

Clayton Axial Bi-Directional Rotary Impeller Turbine. An alternative to Wells and Biradial turbines.

The Clayton Axial Bi-Directional Rotary Impeller Turbine (ABRIT) prevents stalling, ensuring efficient energy capture in air, water, or mixed environments.

Introduction

The Wells Turbine, used in (OWC) Oscillating Water Column systems, has limitations:

- Efficiency: 40-70%
- Stalls below 5 m/s and above 10 m/s
- Air-only and subject to Betz Law of efficiency of only 59.3%.

Unsuitable for water currents. This limits energy capture in diverse marine environments.



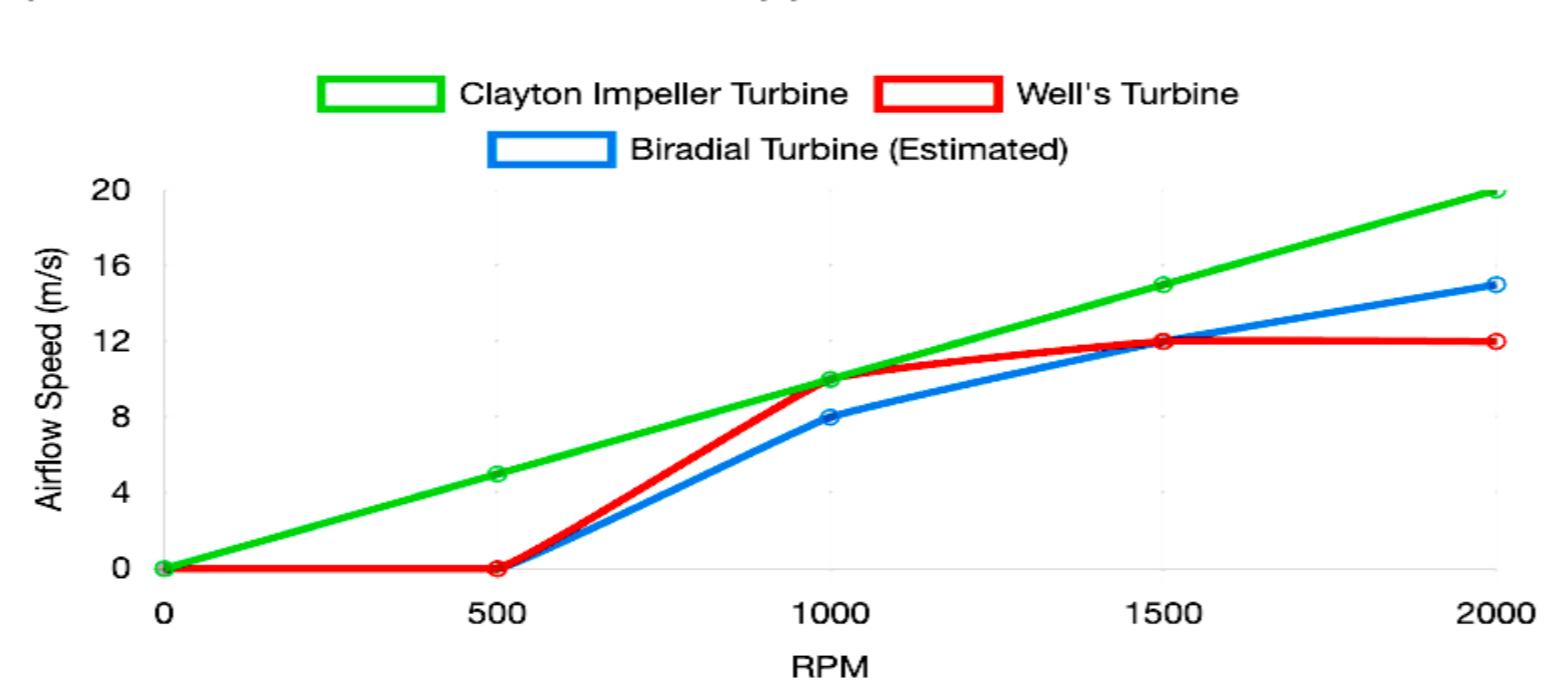
Results are based on the Mutriku Wave Power Plant.



