

# The Advancement of HVAC Systems for Industrial Clean Room Applications in a World of Renewable Energies

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### Aim of Project

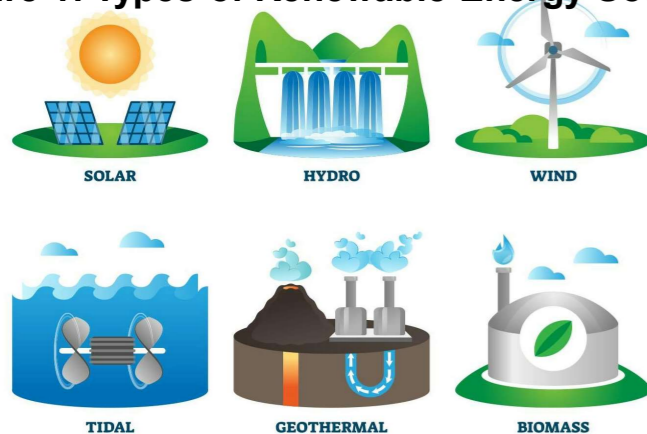
The purpose of this project is to determine the potential effect of implementing renewable energy in heating, ventilation, and air conditioning in clean room applications on factors such as energy efficiency, cost, and environmental impact.

### Methodology

The following methodology was used throughout this dissertation to complete the aim:

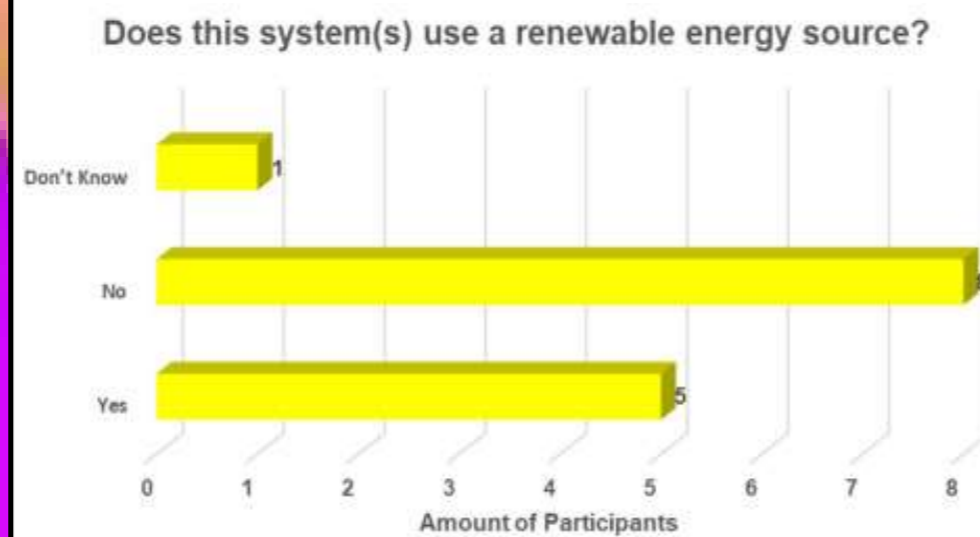
- Critical Literature Review:** An evaluation of the current body of work available was carried out.
- Questionnaire:** Online questionnaire completed with participants experienced in HVAC of cleanrooms for numerical data.
- Interview:** Interview questions with three participants from the questionnaire from different industry backgrounds to gain deeper insight from personal experiences.
- Case Studies:** Examples of the integration of renewable energy in HVAC for cleanrooms in industry were analysed to display the real-life effect of incorporating clean energy.
- Guide:** Comprehensive manual created to facilitate industry transition towards renewable energy sources.

Figure 1: Types of Renewable Energy Sources

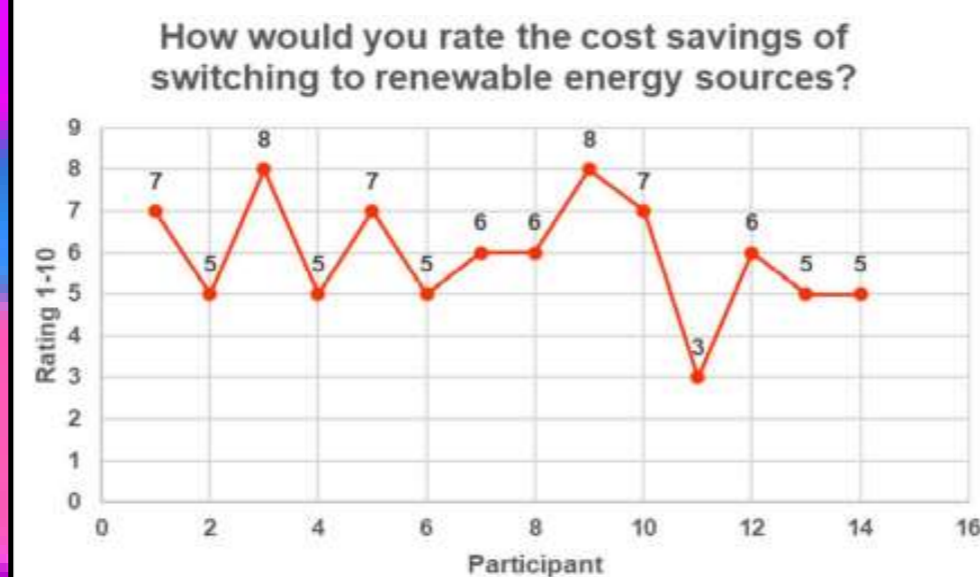


### Results

- Out of 14 participants, only 35.7% (5) answered 'Yes' when asked if their HVAC system in the cleanroom uses a renewable energy source.

