- Hosting a technical steering committee to specify the software and standards used to build the network, to monitor the network’s health, and to coordinate upgrades, configurations, and critical bug fixes
- Hosting a policy and legal committee to specify a network operating agreement the organizations must agree to for connecting their nodes to the network

- Running a system for identity on the network, so participants to trust other participants who they say they are, monitor the network for health, and take corrective action if required.
- Building out a set of vendors who can be hired to deploy peers-as-a-service on behalf of members, in addition to allowing members' technical staff to run their own if preferred.
- Convene a Governing Board composed of sponsoring members who oversee the budget and priorities.
- Advocate for the network's adoption by the relevant industry, including engaging relevant regulators and secondary users who don't run their own peers.
- Potentially manage an open "app store" approach to offering vetted re-usable deployable smart contracts of add-on apps for network users.

Next let talk about the incentive models.

Chapter 5 – Incentive Models

5.1 Incentive Models



5.2 Incentives

The network is fueled by incentives for each party. An example of an incentive is: For every 10 pounds you recycle you get \$10 in Starbucks credits (This might work well in first world countries). Companies can participate and gain brand awareness by offering discounts on their products, much like marketing is done on apps like Ritual. Think of bin owners as users on a traditional Digital network like Facebook. A whole new market can be built with advertisers/rewards sponsors and consumers.

Another incentive could be payment: For every pound of plastic you recycle you get, let's say, a value of \$1.00 USD in PlastiCoin. PlastiCoin could be cashed out to fiat at an exchange (This might work good in third world countries). Or even better yet we could use Bitcoin as the global payment. There are many services like BitRefill that can accept bitcoin and you can cash out for local rewards, like cell phone minutes or coffee gift cards. It would be interesting to investigate the feasibility of creating a market and exchange for PlastiCoin.

This new concept brings on a lot of new questions:

- Could investors speculate and speculate futures on recycling?
- Could the market on PlastiCoin incentive purchasing behaviors of consumers?
- Could recycling be pegged to markets like commodities trading?
- If the value of PlastiCoin was low, then would people be incentivized to not purchase plastic items?

- If the value was high would consumers be incentivized to purchase more? Maybe purchasing more plastic would be a good thing, if for example, a third world country needed more plastic to build a road.

Incentive idea: Your global recycling footprint

Visibility to the impact of your recycling.

bragging rights. "I've saved the planet 1,500 pounds of CO2 out of the air, what have you done today?"

5.3 Wallet

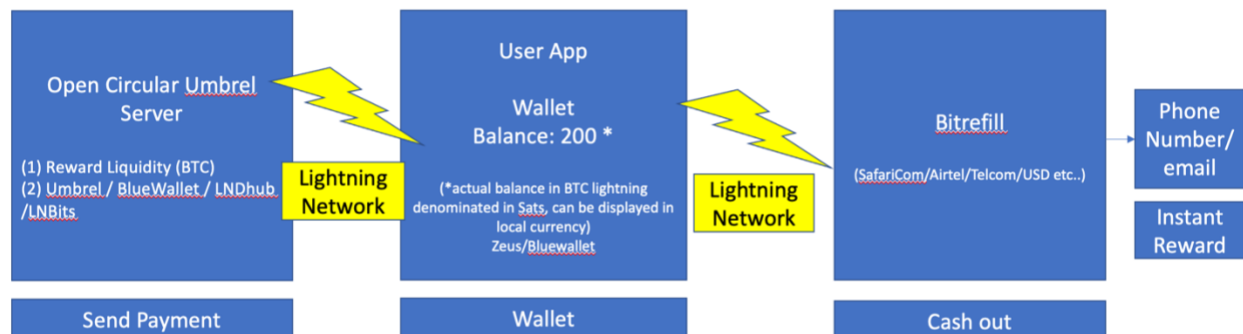
Each consumer, collector, and recycling center will have a wallet in the app. The balance of their rewards will be kept there. If Bitcoin is used, we can implement microtransaction payments and cash rewards out to a service called Bitrefill. Bitrefill support over 150 different countries and could really enable this system to scale everywhere without a ton of work dealing in different currencies (also it could empower the unbanked).

A note on the unbanked

30% of the world is unbanked...so using an open monetary system like Bitcoin could be a very effective solution. They are doing this right now in El Salvador to help the 70% of citizens who are unbanked.

