



Renewable Energy Generation

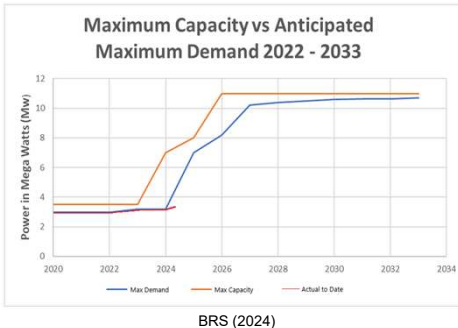
Student: Ian Stuart Lewis
Supervisor: Kelvin Lake
School of **Engineering, Manufacturing & Logistics**
BEng (Hons) Mechanical & Manufacturing Engineering

Introduction

Bristol Airport, a crucial hub in Southwest England since 1957, has continuously evolved, including the addition of a new terminal in 2000. However, it now faces new sustainability challenges, aspiring for Net Zero operations by 2030. This project delves into the implications on future electricity needs and proposes an alternative renewable electricity generation process to help align with the UK government's target for Net Zero emissions by 2050.

Problem Statement

Although Bristol Airport's electrical capacity model indicates it can operate within its eleven-megawatt limit for the next decade, it already integrates energy forecasts (including a new 1.4MW solar array), constraining potential future expansion.



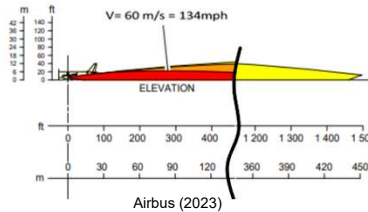
To help offset against exceeding electrical capacity, the airport aims for twenty-five percent onsite renewable energy generation by 2025. Despite the installation of rooftop solar and the new 1.4 MW solar array, only twenty percent of the target has been achieved to date. A shortfall of 0.55 MW remains, pressing the need for new solutions as maximum demand approaches capacity.



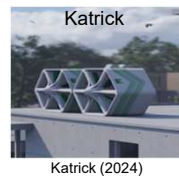
Although solar power is effective at reducing carbon emissions and generating substantial amounts of electricity during daylight hours, it doesn't produce electricity at night. To overcome this and assist Bristol Airport in managing peak electrical demand, generating power continuously day and night would be beneficial.

Alternative Approach

When an Airbus A320 aircraft starts to take-off, it will apply full thrust from both of its CFM international CFM56-5B engines. Each one of these engines can produce 30,000lbf (pounds of force) of thrust and produces a jet blast that can reach approximately 450 meters.



It is proposed that Bristol Airport seize this opportunity to harness the energy dissipated into the atmosphere by these engines and convert it into electricity using a wind turbine. Since traditional turbines with long blades are unsuitable on an airfield, four bladeless wind turbines were investigated.



Potential Locations



After reviewing all limitations and considerations, Catchment Zone A was the preferred option for further investigation, supported by the westerly runway being used 76% of the time over the last decade.

Percentage (%) of Used Runway (27 - 09) from 2013 - 2023

2013 - 2023	Westerly (27)	Easterly (09)
Average	76%	24%

BRS (2024)

Comparison

Following a comparison between all four wind turbines, the Katrick bladeless turbine stands out as a top performer in renewable electricity generation.

Turbine	Generation per Unit per hour (kW)	Estimated Total kWh per Day (for max units)
Katrick	10	4,560
Vortex Bladeless	4	1,920
Aeromine	5	1,200
PowerPod	1	456

Aeromine (2024), Halcium (2024), Katrick (2024), Vortex (2024)

Recommendation

It is proposed that both Katrick and Vortex turbines are investigated further, as both offer unique advantages that could result in a combined potential daily electricity generation of nearly 6.5 MW.

Next Steps

- Testing and Trials
- Financial Analysis and Presentation
- Funding Request and Approval

Acknowledgments

Fraser Dury - Bristol Airport
Richard Withey - Bristol Airport
Rob O'Dare - Bristol Airport
Steffan Roberts - Bristol Airport
Stuart Smith - National Air Traffic Services

References

- Aeromine (2024) Aeromine. Available at: <https://aeromine technologies.com/>
- Airbus (2023) 'Aircraft Characteristics'. https://aircraft.airbus.com/sites/g/files/jlcbta126/files/2023-12/ac_a320_1223.pdf
- BRS (2024) 'Bristol Airport Internal Sharepoint'. Available at: Official Sensitive
- Google (2024) 'Google Maps'. Available at: www.maps.google.co.uk
- Halcium (2024) PowerPod. Available at: <https://www.halcium.com/>
- Katrick (2024) We are Katrick Technologies. Available at: <https://www.katricktechnologies.com/>
- Vortex (2024) 'Vortex Bladeless'. Available at: <https://vortexbladeless.com/>