

Masthead Logo

Wayne State University

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Research Opportunities for Engineering
Undergraduates (ROEU) Program

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Urban Runoff and Energy Recovery

Dimitri Porter

Wayne State University, gi7411@wayne.edu

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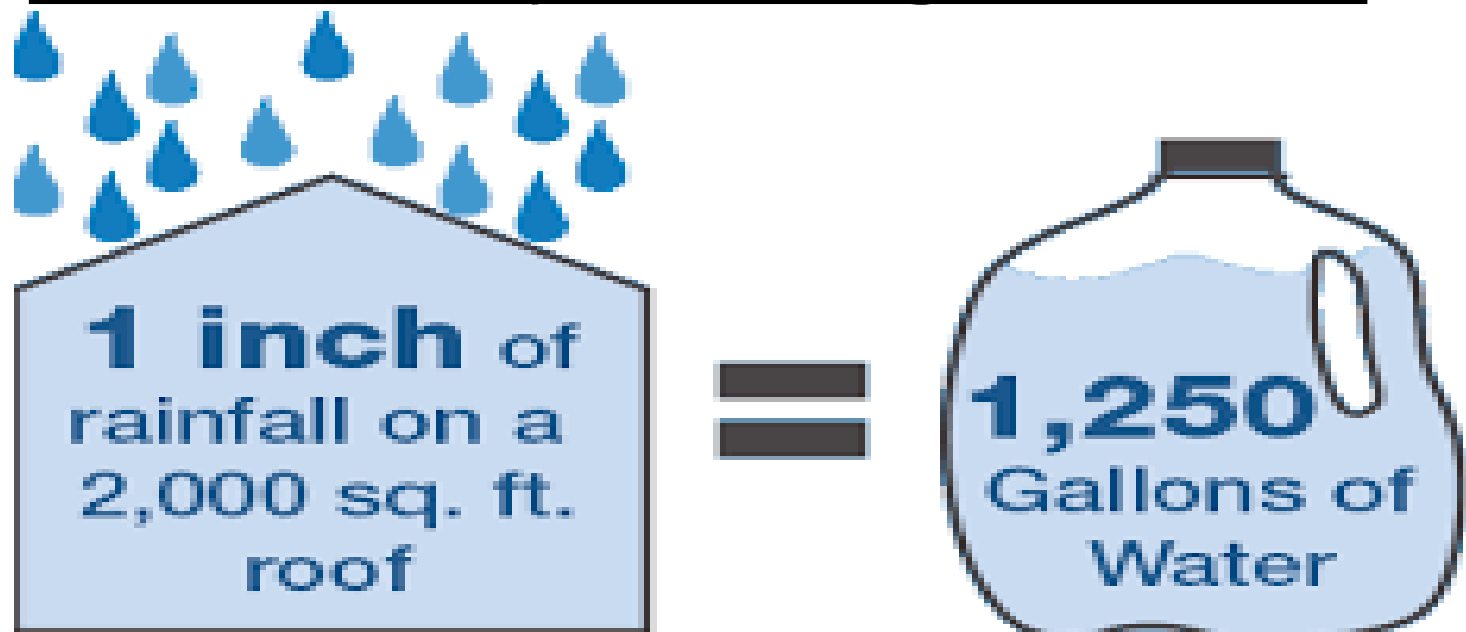


