rotolo

Portable charging system for bikes

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The Project

The Scenario

In this theoretical situation, the power grid has been knocked out by a solar flare. There has been no central electricity for approxomately a year now. We need a product that will be useful for a general consumer given this circumstance.

The Challenge - Right to Repair

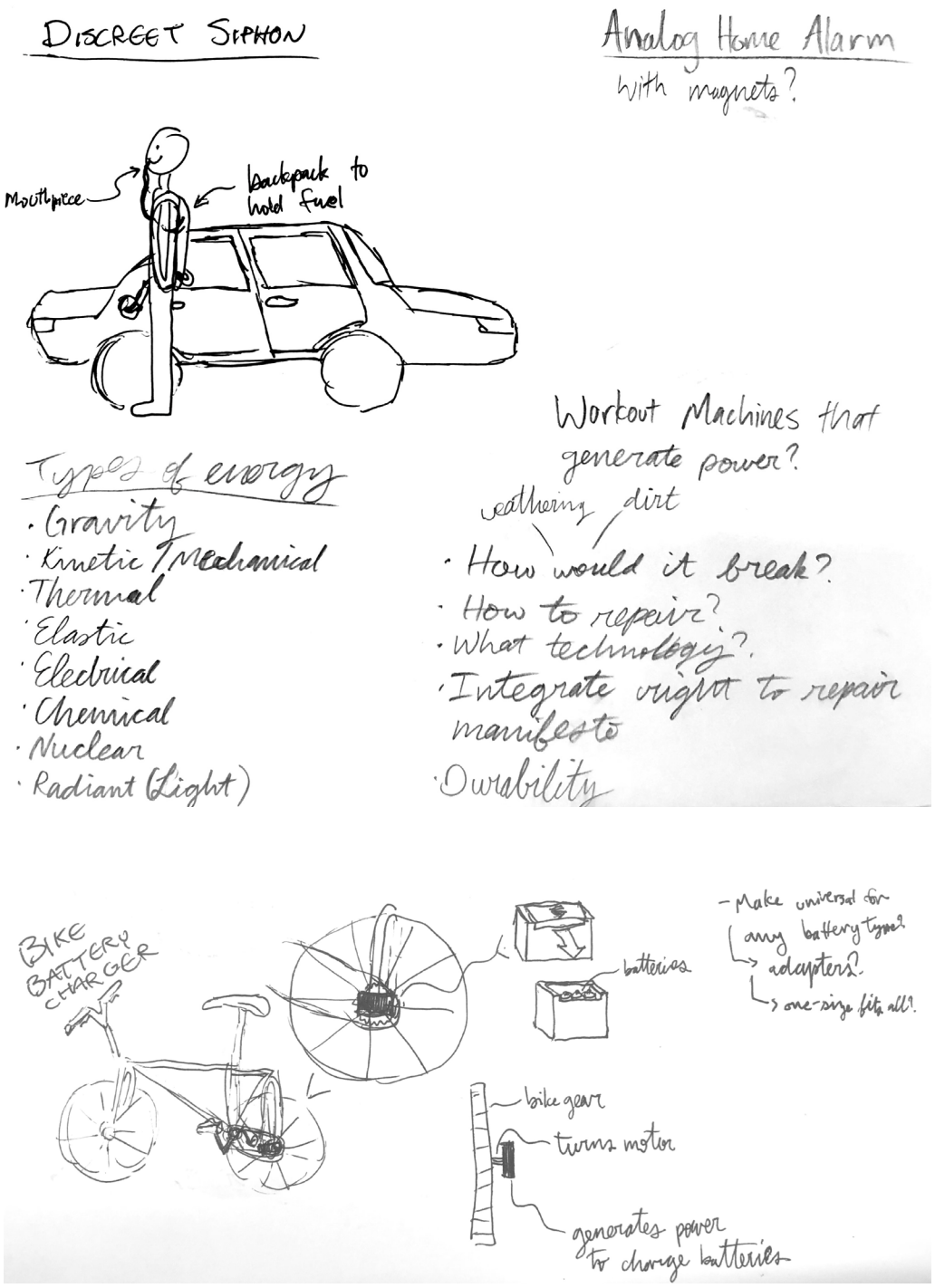
The product solution must be easily and accessibly repairable by the consumer. Consider possible failure points and consider ways to mitigate breakages and make replacement parts and mending solutions accessible.