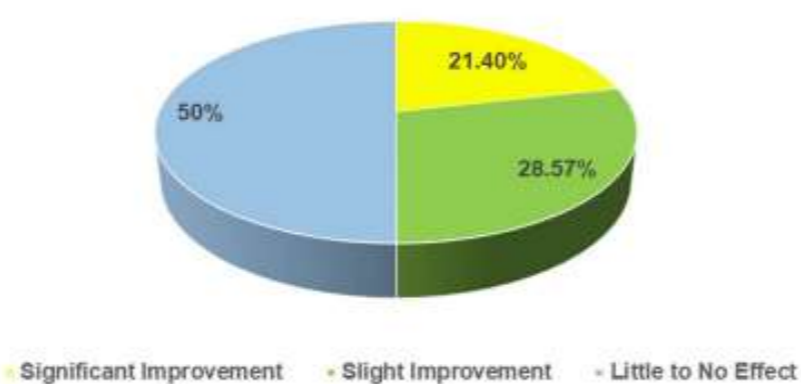


- 92.86% (13) rated the cost savings from switching to renewable energy above 5 on a scale of 1-10.



- 50% (7) stated that there was either a significant or slight improvement on performance efficiency when switching to renewable energy.

What effect, do you think, renewable energy sources have on the performance efficiency of HVAC systems?



### Discussion

- Cleanroom requirements (air particle contamination, temperature, etc.) are of utmost importance when selecting HVAC technology.
- There is a significant lack of renewable energy sources in HVAC of cleanrooms, as seen from the questionnaire.
- There are risks associated with solely relying on renewable energy sources that affects their reliability (e.g. weather conditions), as seen from the interview.
- Back-up energy sources, such as generators or battery packs, are a solution to the unreliability of renewable energy, displayed from case studies and the interview.
- Cost savings are a possible benefit, but not seen as a necessity when maintaining cleanroom environments.
- Ground source heat pumps (geothermal energy) can reduce annual heating and cooling expenses by 70%, and carbon emissions by 65%, conveyed by a case study from Achieve Renewable Energy.

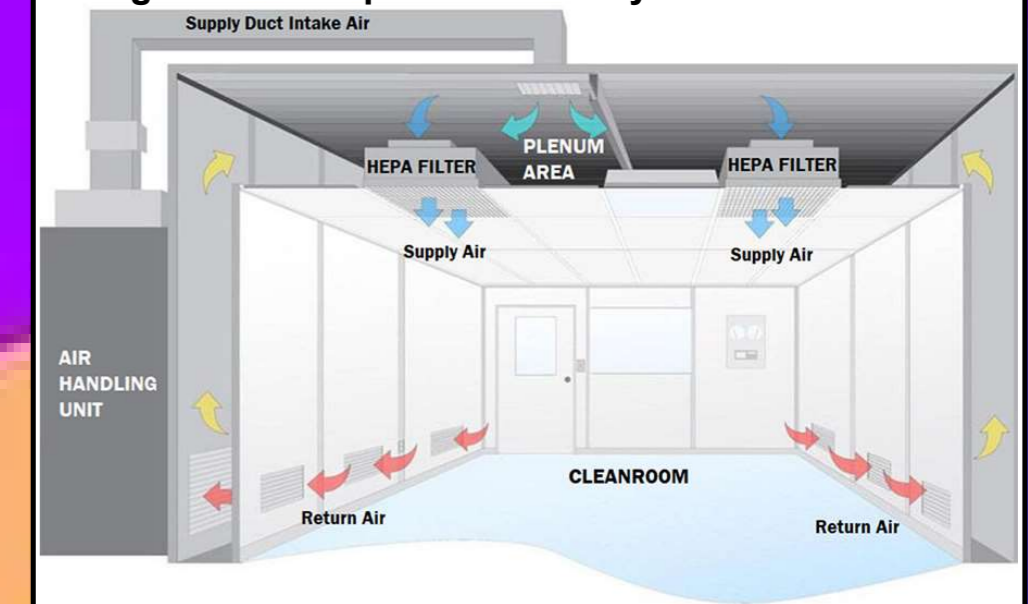
Figure 2: Pfizer Employees in NCC Cleanroom



### Conclusion

- Each objective was achieved by following the methodology which included a critical literature review, questionnaire, interview and case studies.
- A guide for the implementation of renewable energy sources in HVAC of cleanrooms was successfully created.
- Overall, there was a lack of research available online, including for the literature review and the case studies. In future, original research and case studies should be carried out by the writer.

Figure 3: Example of HVAC Layout in Cleanroom



### References

- Figure 1:** <https://www.inspirecleanenergy.com/blog/clean-energy-101/types-of-renewable-energy-sources>
- Figure 2:** <https://www.nashccnews.com/news/2017/03/pfizer-employees-first-to-use-ncc-clean-room/>
- Figure 3:** <https://ciqa.net/heating-ventilation-and-air-conditioning-system-hvac/>