

MetroWay

Redesigning the NYC MetroCard

Pratt Institute Student Submission with



AUTODESK®
FUSION 360™

CRADLE TO CRADLE
PRODUCTS
INNOVATION
INSTITUTE



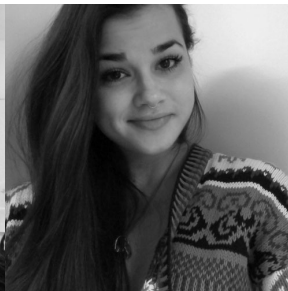
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MetroWay

2.1

The high-traffic commuter system of New York City inspired us to devise a thoughtful Cradle to Cradle product that emphasizes material choice, improves recovery of material stock, and instills regenerative solutions through a Circular Economic Model. Our proposal for the next generation of the MTA's MetroCard, tilted the MetroWay, introduces a new manifesto for better manufacturing practices, and stands as an example of how Cradle to Cradle ideals could impact 7 million people on a daily basis.

2.2

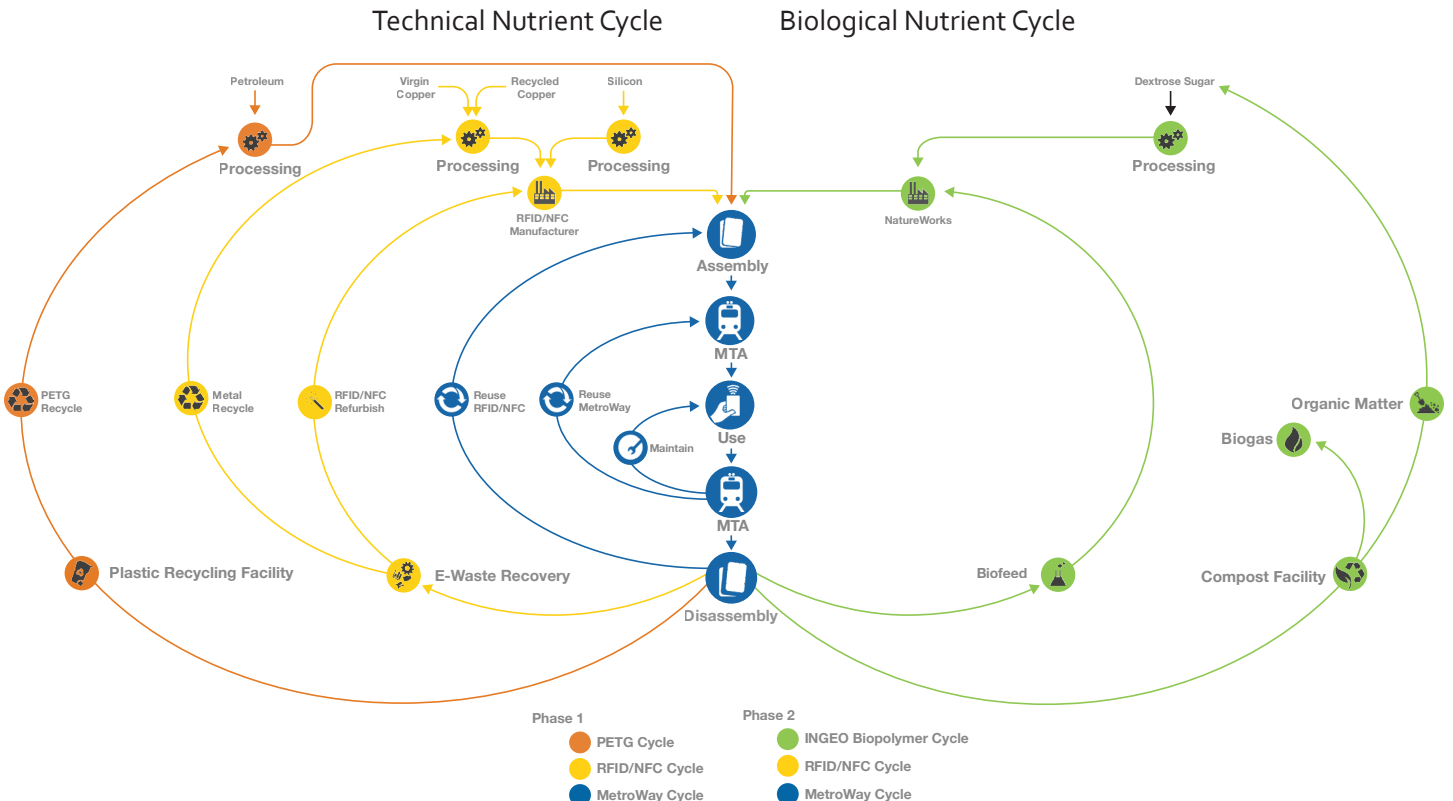


Use Case Scenario:

- The MetroWay is assembled. Embossed housing secures the RFID/NFC tag without glue.
- The MetroWay is supplied to MTA service desks.
- The user receives and activates the MetroWay at an in-station MTA service desk.
- The user creates a personalized login to refill their card on the smartphone app, internet, or in-station MTA ticketing machine.
- The MetroWay does not have to be removed from the user's wallet due to the contactless RFID/NFC technology — eliminating a large amount of wear and tear which extends the pass' life.
- A short time user returns the card to the in-station service desk at the end of their stay, and these cards become a part of the 'reuse' loop and are redistributed to new customers. If a long time user loses their card, they can get a new one from the in-station MTA service desk with a \$10 penalty fee.
- If a resident or long time user has a card malfunction, the card is tested to reveal the cause of the malfunction.
 - Software issue: the pass is reprogrammed and becomes part of the 'maintain' or 'reuse' loops and is redistributed to either the same user or a new one.
 - Hardware issue: the card is sent for disassembly. Strategic die cutting is used to separate materials into their respective nutrient cycles in the 'refurbish' or 'recycle' loops.

The MetroWay uses a contactless RFID/NFC tag that links to a personalized account where users add funds via internet, smartphone app, or the traditional MTA ticketing machine. By creating a refillable pass, not incapacitated by the expiration of a magnetic strip, we extended the longevity of an object previously thought of as disposable. Through creative design thinking, we developed a method of assembly and disassembly, where strategic embossing and die cutting allow for the separation of materials into their individual nutrient cycles. Other contactless RFID/NFC cards currently exist, but MetroWay introduces an innovative design that eliminates the permanent fusing of unlike material, rejecting a linear product model and monstrous hybrids.