The Solution

Rotovo

Rotovo is a portable charger that attaches to any bicycle. It is charged via electromagnetic discs that attach to the bike's wheels. These discs generate electricity when spun against each other. This current is carried through a dock that attaches to the bike frame and onward to the portable charger. The portable charger is popped out of the dock and taken on the go, or can be used while biking for applications such as charging a smartphone or powering USB devices like headlights.

Ideation


DISCREET SIPHON
Mouthpiece
backpack to hold fuel
Analog Home Alarm
with magnets?
Types of energy
· Gravity
· Kinetic / Mechanical
· Thermal
· Elastic
· Electrical
· Chemical
· Nuclear
· Radiant (Light)
Workout Machines that generate power?
gathering
dirt
· How would it break?
· How to repair?
· What technology?
· Integrate right to repair manifesto
· Durability
BIKE BATTERY CHARGER
batteries
- Make universal for
any battery type?
→ adapters?
→ one-size fits all?
bike gear
turns motor
generates power to charge batteries

Research

Electromagnetic power generation from bicycles has already been proven possible in a study at Pontificia Universidad Javerianain Bogota, Colombia. Below are diagrams from the associated article:

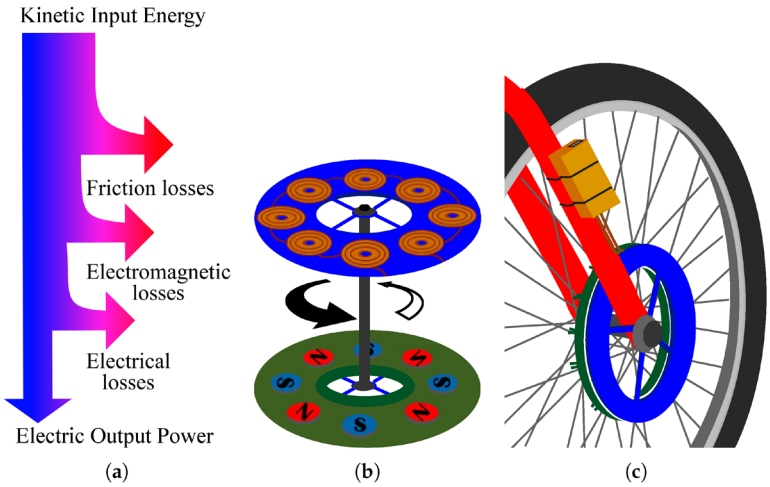


Diagram of electromagnetic transducer placement on bike, energy losses, and how the discs interact to generate power.

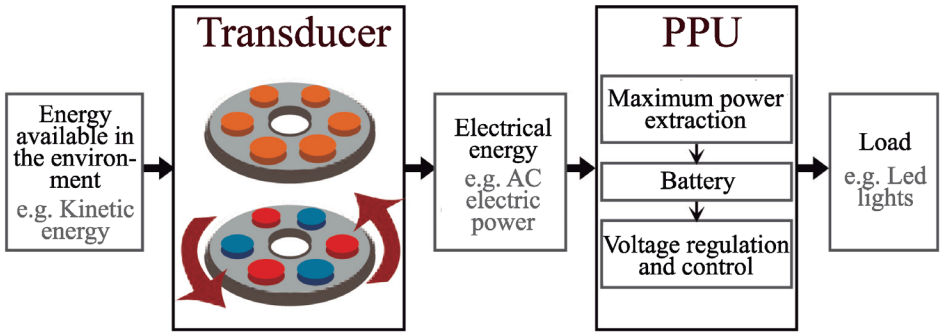
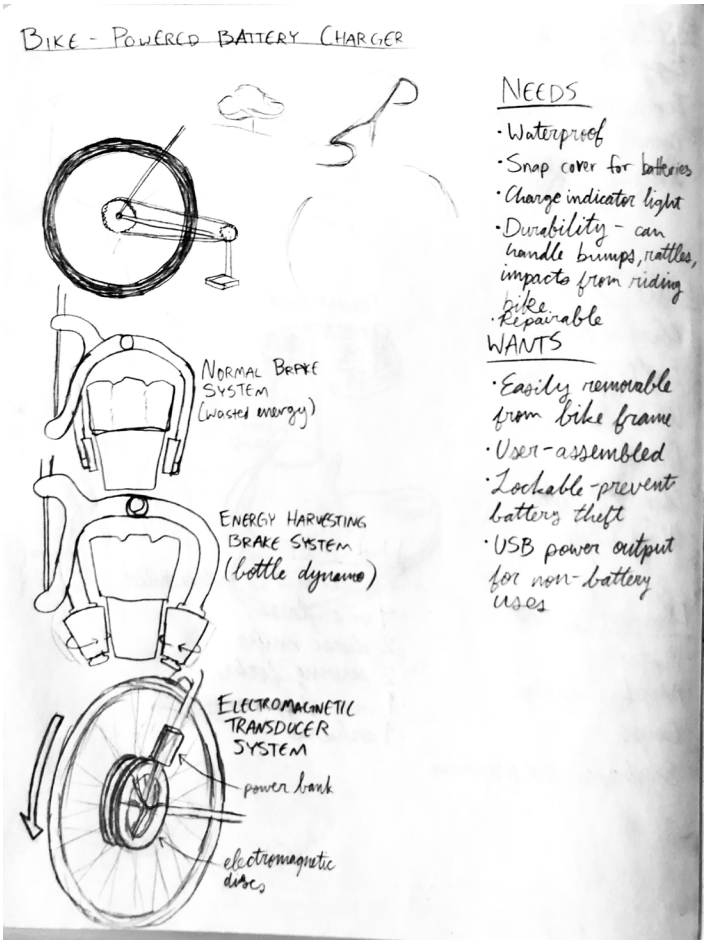