The idea is still early in development but here is high level diagram of what a bitcoin wallet could look like:

The Wallet



<https://github.com/lmbits/lmbits>

<https://getumbrel.com/>

<https://github.com/BlueWallet/BlueWallet>

General Recinace

<https://github.com/ZeusLN/zeus>

Microtransactions

If a wallet is designed in this way it could lead to a new business model to fund the network and incentivize all parties involved with the flow of material (even the engineers building the network). The solution is to charge microtransaction fee (fractions of a penny)

- You can charge the micro-transaction fee every time the material exchanges hands... i.e consumer to collector, or collector to recycling center.
- To make this company profitable the product “PlastiCoin” needs to scale to millions (or billions) of users. If there are only 10 users on the network a fraction of a penny won't matter. If there are millions of users, fractions of a penny start to add up!

Math

If the network charged half a penny per transaction, to make 1 million dollars in profit, we would need to do 200 million transactions. Below is the math.

For example, a fee of \$0.005 (half a penny) cents per transaction can be applied.

- Profit = MicroTxFee x NumTransactions
- \$1,000,000 = \$0.005 x N

This model could be very lucrative. For comparison, Uber does, on average, 15 million ride transactions per day. You can predict this system could do more transactions per day if implemented globally. This leads to the rabbit hole of decentralized finance or DeFi and non-custodial marketplaces. That can be a topic we discuss another day!

5.5 Gamification

Octalysis Framework

The Octalysis framework is a repeatable pattern on how to build human centric design and gamification into an application. It is used by Google, Facebook, Uber and all the large tech companies. It is comprised of these core components:

- Epic Meaning and Calling
- Development and Accomplishment
- Empowerment of Creativity and Feedback
- Ownership and Possession
- Social Influence and Relatedness
- Scarcity and Impatience
- Unpredictability and Curiosity
- Loss and Avoidance

Read about the framework here: <https://yukaichou.com/gamification-examples/octalysis-complete-gamification-framework/>

This framework can be implemented in PlastiCoin in the following ways:

Core Drives

Meaning and Calling

- I'm saving the planet
- The earth will live .000000002 more seconds because of your recycling actions last week.

Social

- Unlock a video of a celebrity after 3 collection

Competition

- I'm recycling more than my neighbor
- How does your recycling stack up to your neighbor (like the energy bill chart)
- You vs Average Neighbor vs Best neighbor (Bar Graph)

Ownership and Possession

- Virtual currency

Group Quest

- Work towards common community goal
- If neighborhood all recycles then you get a free park bench

Positive Reinforcements

Positive reinforcements can work very well to change behavior. In Sweden, cameras were installed near speed limit signs, and those who drove under the speed limit were entered into a lottery system. Over time, the average speed in these areas decreased by almost 25%.

<https://www.wired.com/2010/12/swedish-speed-camera-pays-drivers-to-slow-down/>

5.6 Recycling System Models - One size does not fit all

There is not one global recycling or incentive model. It differs in urban and rural areas. It's different between regions. The system should be configurable to allow any number of recycling models.

Here are some examples of Recycling System Models and different variables you could plug in:

Third World Model Settings

Rural Sub Model

Collector Variables

- Capacity: 1 truck (on average)
 - Availability: 30 hrs a week (on average)
 - Region: 10 mile radius (on average)

Consumer Bin Variables

- Time Sensitive: no
- Location Sensitive: rural area

Smart Route Variables

- *Route Generation Schedule*: 1x week
- *Average Bins per hour (Analytics)*: 10 bins per hour (because they are far apart)
- *Local Variable/Computed/No Collect Zone*: Can't collect on the central neighborhood because its reserved for a local recycling company via a government deal

- *Local Variable/Notification/No Collect after 10 PM*: a local ordinance has a curfew collecting past 10 because a neighborhood does not want random people collecting for safety

Reputation Variables

- Collector Performance Benchmark (Analytics): on average 4 stars with 10 bins hour
- Reliability Average (Analytics): Collectors are 90% reliable on picking up on time

Recycling Center Variables

- The recycling center is in a poor region and needs money to build a sorting center

Incentive Variables

- Subsidized collection rates. You get 1 PlastiCoin per pound extra on top of the market value of plastic for your region. This would be good for high risk regions in third world countries near rivers

Urban Sub Model

How will the model above differ in urban areas compared to rural?

