Mitigating Climate Change with Energy Storage: Regeneration of Energy by Excess Motion

Group 2^2

COLUMBIA | ENGINEERING
The Fu Foundation School of Engineering and Applied Science

Mitigating Climate Change with Energy Storage: Regeneration of Energy by Excess Motion

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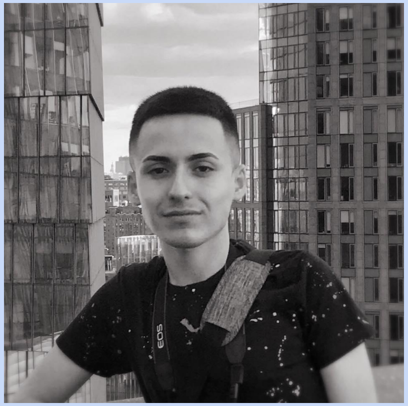

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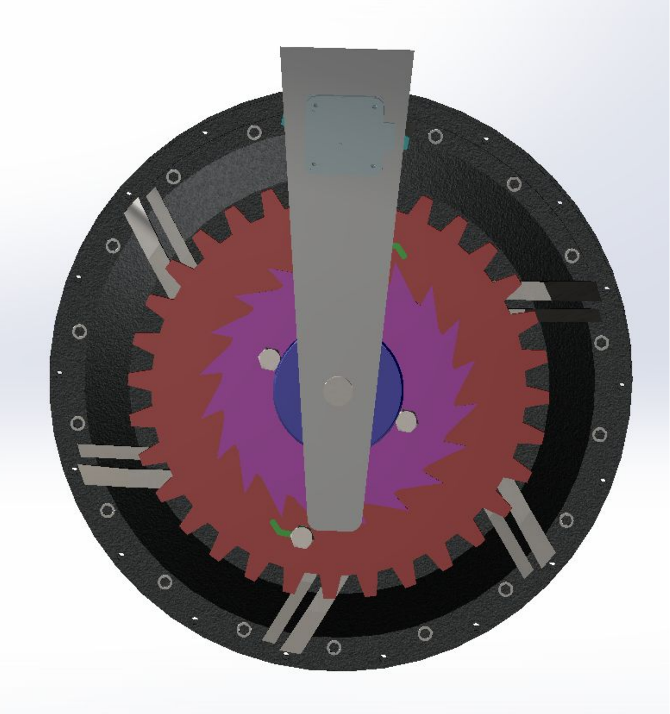
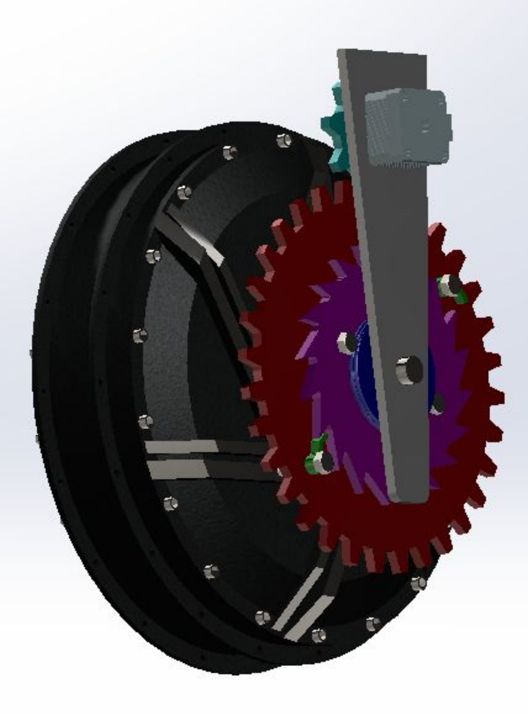
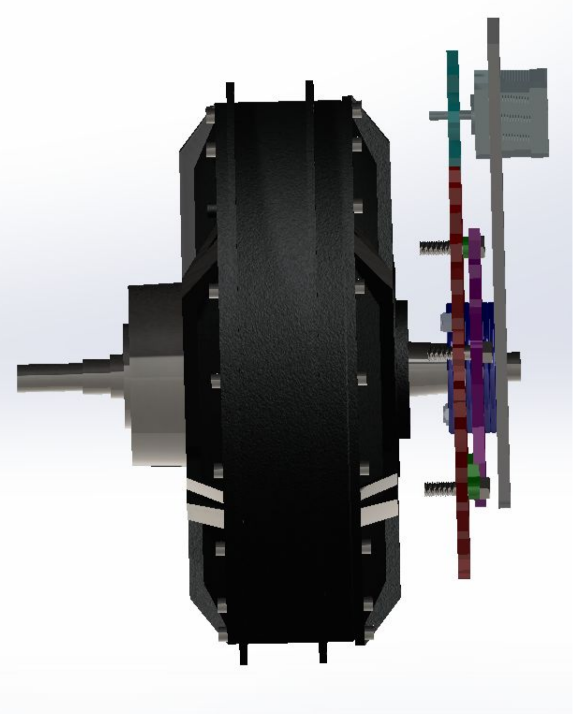
Minimum Viable Product