Performance

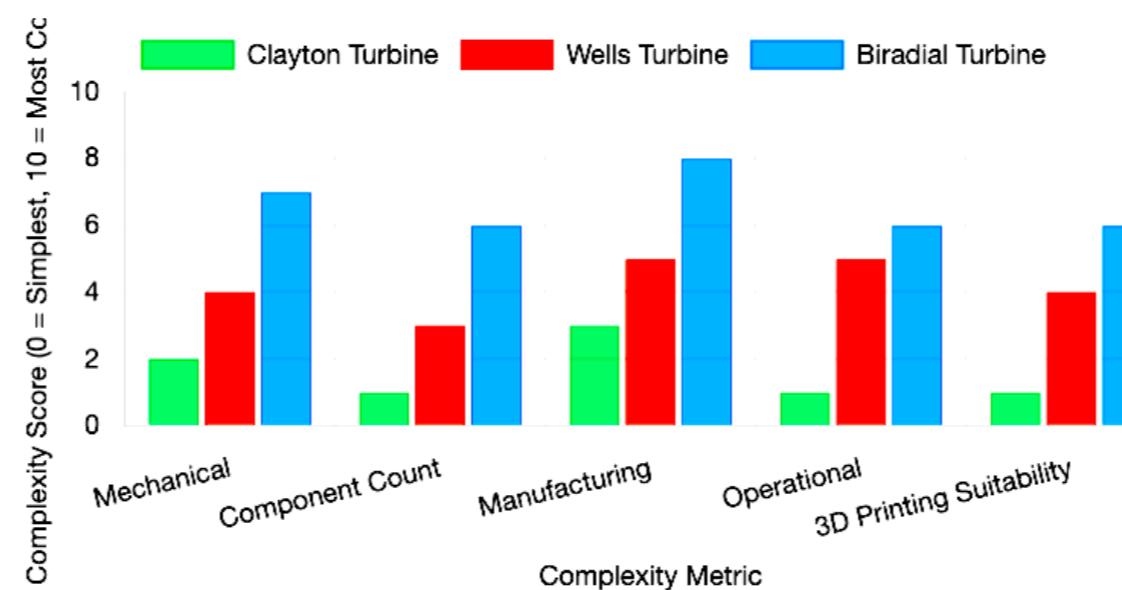
Airflow Speed vs. RPM for OWC Turbines

The Clayton turbine starts earlier and sustains airflow beyond 10–12 m/s, outperforming Wells and estimated Biradial performance. Biradial data is approximated due to limited stats.