2.3 Product System

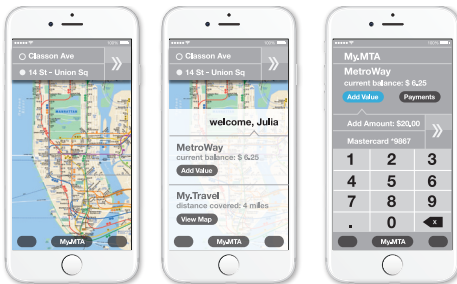
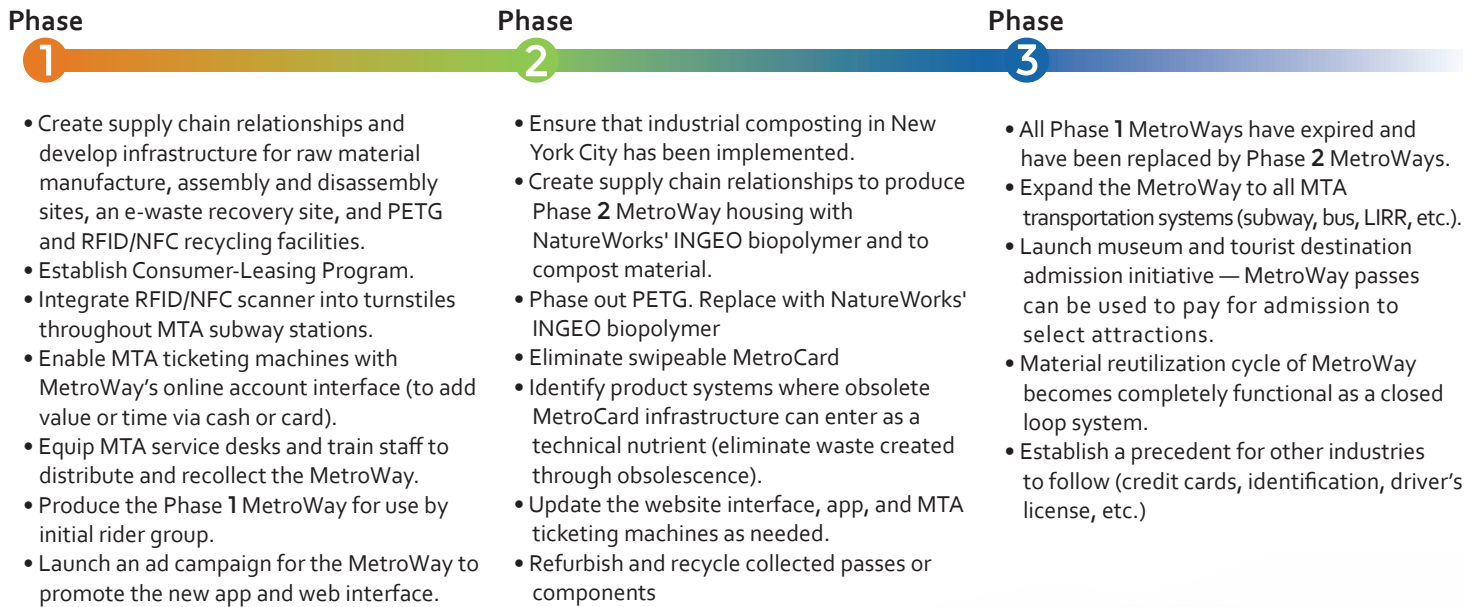


3.1 Business Model Timeline

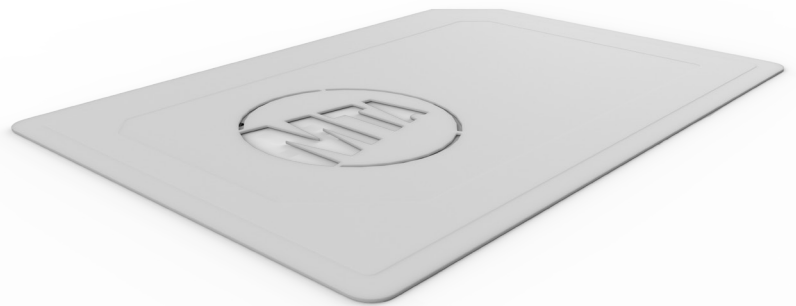
Overview:

The MetroWay is implemented in three key phases. We ultimately endorse NatureWork's INGENO bioplastic (a C2C Silver Certified material) to house the MetroWay's RFID/NFC tag, however the infrastructure for composting biopolymers does not currently exist in New York City. In Phase 1, we suggest PETG be used as the housing material. PETG is currently recycled at the Sim's Municipal Recycling Center in Sunset Park, Brooklyn. A large-scale NYC composting program is in its infancy and when the infrastructure required to break down biopolymers is fully developed, the MetroWay housing material can be easily changed. The MetroWay is specifically designed to evolve with emerging technologies in mind.






The MetroWay functions within a MTA Consumer-Leasing Program. In a circular economy, the leasing of products as performance is the most lucrative and resource efficient method of conducting business. The Consumer-Leasing Program optimizes use (where the MetroWay will cycle through multiple owners) and profits from a well-suited use of durable material. Customers pay an upfront cost to lease the MetroWay pass when setting up their account. As a financial incentive to return it, customers are refunded a portion of their initial investment. All returned MetroWay passes enter the Reutilization Cycle (3.2) so that the MTA can best control their resource stock and in the process, eliminate waste.



