BICYCLE GENERATOR

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BACKGROUND

ENERGY POVERTY IN A STORM

Figure 1: Oregon road blocked by fallen tree during winter wind storm

- 16% of households in the US face energy poverty.
- Rural residents and low-income farmers face challenges accessing resources during power outages.
  - Fuel shortages at stations limit generator use
  - Travel hindered by blocked roads, dangerous weather conditions, and downed power lines.

IN OREGON:

- 2020– Oregon's average duration of power outage time was 5 hours, while the national average stood at 8 hours.
- 2021– severe ice storms caused power outages for up to 26 hours.
- 2024– ice storm caused some households to be without power for 10 days.

PEDAL POWER TO ENERGY GOAL

- **Design a human-powered generator capable of efficiently converting human energy into usable electricity to power lights or water pumps.**
- Target Audience: Low-income farmers, rural inhabitants and anyone interested in emergency preparedness.
- Expanding upon the three previous iterations of McGuire Mechanism LLC's bicycle generator project.

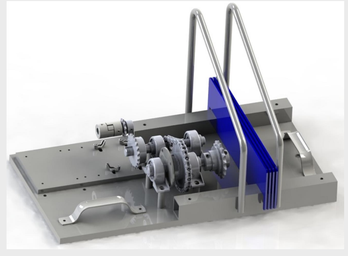
Oregon State University

Figure 2: Team members testing voltage output of first prototype

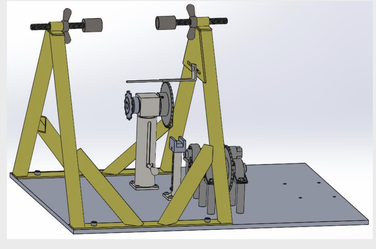
INSPIRATION FROM THE PAST

COMBINING ASPECTS FROM PREVIOUS DESIGNS

HPM01
- Friction drive generator
- Extruded aluminum frame
- Suited to power LED lights



HPM02
- Direct drive generator
- Plastic shims used to adjust wheel fit



HPM03
- Direct drive generator
- No need for drive component changeover

FRICTION VS DIRECT DRIVE

- Friction drive less efficient than direct drive for power generation.
- Direct drive allows for multiple attachments, eg. generator or water pump.

Figure 3: Completed final prototype w/ generator attachment

GETTING TO 2,000 RPM

GEAR RATIOS

- To achieve ¼ HP, the output shaft needs to spin at 1,800-2,000 rpm
- Average pedal speed for a rider is assumed to be ~75 rpm
- Initially tried a 10-1 ratio, but it fell short of reaching our target output shaft rpm
- Later opted for bike cassettes as rpm multipliers

Figure 4: Gear ratios vs rpm outputs at differing amounts of cassettes

- Two 3-1 cassettes met our target rpm

TESTING

SAFETY

- Prototype stability is crucial for user safety, minimizing the risk of falls
- Initially, the base was sized just for the uprights, bearings, and motor/pump
- After initial testing, it became evident that the base needed to be larger to prevent wobbling while the user was riding
- The team opted to widen the base to 20 inches, providing greater stability while still adhering to the 20 by 20-inch size limit

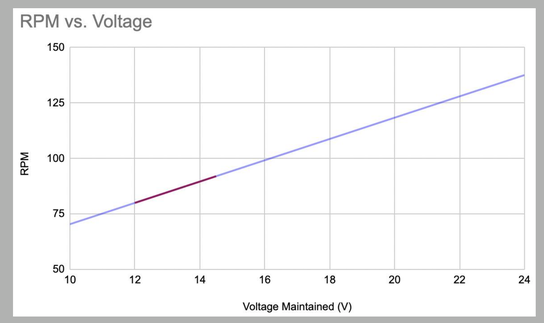


Figure 5: Voltage vs rpm trend based off of testing at 12V and 14.5V

VOLTAGE

- One group member would pedal at a comfortable pace while the voltage output was measured with a multimeter
- Initially, the output peaked at 12V, which was insufficient
- Observed how a low rpm resulted from the chain being attached to the wrong gears
- Once using the correct gears, the voltage output reached approximately 22V, as anticipated
- Employing 3-1 gear ratios allows for efficient energy production while maintaining ease of use

PROJECT SPONSOR

MCGUIRE MECHANISM LLC