Kenya Model

The Mr. Green model charges 300 shillings per pickup. How will this change as competition for this region increases?

First World Country Model

College campus model

The modeling above is a very simplified version of what it could be. The more regions we deploy the solution to, the more fine grained the system can get. This leads to a more in-depth analysis of plastic economics...or...Plasti-Nomics! Now let's talk about markets and economics.

Chapter 6 – Markets and Economics

6.1 Markets and Economics

Plasti-Nomics: What is 1 PlastiCoin Worth?



One PlastiCoin is worth One unit of weight of the material. The local markets determine the exchange rate. It's very hard to track the different types of plastic in a bin, so we can take an average. Since we are simply tokenizing the asset of plastic, it can be pegged to the average value of a basket of typical plastics (LDPE, HDPE etc...). Stable coins in cryptocurrencies (USDT and USDC) are generally pegged to the value of a fiat currency, or in Facebook Libra's case, a basket of fiat currencies.

Bootstrapping the network with funds

To enable the network to remain open and free, the core base layer would need to be funded and built by companies who have something to lose (like plastic manufacturers and oil companies). These companies can help bootstrap the network and economy. Consumers and collectors could be funded by sponsors rewards and open market value of plastic. Recycling centers can be funded by selling recycled plastic on an exchange. In the long run, the network would need to have a business model to sustain itself, a model like Micro-Transaction-Fees (Tax). We discuss this model in more depth in the next paragraph.

Companies like Dow might need to bootstrap the network by building some of core network and collection apps. They will also need to get a consortium together (Open Circular) to run the initial nodes. Eventually the market forces and entrepreneurs would have sufficient incentives to keep the network going. The publicity alone would probably pay for the expense and turn Dow and other plastic manufacturers into positive household brands. The data on the ledger could be a future revenue stream for Dow by mining the public data on what recycled plastics are working the best and could become a feedstock for future products.

If the government starts regulating and requires a percentage of feedstock to come from recycled plastic vs virgin oil this could lead to new Dow products that were not feasible before. Why not get rid of heavy glass beer bottles (expensive to ship and recycle, bad carbon footprint) for an insulated plastic beer bottle (light and easy to ship)?

Micro-Transaction-Fees

To sustain the network, a self-funding business model needs to be created. One that is not based on credit, but on collateral! After the network reaches a certain scale, let say for example, 5,000 citizens, 500 collectors, and 50 recycling centers, the system can start collecting tiny micro-transaction-fees every time a consumer recycles a bundle of plastic. This would be invisible to the consumer, and they would still receive a free collection service. Micro-fees are fairly easy to do since we are using a digital token. For example, if a citizen recycles 1 pound of plastic, they could receive 0.9999 tokens and the system would receive 0.0001 token. The fee is fungible and comes from the value of the material that can be

exchanged for cash. The sum of the total transaction fees can be automatically aggregated into an escrow account or trust ran on the blockchain.

Outstanding Problems: Initial Liquidity - Who is going to pay the first consumer for his material?

To make the open system work we need to think about initial liquidity. Who is going to pay the first consumer for his material? Does it come out of the collector's pocket? Does it come from an escrow account owned by the consortium? Does it come from the local Recycling Center? Or does it come from some new emerging liquidity bootstrapping market?

There is no easy answer to this question and the solution involves considering many trade-offs.

Trade-offs:

1. If the collector fronts the bill and pays the consumer for the material up front, he may run out of capital if he has a large route because the money comes out of his own pocket until he pays the recycling center. This would lead to inefficient smaller routes. It might not in small countries where the collector has little money.
2. If the Recycling Center provides the initial liquidity, then it might lead to a monopoly in the region because everyone has to deliver to the only recycling center that has the money. It might cause competitors to never be able to compete in a region and the materials accepted to be limited by type.
3. If the consortium provides the initial liquidity it might lead to slow growth in emerging regions. Setting up a consortium and getting liquidity might take a long time. It will cause the solution to not scale very fast across the globe. It might also be stunted by outdated regulations and wire transfer fees.
4. If an Open liquidity market emerges it might solve all of the problems above. It will allow the collectors to be bootstrapped into the network while an individual liquidity giver can earn a yield. More on this below. This is a huge innovation happening right now!

