ASHRAE Setty Family Foundation
Net Zero Energy

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Project Background

A new medical office building is set to be built in the city of Manchester, England. The medical office building will be a 3-story structure and aims to provide medical services to the residents of Manchester. The owner of this building is requesting for the design to be Net Zero Energy and Decarbonized.

Objective

The purpose of this project is to design an HVAC system that will operate as net zero energy through on site renewable energy and have no carbon emissions. To be net zero, the same amount of energy consumed in one calendar year by the entire building must also be generated through renewable sources. As there must be no carbon emissions, gas and oil will not be used within the design.

System Level Requirements

	Requirements
Life of System	30 year of life
Budget	$10,000,000
Temperature & Humidity	Summer: 75 F (24 C) DB Winter: 72 F (22 C) DB RH: 30-50%
Mechanical/ Electrical Rooms	55 F DB (13 C) to 85 F DB (30 C) No RH requirement
Operation Hours	Monday – Friday : 7 AM – 7 PM Saturday: 7 AM – 12 PM Sunday: Closed

Design Approach

By using ASHRAE standards, load calculations are used to size HVAC equipment. Integrated Environmental Solutions will be used simulate how much energy the building will consume and will be used to size the renewable energy. LEED will be used as well to help guide the design approach by leading the project to be more efficient, healthy, and cost effective.

Floor	Heating (BTU)	Outdoor Air Rate (CFM)	Cooling CFM	DOAS Outside Air (CFM)	Exhaust Air (CFM)
1	400,941	2310	19,044	6014	1560
2	394,600	2410	18,743	5918	1820
3	411,052	2766	19,525	6166	710
Total	1,206,593	7486	57,312	18,098	4090

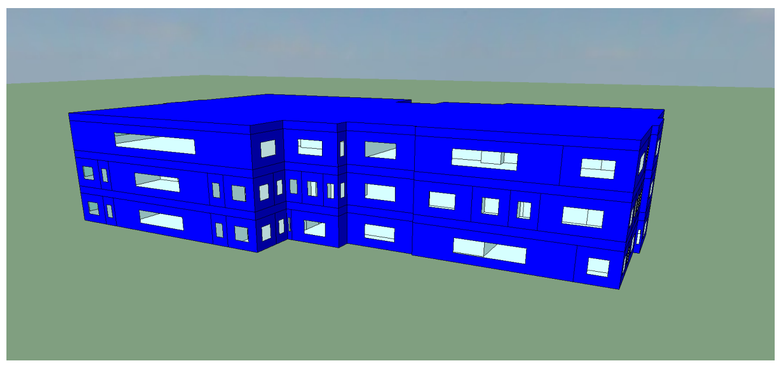
HVAC System

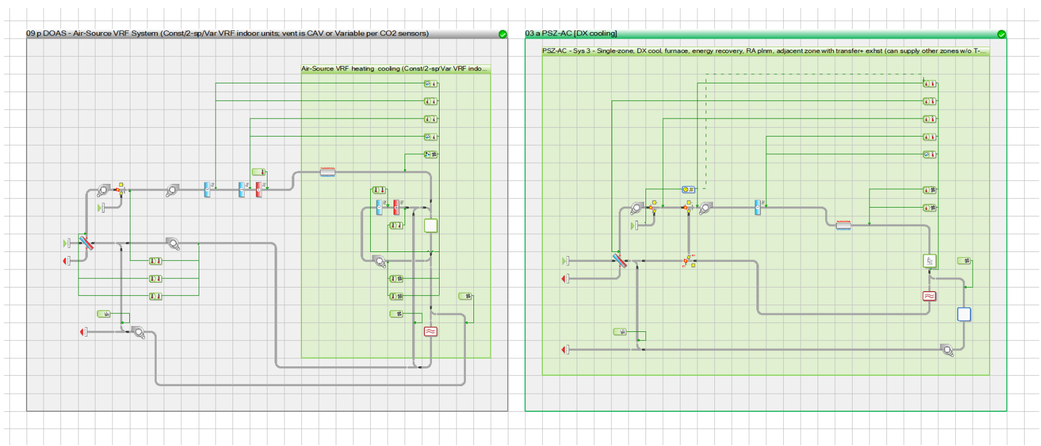
Results

IES compared the proposed HVAC building design to a baseline design, which will give an estimate of the energy savings. The proposed HVAC design resulted in energy usage that is 33% less than the baseline. Energy Usage Intensity is the ratio of annual energy usage over gross floor area and is used to represent the efficient the building uses energy.

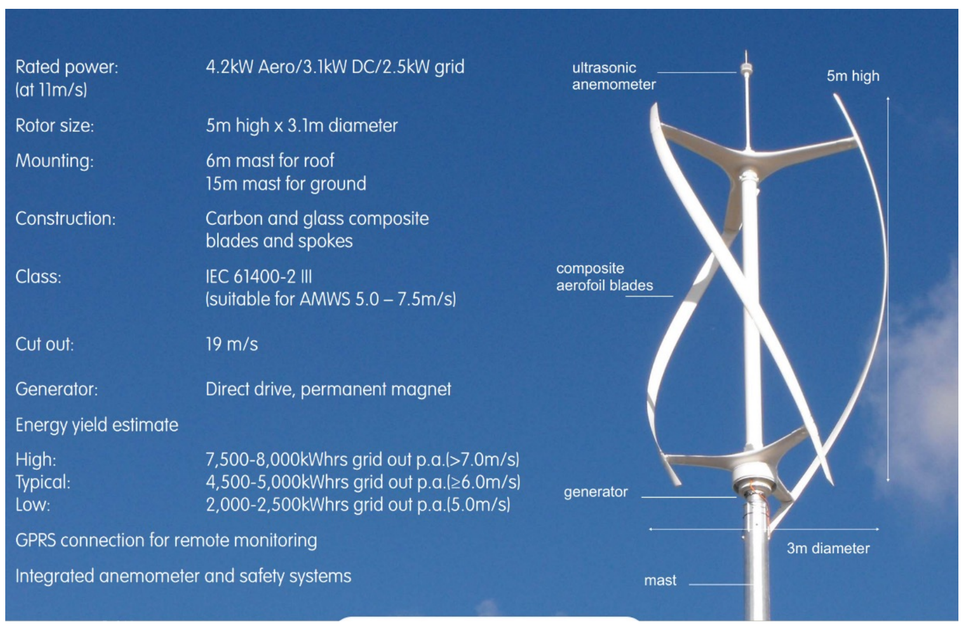
	Proposed Design	Baseline Design	Percent Savings
Energy	2,937,290.99 kBtu	4,383,983.44 kBtu	33.00 %
Cost	77,949.50 ₤	117,514.35 ₤	33.67 %

$$EUI = \frac{total\ annual\ energy}{gross\ floor\ area} = \frac{2{,}937{,}290.99\,\frac{kBtu}{yr}}{66{,}433\ ft^2} = 44.21\,\frac{kBtu}{yr\ ft^2}$$





Renewable Energy



Conclusion

As future buildings are designed, it is important to consider the negative environmental effects and carbon footprints. The medical office building was designed to optimize energy usage which resulted in lower operating costs with 33% savings. Renewable energy systems allowed for the building to operate as net zero while also ensuring no carbon emissions. Overall, all customer requirements were met.