MTA's embark NYC app



3.2 Reutilization Cycle

-  If a user experiences a software malfunction, the MetroWay pass is examined at an MTA service desk where the card enters the 'maintain' loop.
-  If a short term user is finished using their MetroWay, the pass is returned to an MTA service desk where the software is reprogrammed to enter the 'reuse' loop.
-  If a malfunctioning card is returned and there is no software issue, the card is disassembled and the RFID/NFC hardware is repaired (if applicable). The repaired RFID/NFC tag enters the 'refurbish' loop.
-  When the card is disassembled, the housing material moves through its specific nutrient cycle. The phase 1 PETG components enter into the 'recycle' loop. The phase 2 INGENO biopolymer enters into a 'biofeedstock' loop and can be used to create new MetroWay passes or other biopolymer products. The unrepairable RFID/NFC components enter the 'recycle' loop after being sorted at an e-waste recovery site.
-  If the phase 2 INGENO biopolymer does not enter into the 'biofeedstock' loop it moves into a 'composting' loop, where it becomes organic matter to grow crops of raw material for new biopolymers.

4.1 Material Overview

Card Housing

Phase 1 (see 3.1)

PETG

low cost, versatile, durable, recyclable

Phase 2 (see 3.1)

INGEO Biopolymer

low cost, versatile, durable, low carbon footprint, compostable, recyclable

RFID/NFC: Antenna

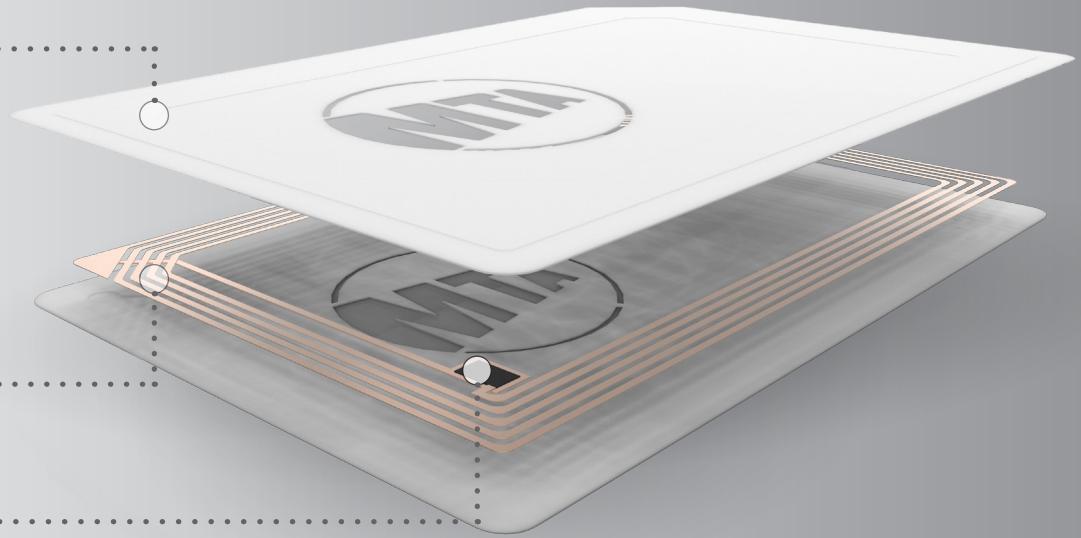
Copper

efficient conductor, low cost, recyclable

RFID/NFC: Chip

Silicon

efficient semiconductor, recyclable



Strategic Die Cut

Disassembly method

accurate, low cost, efficient



4.2 Material Reutilization

Phase

1

95.4

recycled

68.5

virgin

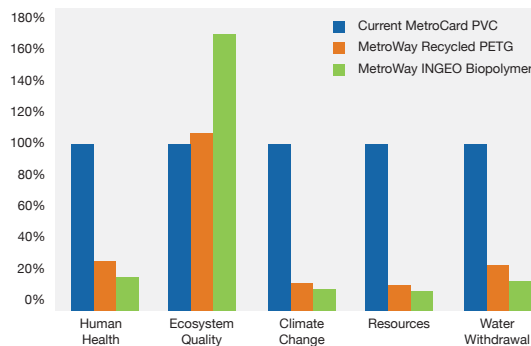
PETG

Phase

2

95.5

INGEO Biopolymer



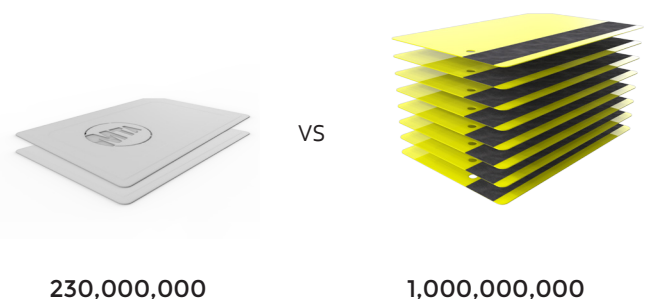
Quantis 2.0 Graph

We used Quantis 2.0, a life cycle assessment tool, to compare the impacts of our product that were dependent on varying material candidates. Using Quantis 2.0 assisted in evaluating the impacts of our design decisions. This allowed us to make informed choices on ideal materials and sustainable strategies. We extracted material data from Fusion 360 to help model MetroWay's components in Quantis to a degree of accuracy which would not have otherwise been possible. This method aided our understanding of how our specific material choices affect the life cycle of the MetroWay from four impact categories — Resource Usage, Ecosystem Quality, Human Health, and Climate Change. However, because Quantis 2.0 is a streamlined LCA tool, the data provided is approximated based on what information was accessible.

4.3 NFPA Health Scores