Dimitrios Kakaris Porter

Advisor: Timothy Dittrich

Civil and Environmental Engineering

Opportunity and Significance



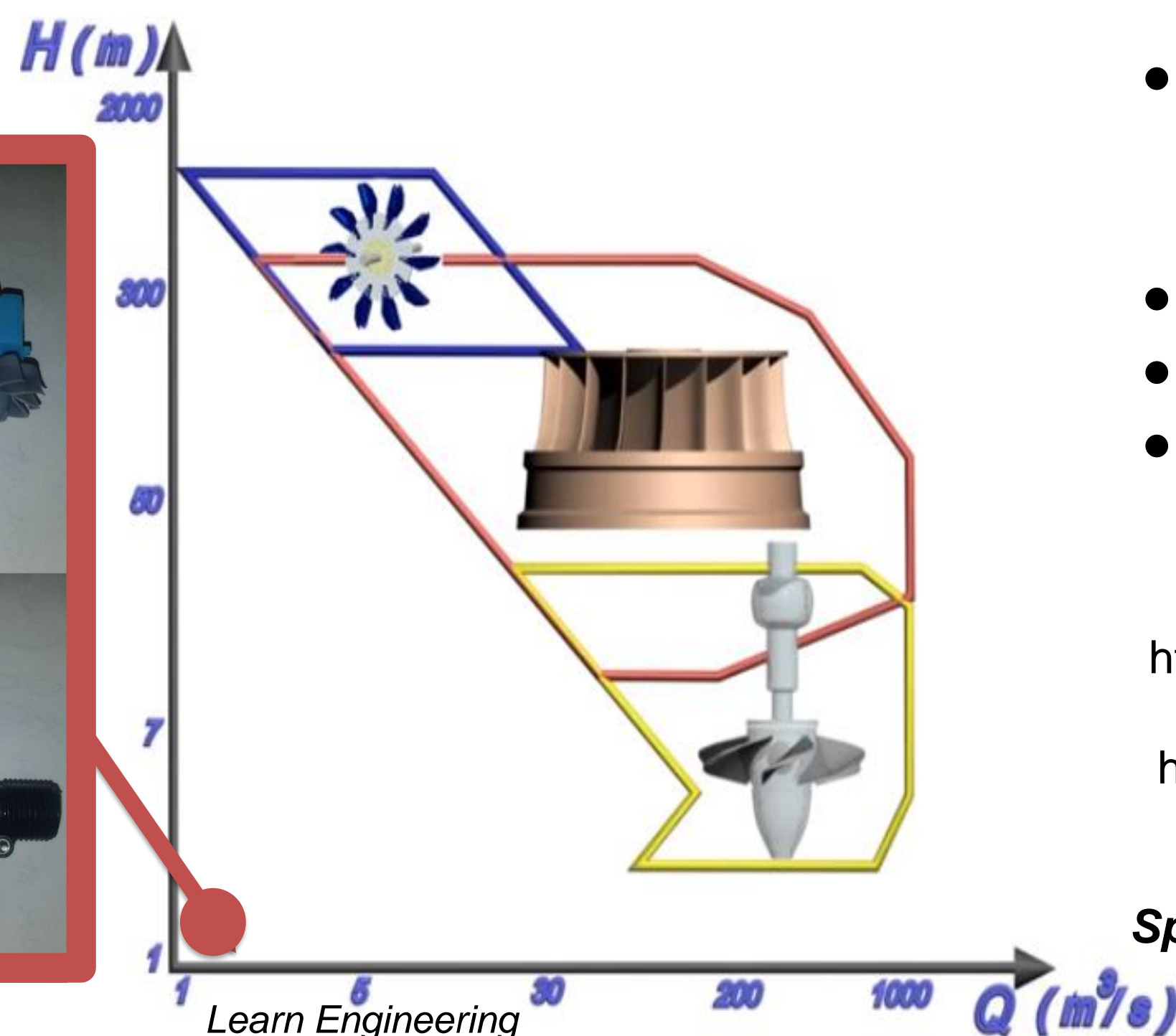
Aquascape, Inc.

- Average annual rainfall in Detroit is **30.97 inches**
- Total building area of Detroit is roughly **15.75 mi²**
- A water volume of **12,838 Olympic size swimming pools per year** falling from buildings.
- **Limitation:** Small amounts of electricity—Water storage
- **Opportunity:** Remote sensors can be powered through runoff—Improved residential rainwater systems