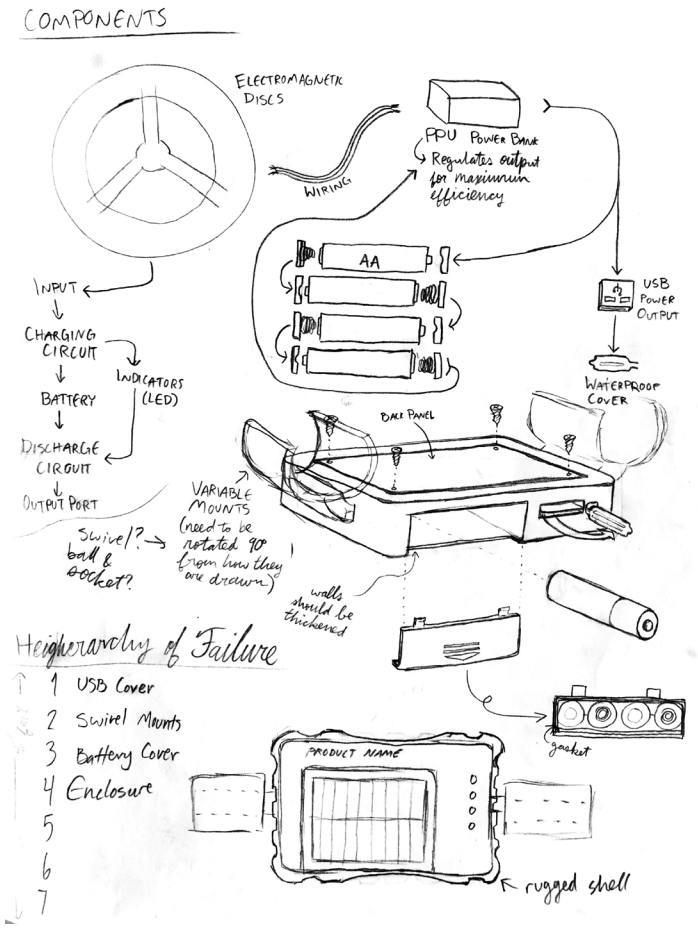
Diagram of electrical generation and harvesting.

Source: Urbina R. et al. A Bicycle-Embedded Electromagnetic Harvester for Providing Energy to Low-Power Electronic Devices. Electronics. 2023; 12(13):2787.

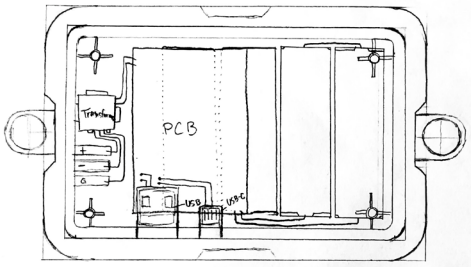
Iteration



Brainstorming how to harvest power and what aspects are wanted out of the product.



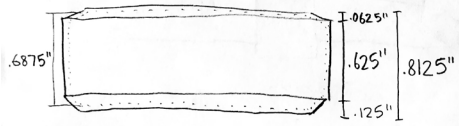
Figuring out how the product would actually work, considering hierarchy of failure, and planning construction.



Battery pack: 2.32" × 2.00"
Dock: 5 3/16" × 3" (including screwholes) share A60?
Body: 4" × 2.5"

Planning out the dimensions of the product and the internal construction, considering how the user would be able to repair or replace components.

