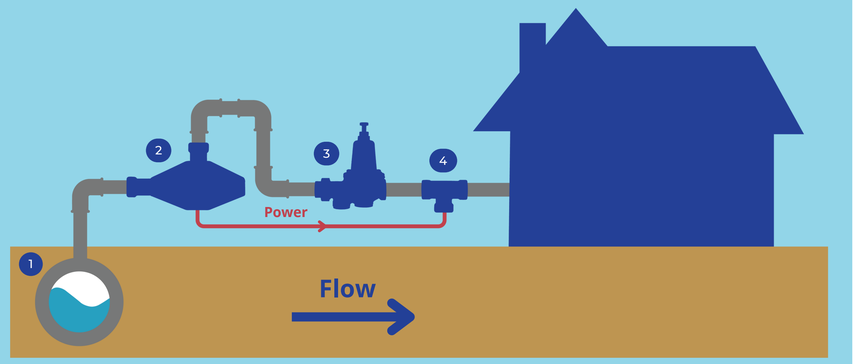
Energy Harvesting from Pipe Flow

Watts Water Energy Harvesting Team
SCOPE 2021-2022

Our project goal was to develop a device to generate electricity from water flow, in order to power in-pipe sensors. Our work will enable access to electricity for Watts' sensing devices, and will help streamline inexpensive, low maintenance, and sustainable data collection.

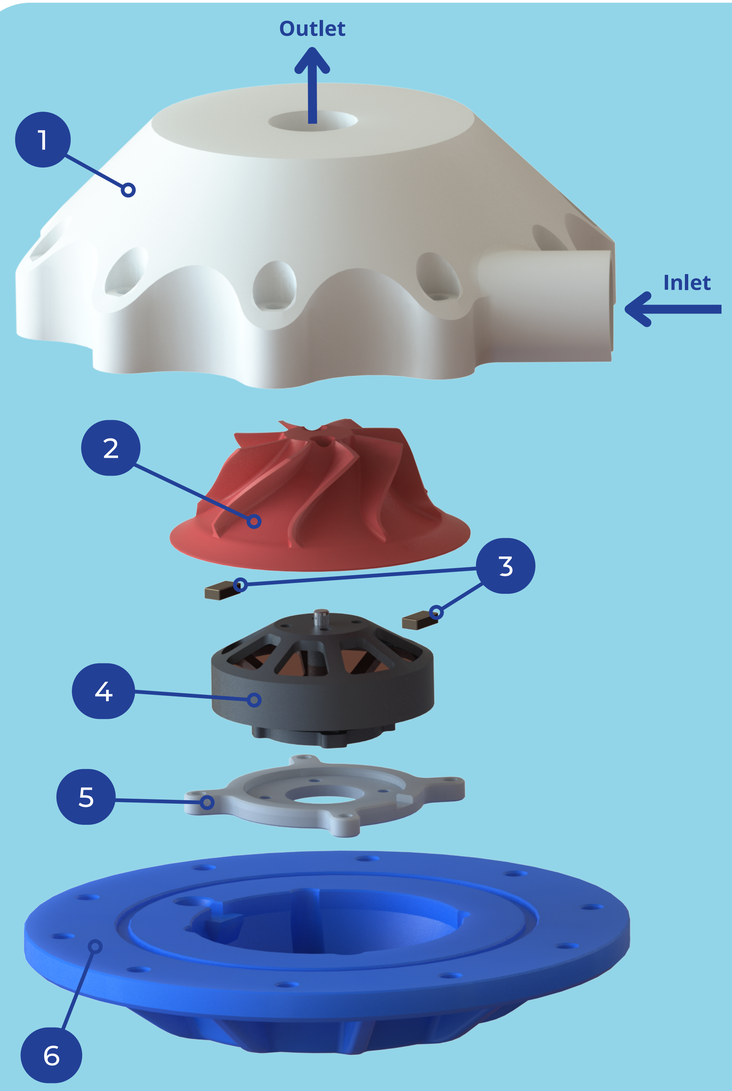
Water usage data will allow for effective resource allocation, leading to more efficient and reliable water systems and a better understanding of individual and community water use.

Batteries require maintenance, and routing an external source of electricity is not always cost effective or logistically feasible. In response to this, we have developed a solution to harvest energy from the water in the same pipes where these sensors are being used.



1. Water Main
2. Turbine
3. PRV
4. Sensor

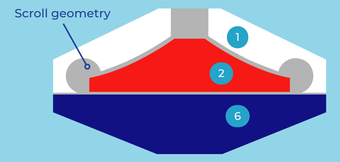
Our device is designed to be installed in front of existing pressure-reducing valves (PRVs), which are water pressure regulators located between the high-pressure water main and low-pressure plumbing in residential buildings. The excess energy from the pressure regulating process is dissipated as heat. By placing our device upstream from the PRV, energy can be harvested from the water with no extra restriction on the water main.



Our prototype is a **centrifugal scroll turbine** with a **built-in generator** that produces power from water flow.

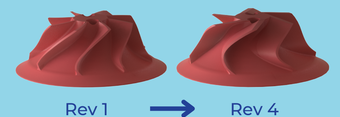
1 Scroll Housing

The scroll geometry reduces recirculation, which improves efficiency by distributing flow around the circumference of the turbine, creating constant inwards radial pressure through the constriction of the scroll.



2 Turbine

Through design iteration and testing, we found that more aggressive turbine blade angles resulted in an increased turbine efficiency and better performance.



3 Hall Effect Magnets

In order to capture RPM data, magnets are attached to the rotating turbine to interface with a stationary hall effect sensor.

4 Generator

An off-the-shelf multirotor motor is used as a generator. As our turbines spin the generator, the resulting three phase voltage is fed through a three phase full wave rectifier which converts the voltage to DC.

5 Generator Mount

The generator is mounted onto an additional plate in order to prevent leaking by avoiding bolt holes through the housing itself.

6 Backplate

The backplate provides a standardized interface to test multiple motors, turbine designs, and housing geometries. An O-ring groove is embedded in the backplate for reliable sealing.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