In ten years, the MTA would need to produce 1 billion MetroCards to sustain the current system. If they were to implement the MetroWay they would only need to produce 230 million.



5.1 Design with AUTODESK FUSION 360™

Learning to use Autodesk's Fusion 360 provided us the opportunity to breath life into our concept. As a team, we created a 3D model that we could collectively and visually understand, therefore promoting discussion and facilitating better collaboration between team members. For us, the advantage of Autodesk's Fusion 360 was that it is the only cloud-based 3D modeling tool. We were able to work together without the hassle of file transferring, formatting, or file corruption. Additionally, the access to an interactive online platform gave us a place to ask questions, join webinars, and learn from advanced users, facilitating a growing educational environment.

Using Fusion 360 gave us the ability to rapidly create different model variations and compare a variety of materials. Fusion 360 allowed us to extract specific material information about density and mass within

a given area and volume. We took this precise data out of Fusion 360 and input it into Quantis 2.0 in order to evaluate the ecological and human impacts of our decision making with great accuracy. This quantitative assessment assisted us in providing support for our concept. By using Fusion's parametric modeling, we were able to constrain our model in a predetermined parameter. We used the direct modeling feature to quickly ideate aesthetic variations, helping us visualize our product family. The versatility in simultaneously using both modeling approaches allows opportunities for designers to vary their approach based on their models. However, this can be a challenge for modellers - there can be confusion as to whether designers are using parametric or direct modelling. We believe Fusion 360 could be further improved

upon if designers were informed about each modelling technique, as well as the difference between them, in a tutorial or overview video.

Fusion 360 has prolific potential. No matter user preference, Fusion 360 functions well with both PC or Mac and is free for students, allowing anyone within the academic community to learn and use the software. Treating Fusion 360 as an educational tool to model, but also implement Cradle to Cradle principles, we used it to successfully realize our vision of a simple assembly and disassembly method. The ability to generate realistic geometry that supported our projected manufacturing processes, brought a level of tangibility to our material reutilization story - an imperative aspect of creating a system of circularity where there is no longer waste.



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