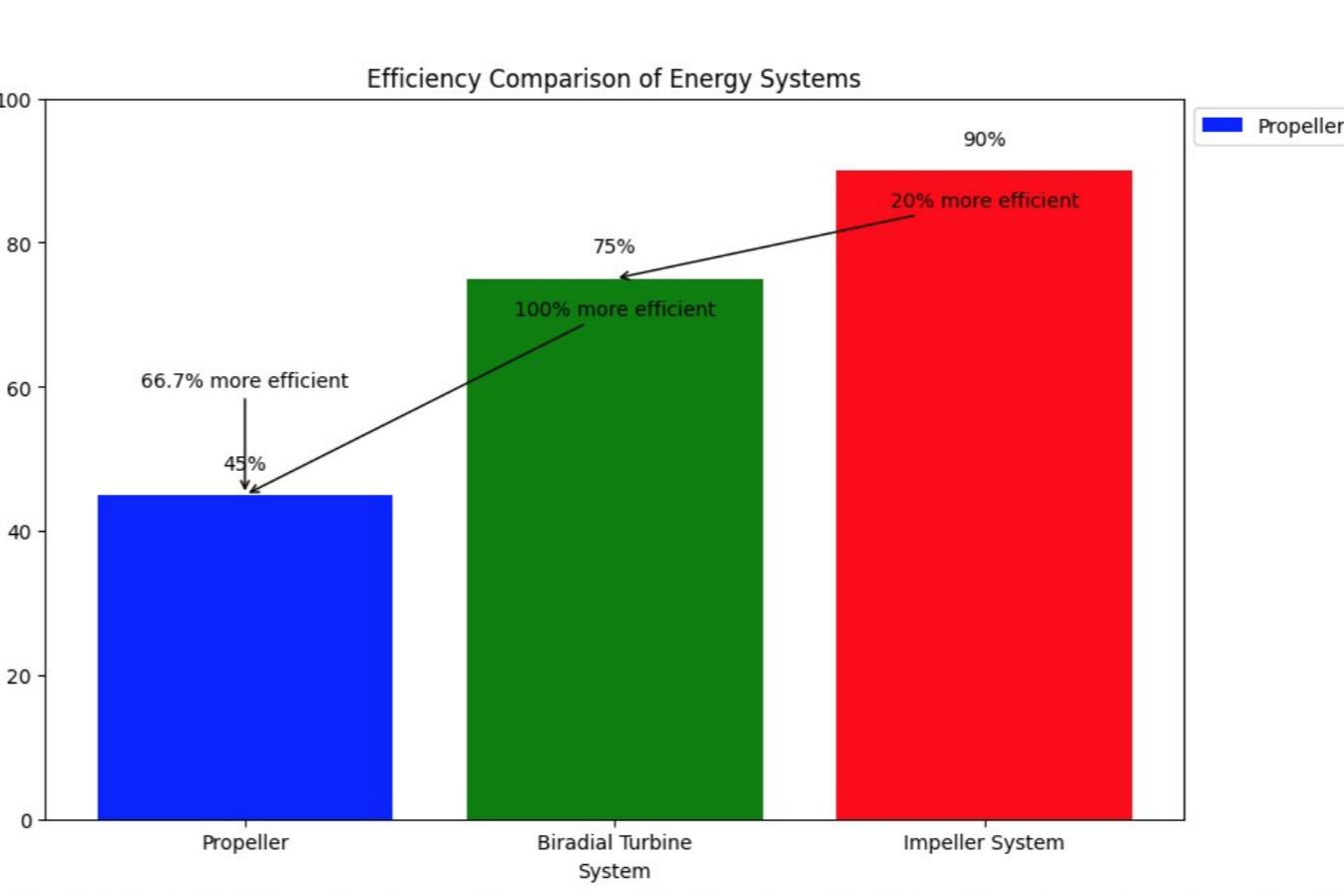
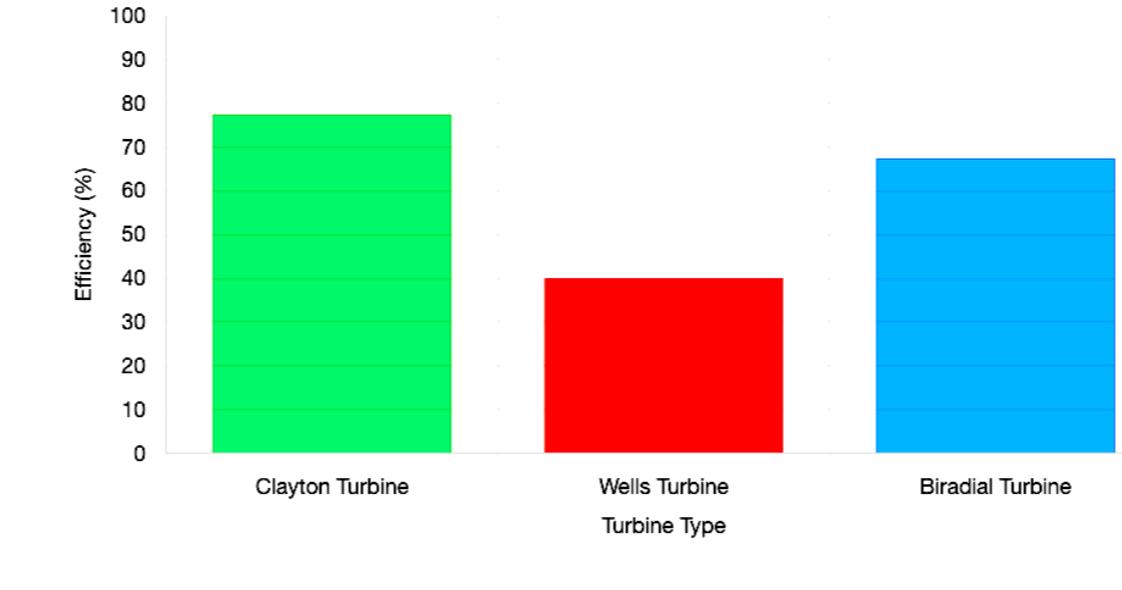
Complexity Comparison of OWC Turbines