Technical Objectives

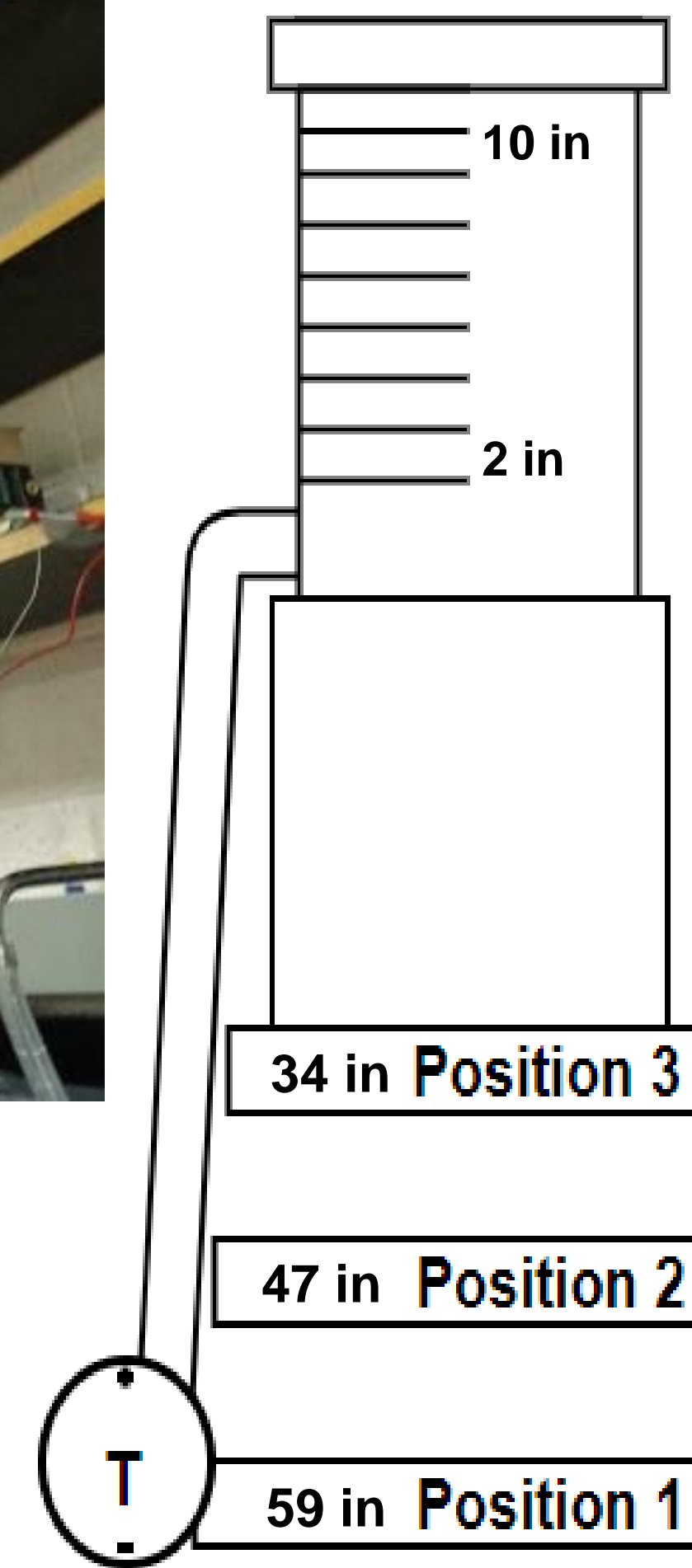
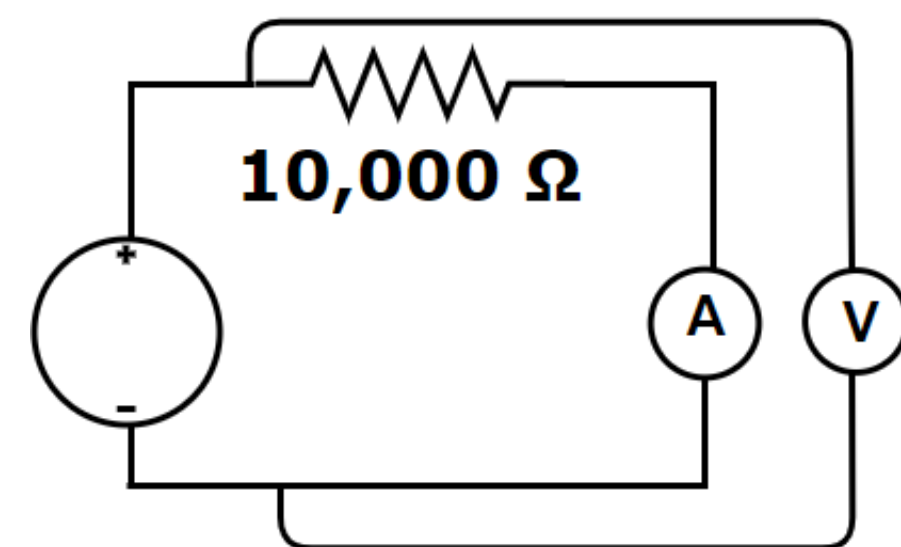
- Can microturbines operate with low flow (~0.024 gal/sec) and low head (1-6 ft)?
- How much power can microturbines generate under these conditions?