Screw rod diameter: .09375"
Screw hole diameter: .0625"
Rib thickness: .03125"
Wall thickness: .0625"

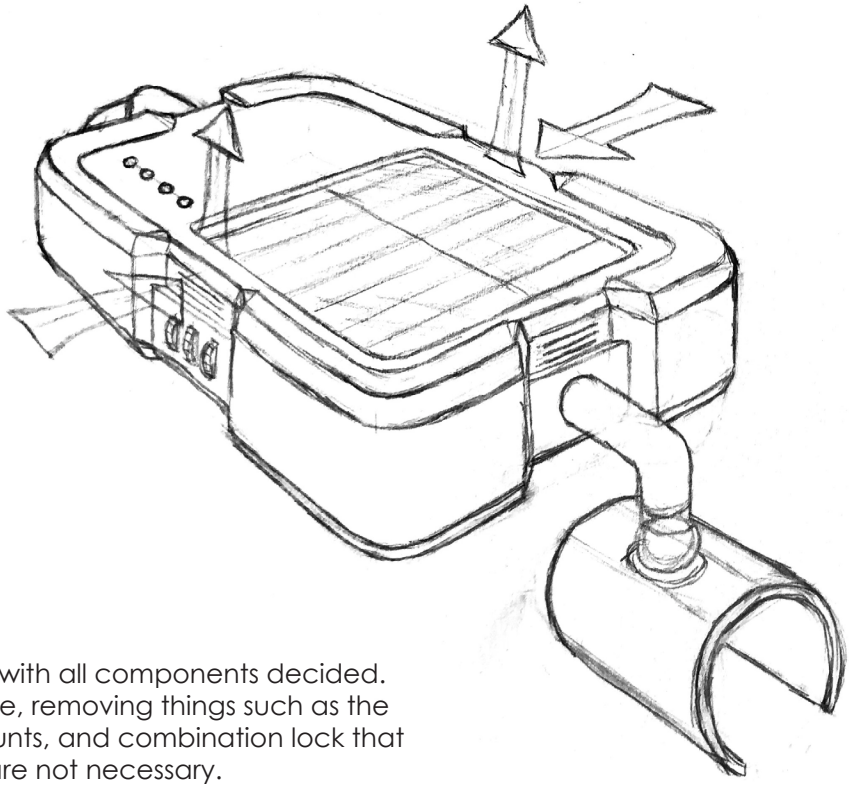


Center of screw from inside wall: .1875"

AMPLICYCLE
CYCL
MAGNAPAK
ROTOVO

SILVER,
YELLOW,
GREEN

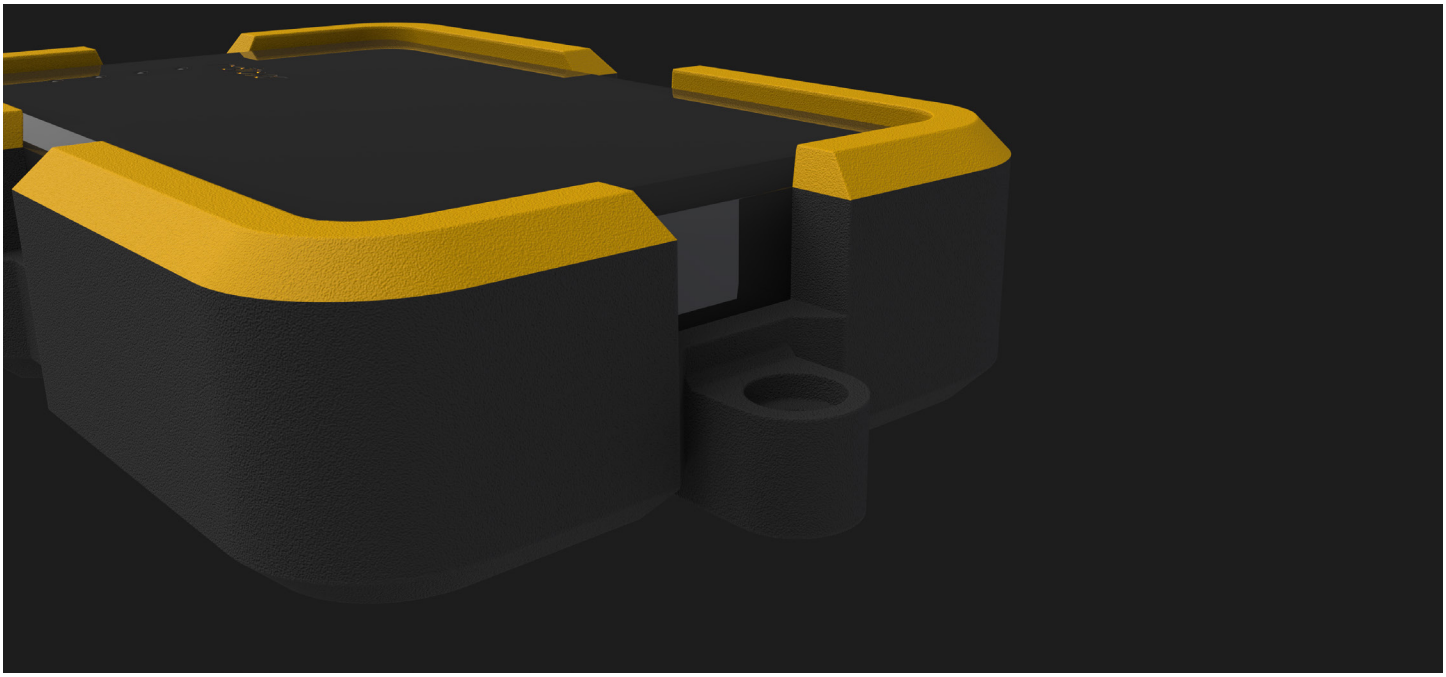
ROTOVO
READY TO VENTURE.