The Clayton turbine's low complexity (average score: 1.6/10) enables efficient 3D printing and polishing for small-scale wave energy extraction in coastal environments, outperforming the Wells (4.2/10) and Biradial (6.6/10) turbines.



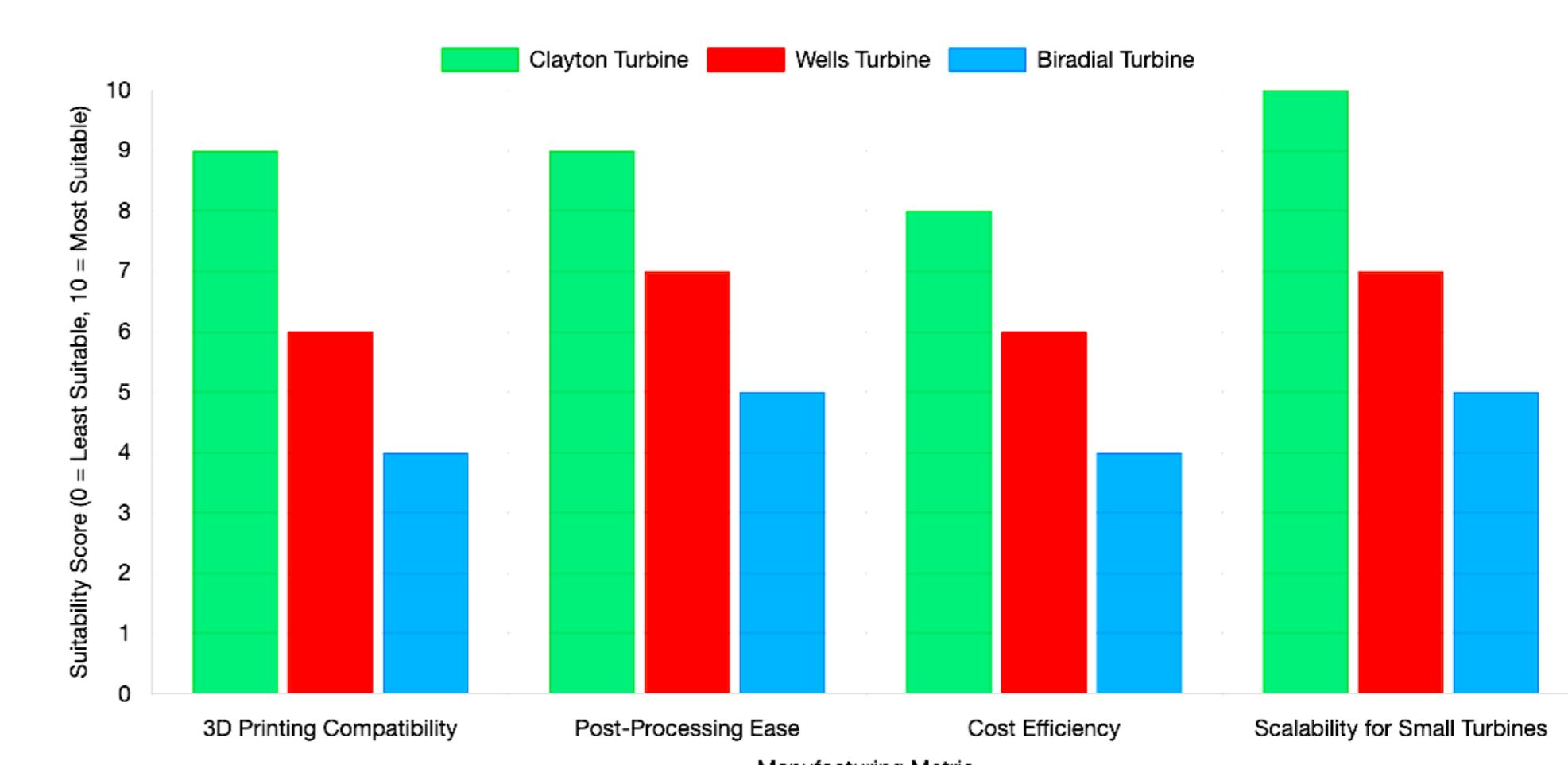
OWC Turbine Efficiency Comparison