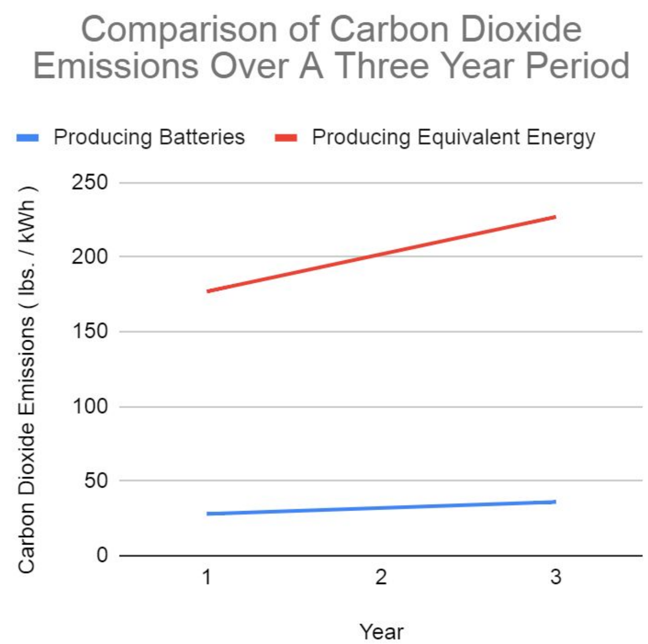
- Synthesis of two contemporary problems
  1. Friction-based braking converts kinetic energy of wheels into thermal energy - “wasted” energy, excess motion
  2. Lack of reliable household energy in many developing countries

How does this mitigate climate change?

- Environmental impacts
  - Reduces reliance on wall outlets / traditional electricity production (often produced with nonrenewable resources)
  - Maximizes productivity of the electricity initially used to charge the electric bikes' batteries

- 1.00 lbs of CO_2 per kWh to produce our batteries
- 1.34 lbs of CO_2 per kWh to produce the electrical energy

Year	Batteries In Use	Total kWh	CO_2 pounds to produce batteries	CO_2 pounds to produce equivalent energy	Reduction in CO_2 pounds pounds
1	28 million	132 million	28 million	177 million	149 million
2	32 million	151 million	32 million	202 million	168 million
3	36 million	169 million	36 million	227 million	191 million



Technical Description

- Important specs
  - **Size:** smaller than 9 inch radius (red gear) and 2.5 inch width
    (from direct drive motor to outermost shaft lock)
    - GR: 32:8 (red to light blue gear)
  - **Cost:** ~$75/assembly
  - **Material:** 12V DC motor (1.5"x1.5"x1.25") ($14), carbon steel 0.187" for gears (~$12), washers/bolts ($5), heavy duty springs ($10)
    - **Charging circuit:** voltage control circuit
      - resistors, diodes, and cables (USB to portable battery) (~$10)
  - **Portable Battery**
    - Li-ion Battery (0.15 kWh): ~$24 (~$156/kWh, 2019)
    - Based on commercial portable chargers: 0.6 - 0.7lb, 10 - 12 cubic inches
- Viable given current technology readiness level
  - Widespread manufacturing of various models / sizes of portable chargers
  - Widespread manufacturing and distribution of electric bicycles, particularly in Asian countries like China
  - Extensive research already done to streamline the mass production of Li-ion batteries
  - Various mechanical brake assists and regenerative braking systems have already been implemented in both automobiles and electric bikes

Business Model / Sustainability

- Target market: Asia-Pacific region, especially East Asia / China

- Target customers: People who use electric bikes to commute to work on a regular basis and who either have unreliable household electricity or would like a portable source of power

- Cost ($75)
  - Profitability viable due to expected demand which is helped by relatively affordable cost and marketable desirability

- Why will customers choose this over conventional methods?
  - Presents a convenient, affordable source of transportable back-up power which utilizes an everyday routine, i.e., transportation via. electric bicycle
  - Marketable as a sustainable investment, i.e., a means of obtaining "free power" from a routine these customers already have
  - Increased reliability of power in rural areas
  - Desirability of "modern," dual-purpose technologies