First sketch of product with all components decided. I pared down from here, removing things such as the solar panel, swivel mounts, and combination lock that could easily break or are not necessary.

Final Design


rotolight

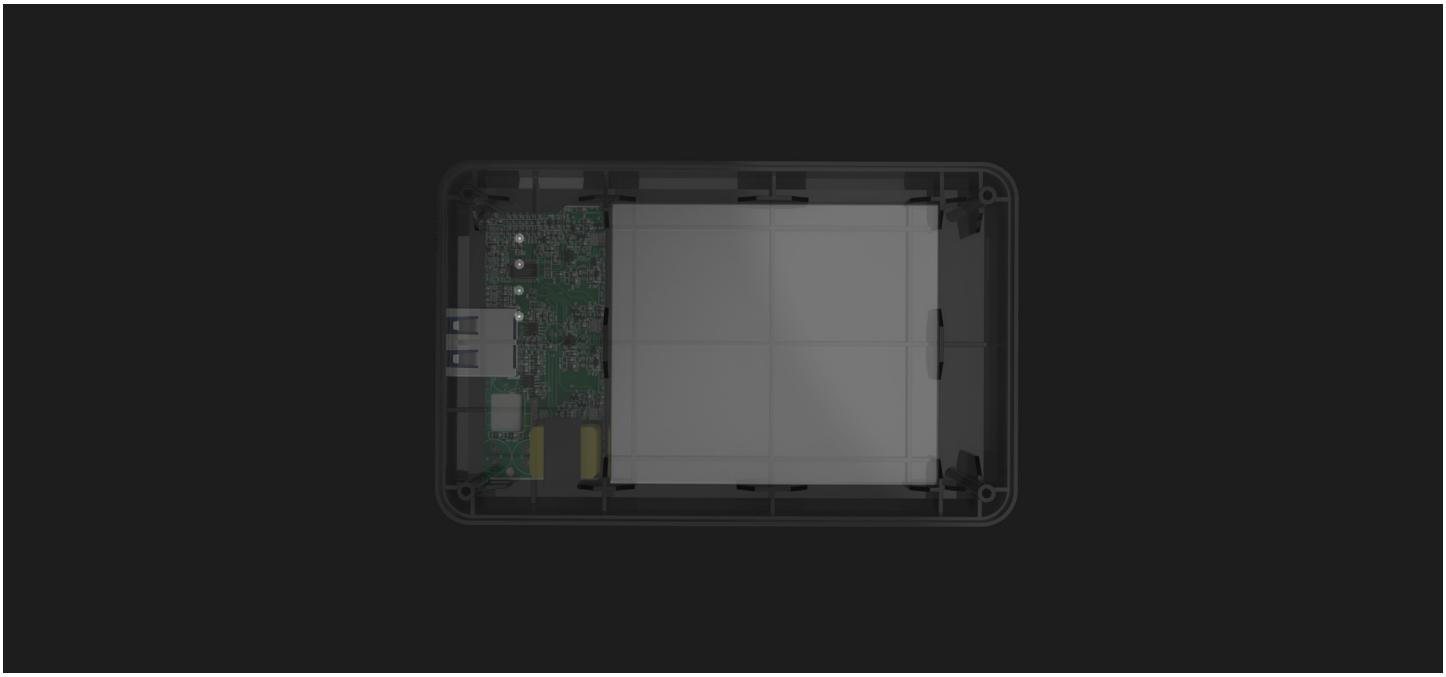



BOLT

Right to Repair

Design Notes:

