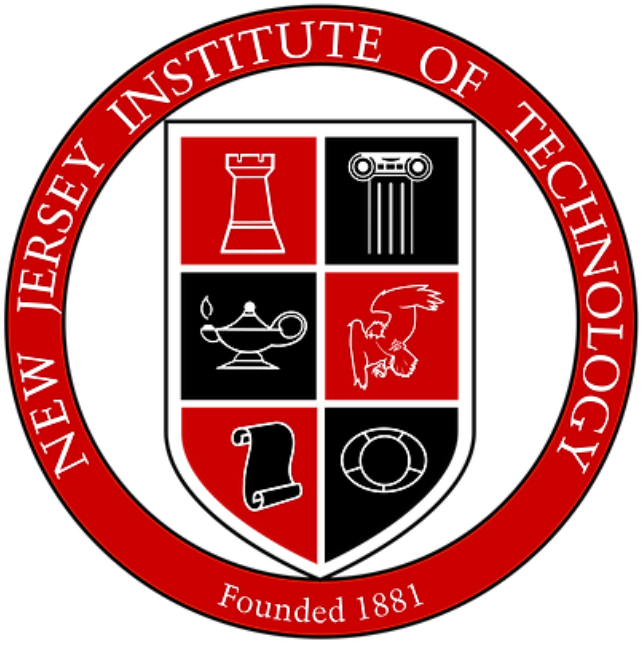


# Project Definition: Bike-Powered Generator

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# High-Level Description

**Name of the Project:** Pedal-to-Power: Modular Bicycle Energy Harvesting System

**Summary:** A prototype system that converts cycling energy into usable electricity, stores it in batteries, and powers USB devices. The design can scale modularly—multiple bikes linked together to form microgeneration hubs that supply excess power to the grid.

# Purpose

**For the user:** Provides renewable, on-demand energy while exercising, commuting, or during outages. If scaled large enough, users can sell excess power that was generated back to the grid.

**Why we're making this:** To demonstrate sustainable energy harvesting, promote fitness, and explore a scalable alternative to grid power generation.

**Top Usage Scenarios / User Stories:**

1. Cyclists can charge their devices via USB.
2. Gym chains connect multiple bikes to offset facility energy usage.
3. Community micro-hubs sell surplus energy back to the grid, incentivizing participation.
4. Backup power source during emergencies.

# Client

**Contact:**

- Victor Cortes - vmc26@njit.edu
- Christopher D'Aloia - cd468@njit.edu

**Roles:**

- Project manager: Victor Cortes
- Parts manager: Victor Cortes
- Design Team: Victor Cortes & Christopher D'Aloia
- Testing: Victor Cortes & Christopher D'Aloia
- Electrical Engineering Lead: Christopher D'Aloia

**Budget:** $100

# Communication

**Repository:** GitHub / Google Drive for schematics, code, BOM.

**Logbook:** Maintained digitally + hardcopy for changes, issues, milestones.

# Objectives

**High-level:** Build a modular, pedal-powered energy harvesting prototype that stores energy in a battery and charges USB devices, with future expandability to grid-level integration.

**Deliverables:**

- Proof-of-concept prototype (single bike).
- Brochure explaining the grid-integration vision.
- User demo model.

# Scenario

**User Interaction Stories**

**(INSERT)**

# User Interface

**Displays:** Small LCD or LED wattmeter showing generated power.

**Buttons/Switches:** On/off switch, reset button.

**Indicators:** Charging LED, error LED, grid-export status light.

# User Acceptance

**Criteria (Given-When-Then):**

- *Given* a user pedals steadily, *when* they generate ≥6W, *then* the USB port must charge a phone.
- *Given* multiple bikes are linked, *when* combined power > threshold, *then* surplus should be export-ready.

**Quantifiable Goals:**

- ≥5V stable USB output.
- ≥80% energy conversion efficiency.

# Parameters

**Technical**

**Dimensions:** Compact generator mount ( ≤ 24” x 30”).
**Weight:** Add-on module ≤15 lbs.
**EMC/EMI:** Must not interfere with nearby wireless devices.
**Protection:** Overcurrent and reverse polarity protection.

**Functions**

- Convert mechanical pedaling to DC electricity.
- Regulate and store energy in a rechargeable battery.
- Supply power to USB or grid (future).

**Integration**

**Interfaces:** USB, DC bus for bike-to-bike linking.

**Protocols:** Basic DC distribution, future smart-meter protocol.

### Operational

**Restrictions:** Prototype for light loads (USB).

**Duty Cycle:** Short-to-medium term (30–90 min pedaling sessions).

### Regulatory

- Laws/Policies:
    - Consumer safety standards.
    - Future compliance with grid interconnection standards (IEEE 1547).

## Life Cycle

**Manufacturing:** Simple 3D-printed mounts, off-the-shelf generator + controller.

**Programming:** Microcontroller for monitoring + grid sync (future).

**Tracking:** Energy logs stored locally or via app (future).

**Service:** Replaceable and interchangeable battery pack(s).

**Associated Services:** Community energy-sharing platform (future).

# Environment

**Temperature Range:** 40–95°F (indoor use)

**Hazards:** Sweat/moisture → waterproof casing needed.

**Ingress:** IP-44 (dust/splash resistant).

**Power:** Human-powered; optional wall-charging for hybrid use.

# Starting Point

**Existing IP:** Bicycle generator concepts, USB charging kits.

**Existing Prototypes:** Dynamo hubs, off-grid pedal power projects.

# Key Concerns

Efficiency of conversion and storage.

Stability of modular connections.

# Future

Expand prototype to **multi-bike gym installations**.

Develop **grid-tied inverter module** for power export.

Incentivize users with **credit for supplying power back to grid**.

Integrate with **IoT dashboards** for tracking and gamification.

# Glossary

**Microgeneration:** Small-scale production of electricity.

**Modular Design:** System can expand by adding units.

**Grid-tied:** Connected and synchronized with local utility grid.

**USB Output:** Standard 5V DC charging.

# Open Questions

How to safely synchronize multiple bikes for grid export?

What business model could sustain grid buy-back incentives?

What is the optimal battery type for modular scaling (Li-ion vs supercapacitors)?

How to ensure regulatory compliance for future commercialization?