A note on emerging liquidity markets built on an open monetary system

We are in the early days of liquidity markets for new open global non-custodial systems. A good case study is the Bitcoin Lightning network. They have an open liquidity market for channel leases <https://lightning.engineering/pool/>. The main problem is how do you allow 2 individuals to open payment channels with each other without forcing them to have thousands of dollars up front (not everybody is rich). The system is not based on credit, you need the actual collateral up front to open and lock into the channel. So how do two parties transact thousands of dollars on the channels when they do not know how much money to put up front. Maybe the user starts with a \$100 dollar channel, then they realize they need to pay somebody \$200. The unhappy path is to open a new channel with \$200, but this would require an on-chain transaction in Bitcoin (and maybe high fees like in 2021, up to \$30!).

The solution is an open marketplace for people who have money sitting around un-used on already open channels. Put your money to work! You simply charge a small fee (maybe a fraction of a penny) to allow somebody to "lease" your liquidity. This is an amazing innovation that can be adopted to many use-cases. It can revolutionize the finance industry and allow for high-yield accounts again (instead of the miniscule half a percent account banks offer today – worth basically nothing after inflation). There is no reason this liquidity market idea cannot be used for the problem of bootstrapping the Open Circular Network with capital to pay collectors and consumers! Mindful investors with money can put up collateral and earn a fixed APY yield.

Now let's talk about the current market price of recycled plastics. Are there even any existing exchanges?

6.2 The Plastics Exchange

At the time of writing this (10/28/2019) the exchange rate of 1 pound of LDPE is around 50 cents according to a US based exchange in Chicago <http://www.theplasticsexchange.com/default.aspx> . 23 water bottles equal 1 pound = 50 cents.

Here is the 10-year chart for LDPE. Notice the high of .87/pound in 2011. Today it is at a low at .48/pound



The average of this basket of different plastics is $(42 + 41 + 42 + 49 + 42 + 52 + 54 + 49 + 49) / 9 = 47$ cents

LDPE Inj - 20 melt
HDPE Film - HMW
HDPE Blow - HIC
HDPE Inj - Pail
LDPE Film - Clarity
LLDPE Film - Butene
HoPP Inj - 20 melt
CoPP Inj - 20 melt
LDPE Inj - 20 melt
LLDPE Inj - 20 melt

Correlation to Crude Oil

There is a similar trend line in price for crude oil vs recycled plastic over 10 years (chart above)



You can see that recycled plastic certainly has a lot of value and has some interesting correlations with crude oil. This would be an interesting topic of research for the project when the market is in the price discovery phase.

6.3 New Markets will be created

There are already new innovative companies that re-use plastics in creative ways. Below we are going to explore some interesting companies and ideas that will create demand for a formal recycled materials market.

RE-Spun – Reuses old t-shirts





Hurley – Converts recycled bottles to Boardshorts

Converting used plastic bottles to clothing could be a big trend for clothing companies.

6.4 Smart Cities

What is a smart city?

A smart city is an urban area that incorporates information and communication technologies into its systems. Sensors gather data to inform authorities and residents, reducing waste and making resource consumption more efficient. <https://www.iota.org/solutions/smart-city>. Early adopters of this system could be smart cities.

Lastly let's talk the value proposition and why a system like PlastiCoin and the Open Circular Network needs to be built and how it benefits companies that are involved!

Chapter 7 – Value Propositions

7.1 Value Propositions

For material science companies like Dow

If the entire world's recyclable material were indexed with type, weight, purity, and location then companies, like Dow, could use the information to enter new markets such as chemcycling. The risk and capital costs would be lower to build these facilities near mouth of flowing materials. Being able to model and predict with this data would be game changing for companies wanting to build a new business model. It also secures current and legacy business models in the Plastics industry and could be the solution to grant them a “license to operate”.

For companies, like Dow, there is potential to track their internal products/plastics to demonstrate how much is actually being recycled in certain geographies. There is also new data that will be coming that shows how much of a certain plastic stream exists in different geographies. This could be used to make decisions on larger scale plants/processes for recycling whether mechanical or chemical – this type of data is valuable and worth investing in. It also helps modify consumer behavior which enables higher value recycled streams.