1. Screw tubes slide into inserts on back panel for easy assembly and alignment.
2. Top panel has guides that perfectly fit components for easy replacement and reassembly.
3. PCB features inserts for large components to be replaced (USB port, transformer, LEDs, battery).
4. Rubber dock features recessed areas for ease of bending to remove the charger body while minimizing the chance of tearing.



Rotovo is designed for the average consumer in everyday use. In the case of a power grid failure, one would have the means to generate their own supplemental electricity on the go, which could prove incredibly useful. Harnessing enough power to charge a phone battery at normal speed, it would surely prove useful as a portable power bank for small devices. It only has 1 USB port, forcing the user to choose carefully where they spend their power at any given time.

In terms of repairability, Rotovo is easily unscrewed from the bottom panel of the power bank, and all parts are loaded into the top panel. The bank has very few components: a battery pack, PCB, LEDs, transformer, and USB port. Components that are already commercially available include the bike frame U-mounts, battery pack, LEDs, PCB, and transformer, making them easy to replace. In the case of failure of a structural component, replacement parts would be available, but the type of plastic (SABIC® HDPE M80064S) used in the powerbank is an incredibly durable and UV-resistant polyethylene. Being a thermoplastic, it is fully recyclable, and SABIC takes back used components and recycles them into the original polymers, which they claim are identical to virgin polymers. (See “SABIC’s Circular Solutions...”)

Costing

Material	Part	Upfront Costs	Piece Price	Numbe
90 Shore A Vulcanized Rubber	Case	7000	3.00	
HDPE Sabic M80064S (Polyethylene)	Top Shell	6113	0.37	
HDPE Sabic M80064S (Polyethylene)	Bottom Shell	4053	0.33	
Lithium Polymer, Copper, etc.	Battery	0	0.68	
Fiberglass, Aluminum, Copper, Lead	PCB	0	0.80	
Copper, Silicon Steel, Paper, etc.	Transformer	0	0.20	
Various metals, Silicone, Polycarbonate	LEDs	0	0.01	
Aluminum Alloy 6061-T6	Bicycle Tube U-	0	0.20	

Material Expenses	171366
Unit Material Cost	8.57
# Expected Sales	19000
Base Unit Cost	9.02
Material Cost + 20% Variable Costs	10.82
Wholesale Price (+35%)	14.61
Retail Price (+50%)	21.92
Profit	71973.72
Break Even Point	15833.33

er of Pieces	Total Pieces Cost	Shipping/unit	Total Pieces Shipping	Total w/ Tooling & Shipping
20000	60000	0.25	5000	72000
20000	7400	0.17	3400	16913
20000	6600	0.12	2400	13053
40000	27200	0.21	8400	35600
20000	16000	0.02	400	16400
20000	4000	0.05	1000	5000
80000	800	0.005	400	1200
40000	8000	0.08	3200	11200
			Material Expenses	171366
			Unit Material Cost	8.57

About the Designer

Dominic Drecchio is a designer who seeks something more - or maybe less - out of life. He longs for simplicity and pleasure in the age of haste. Though these ideas are contradictory, he believes he can achieve this world through the power of design.

With Rotovo, Dominic aimed to provide the user with something passive that could still prove useful in daily life. Without overcomplicating the user's life, there is an added benefit of passive generation of electricity along with a feeling of accomplishment. Yes, cyclist, you just charged your phone - with your legs!

References

SABIC. SABIC's Circular Solutions Helping to Address Key Sustainability Challenges. 2024; https://www.sabic.com/en/newsandmedia/stories/our-world/sabics-circular-solutions-helping-to-address-key-sustainability-challenges#:~:text=We%20are%20the%20first%20petrochemical,original%20polymer%20for%20commercial%20application.

Urbina R, Baron L, Carvajal J-P, Pérez M, Paez-Rueda C-I, Fajardo A, Yamhure G, Perilla G. A Bicycle-Embedded Electromagnetic Harvester for Providing Energy to Low-Power Electronic Devices. Electronics. 2023; 12(13):2787. https://doi.org/10.3390/electronics12132787