Related Work and State of Practice



Method

- Compare commercially available low cost microturbines (12 V).
- Replicate reservoir system with 5 gallon bucket.
- Wire turbine to load (10,000 Ω).
- Drain bucket to test power generation.
- Test three different turbine heights.



Next Steps for Testing and Development

- Determine best turbine type for low fluid conditions.
- Test same volume reservoir with smaller area. This should simultaneously increase head and flow.
- Power sensors on campus with microturbines.
- Pair with micro wind turbines and/or solar cell.
- Model more efficient microturbines for 3D printing.

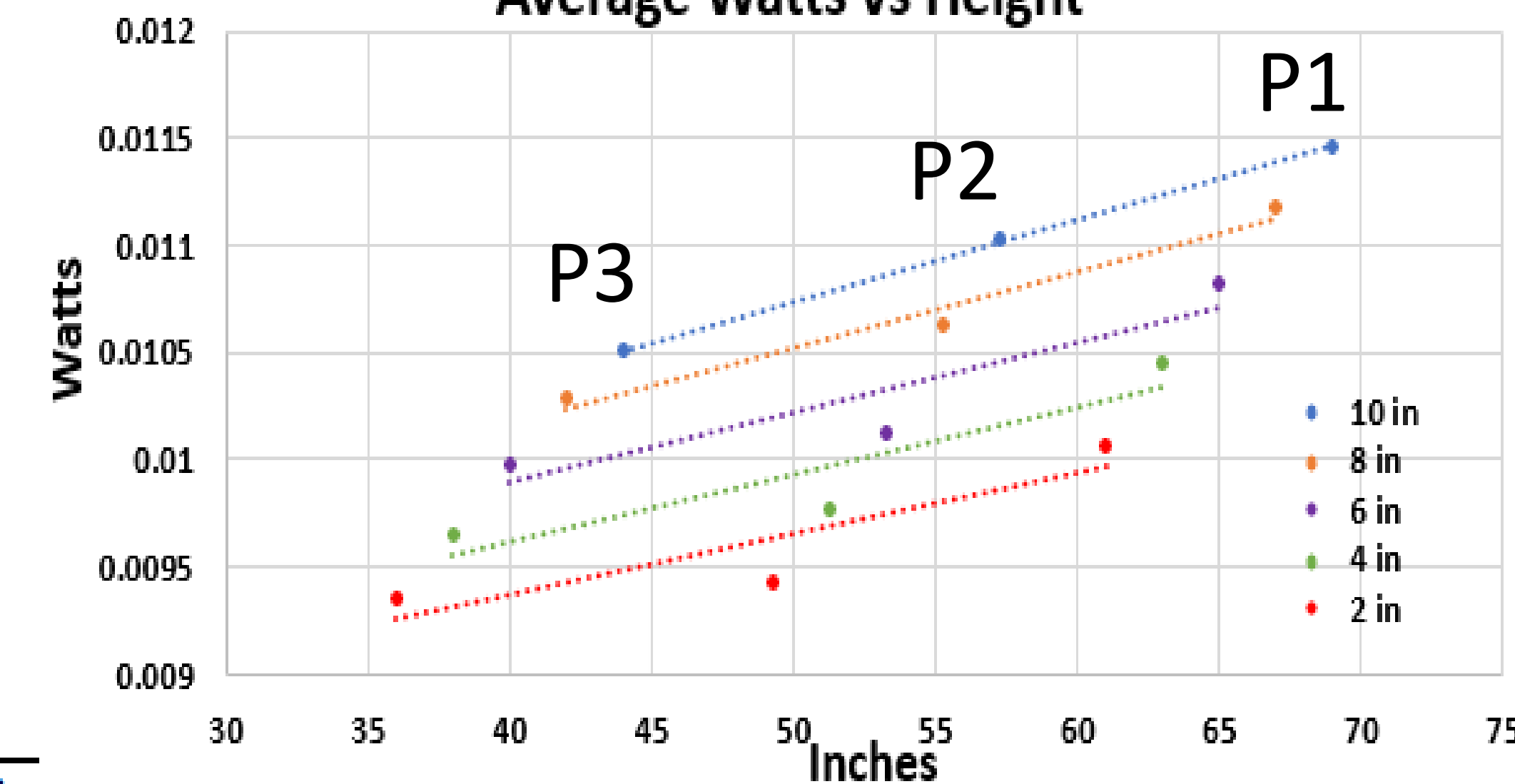
References

<https://www.usclimatedata.com/climate/detroit/michigan/united-states/usmi0229>