Certain high-quality plastic streams are significantly increasing in value. Brand owners are making promises to incorporate recycled content but have difficulty in doing so without degrading performance. This could be taste/odor impact, or mechanical performance. Therefore, the well sorted, clean plastic streams are in high demand. Food grade in particular is very high – natural HDPE is >\$1.20/lb! The streams that come from this type of program could go into these higher value markets.

<https://resource-recycling.com/plastics/2021/03/17/post-consumer-plastic-bale-prices-jump/>

7.2 Side Effects

There are several positive side effects of the PlastiChain network. Uber was one of the first companies to stimulate contract work in this new gig economy. I have been in several Uber rides and talked with the driver and a lot of them said Uber has changed their life for the good. Flexible hours chosen by the contractor and an extra (if not, primary) source of income. Emerging geographies could really benefit from new jobs and the gig economy. Cities will also be cleaner because now the plastic laying on the side of the road has value.

Outro

Technology will be the enabling tool to build the Circular Economy. Systems like the Open Circular Network and PlastiCoin have the potential to solve the global waste problem while creating new markets and wealth for the people around the world who need it most.

In closing here is another quote from the book “The Circular Economy: A wealth of Flows” by Ken Webster:



Hyde Park tollgate

The IT revolution is enabling circularity and the rethinking of materials, energy and credit flows. It is also one key to rebuilding social capital, social networks. It has lowered barriers to access to the tools of self-reliance and community building and has opened up new possibilities for operating on a variety of scales and

Information technology is central to finding markets for niche and local products or materials, aggregating small suppliers to meet demand and controlling variables – in food growing, in manufacturing and distribution. It is enabling small-scale businesses with a global presence, small-scale renewables with better returns, accessing assets, enabling sharing and rebuilding community relationships. IT is also enabling exchange and new funding sources. Social capital is built through interaction and these tools create networks in novel ways.

Meanwhile, information technology enables us to increasingly track 'stuff' and its use. This might be raw materials but it might be infrastructure. It might be buses and trains and taxis or it might be the legacy of a hundred-odd years of stuff, the assets on the ground and under the ground, in our cities and towns and suburbs. IT also allows us to track each other, since there are more mobile phone accounts than toilets on the planet. Not only is stuff now connected to us – there is an app for that! – it is increasingly connected to other stuff, the internet of things: where fridges adjust their cycling to energy price information,

Decentralization

A linear economy has centralising characteristics – a circular economy has distributive ones – at least that is the aspiration. And with all this

Glossary

Consumer Bin – A bin that is owned by a consumer. It has a QR code with his wallet/identity on it. The bin is scanned when items are recycled.

Business Bin – A recycling bin that is owned by a commercial business. They offer local incentives at their business. For example, a bar tender (Moderator) sells 10 drinks to a consumer. When the tab is settled, they recycle 10 plastic straws and are offered a local reward chose by the business, such as a 5% discount.

Plastic Transporter – An Uber-Like entity that transports the plastic items to a recycling center. They are incentivized by reward such as gas and coffee discounts. (Moderator)

Recycling Center – A recycling center that repurposes a plastic raw material into a second life use. They are incentivized by free raw materials. (Moderator)

Rewards Sponsor – A company like Starbucks that offers rewards.

Moderator – They prove certain conditions happed and write transactions to the Blockchain. They make sure items are valid when they are removed from the bin and deploy rewards to consumers. Plastic transport contractors and Business owners can be moderators.

PlastiChain – The consortium blockchain that acts as a distributed ledger to store ordered transactions on. It's a federated network that entities can be invited to join. Dow will run a node, PNG and Coke can run nodes and free market entities can run a node. There are many incentives to run a node. A plastic manufacturer is incentivized to run a node to keep selling more plastic and not go out of business. A free market entity will want to run a node to mine important data, such as what products are being recycled, where are they being recycled, is there a material I can repurpose and create a new product with?