Potential electrical generation efficiency for Clayton, Wells, and Biradial turbines. The Clayton turbine's high efficiency (70–85%) supports its use in small-scale wave energy extraction from coastal and rocky shorelines.



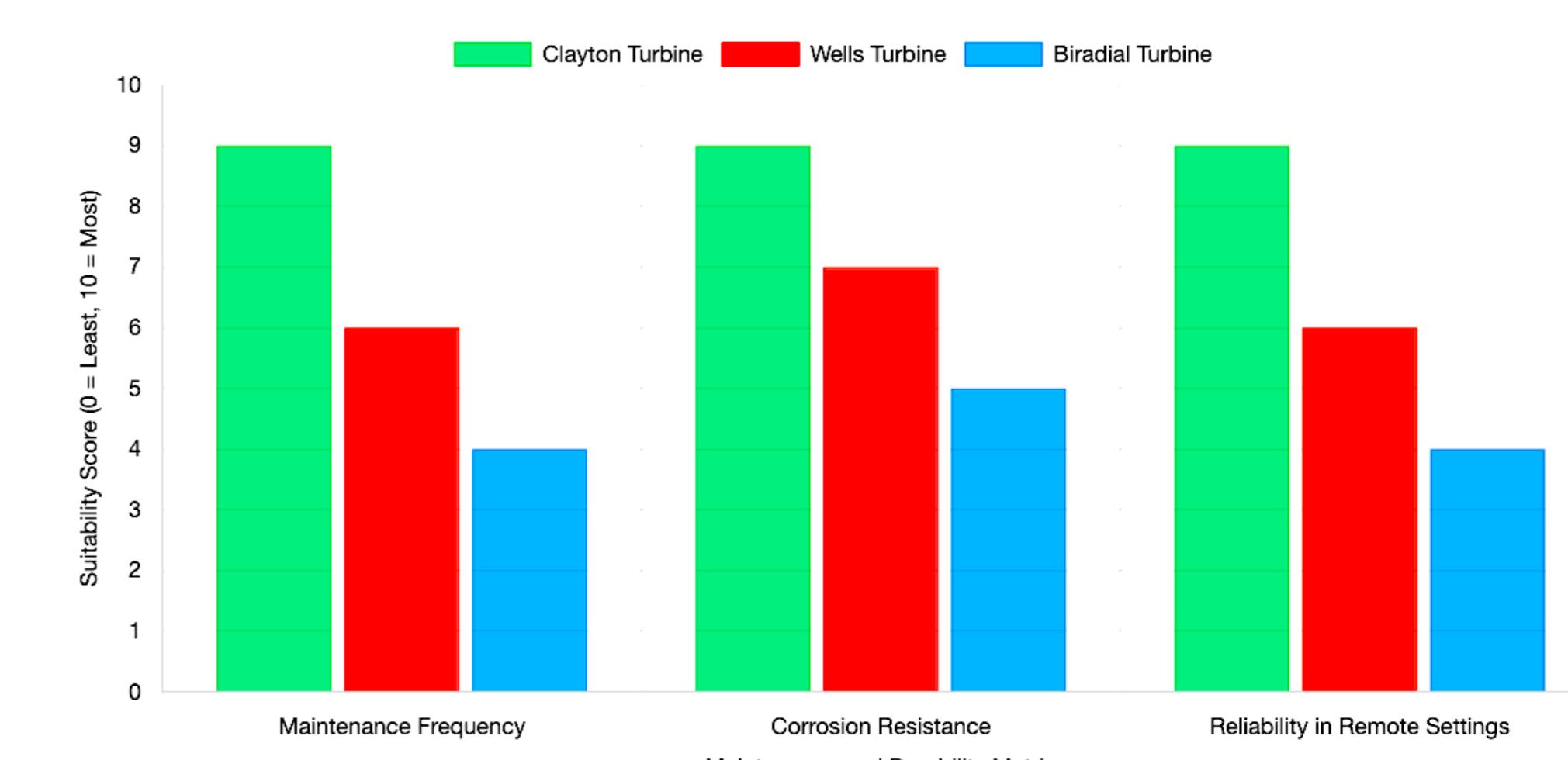
Manufacturing Suitability for Small-Scale OWC Turbines