<https://maps-semcog.opendata.arcgis.com/datasets/buildings-detroit>

Sponsored by WSU College of Engineering through the Research Opportunities for Engineering Undergraduates program.

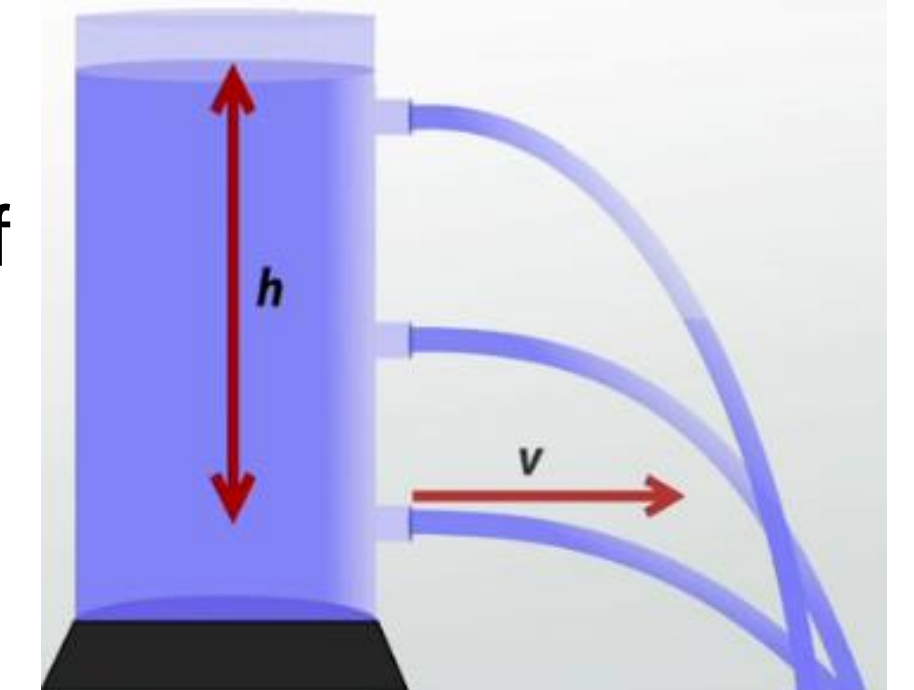
Results

Average Watts vs Height



Flow of water decreased along with water level in bucket.

Velocity of water related to height of water level from bucket outlet.



Physics Stack Exchange

Commercialization Plan

- Store water as a battery on elevated surfaces.
- **Charge** sensors without wired power using micro hydro/wind/solar.
- 3D print microturbines
- Use collected water for irrigation or outdoor use.
- **Reduce** residential water consumption.



Los Alamos National Laboratory