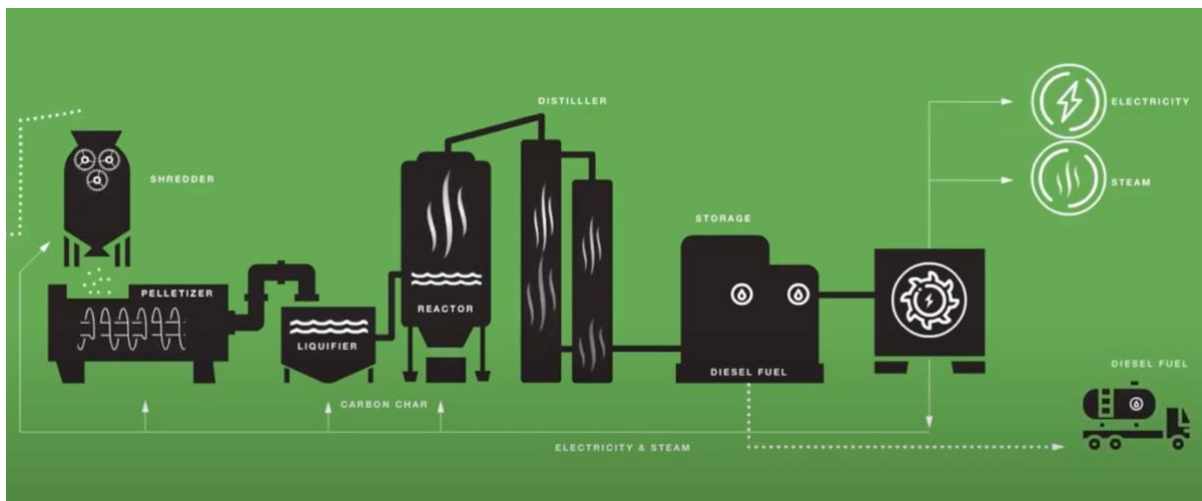
Brainstorming Names

- PlastiBin – A bin for Plastic
- ShoddyBin – Shoddy is an old term for textile recycling
- SustainaBin
- EnviroBin
- SalvageBin
- PolyBin
- PlastiCoin – tokens
- REcircle – mashup of Recycling and Circular
- Open Circular – maybe the name of the open-source community
- Bitcycle – mashup of Bitcoin and Recycle

Research

- **Greedy Mining**
- **Blockchain** - <https://github.com/Azure-Samples/blockchain/blob/master/blockchain-workbench/application-and-smart-contract-samples/basic-provenance/readme.md>

- **Provenance Smart Contract Code** - <https://github.com/Azure-Samples/blockchain/tree/master/blockchain-workbench/application-and-smart-contract-samples/basic-provenance>
- **Adding a consortium member** - <https://docs.microsoft.com/en-us/azure/blockchain/service/create-member>
- **QR code**
- **Public/Private key pairs**
- **Reputation System**
- Research about the **history of recycling**
- **Economics:** This article shows the model settings for a town in New York. It goes into detail talking about how many houses are in town, broken up into districts and capacity and capability with economic and market constraints
<https://commons.library.stonybrook.edu/cgi/viewcontent.cgi?article=1019&context=techsoc-articles>
- **Chemical Leasing** <https://chemicalleasing.org/what-chemical-leasing>
- **Pyrolysis** - Pyrolysis could be a game changer for turning mixed plastic to fuel. The more hybrid food packaging Dow makes, the harder it is for waste management to mechanically recycle it.



Sources

not finished

[1] <https://www.businesswire.com/news/home/20210605005045/en/Strike-Drives-Bitcoin-Forward-as-El-Salvador-Becomes-World%E2%80%99s-First-Country-to-Adopt-Bitcoin-as-Legal-Tender>

[x] https://www.michigan.gov/documents/deq/480235-14_NEMCOG_FINAL_RECYCLING_REPORT_521916_7.PDF

[y] <https://commons.library.stonybrook.edu/cgi/viewcontent.cgi?article=1019&context=techsoc-articles>

The code is inner sourced and is currently available for open Dow contributions on Github. The goal is to open source the entire project as an MIT license.

[Code] <https://github.com/dow/plasticoin>

[Backend] <https://github.com/Dow/plasticoin/tree/master/src/server/services>

[Front End] <https://github.com/Dow/plasticoin/tree/master/src/client/react-native>

[Smart Contracts]

<https://github.com/Dow/plasticoin/tree/master/src/blockchain/hyperledger/applications/chaincode/recyclable/node>