The Clayton turbine's high suitability (average score: 9.0/10) for 3D printing and polishing enables cost-effective production of small turbines for coastal wave energy, outperforming Wells (6.5/10) and Biradial (4.5/10).



Maintenance and Durability for OWC Turbines

The Clayton turbine's minimal maintenance and high durability (average score: 9.0/10) make it ideal for remote coastal deployments, outperforming Wells (6.3/10) and Biradial (4.3/10).



COMPARISON

The chart titled "Airflow Speed vs. RPM for OWC Turbines" compares the performance of the Clayton Impeller Turbine, Well's Turbine, and Biradial Turbine (estimated) in Oscillating Water Column (OWC) systems. The Clayton turbine demonstrates superior performance, starting earlier and sustaining airflow speeds beyond 10-12 m/s, outperforming both the Well's and estimated Biradial turbines. The Well's Turbine shows limited airflow speed, particularly at lower RPMs, while the Biradial Turbine's data is approximated due to limited statistics. The Clayton turbine's ability to operate efficiently across a broader range highlights its advantage in wave energy conversion.



MANUFACTURING

The Clayton Turbine stands out for its manufacturing simplicity, featuring a single moving part—the rotor-shaft—making it ideal for 3D printing with materials like AISI10Mg or Ti-6Al-4V for corrosion resistance. This design minimizes costs and maintenance, outperforming the more complex Wells (4.2/10) and Biradial (6.6/10) turbines, which require multiple components and precision assembly. Its static construction, devoid of hydraulics or valves, allows efficient CNC machining or 3D printing, and the use of conductive metals like aluminum or titanium enables biofouling prevention through electrical surface shocking.



Future Work Next steps

Future work and next steps for the Clayton Turbine involve initiating flume testing with Pedro Lomonaco, PhD, Director of the O.H. Hinsdale Wave Research Laboratory at Oregon State University's School of Civil and Construction Engineering, to assess performance and acquire critical data points. This will be followed by validation through Computational Fluid Dynamics (CFD) modeling and open-water trials at PacWave. Further efforts will concentrate on optimizing efficiency across diverse air and water conditions, scaling the design for larger deployments, and exploring its potential for remote, non-grid locations. Collaborations with OSU and support from TEAMER will propel commercial development and enhance manufacturing processes. Additionally, leveraging its impeller design, the Clayton Turbine can switch between generator and pump modes, offering valuable applications in agriculture and aquaculture.

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