Advancements in Fuel Cell Combined Heat and Power Generation and the Challenges Experienced in the Commercialising of this System in Ireland

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Aim of the Project

The Aim of the project Advancements in Fuel Cell Combined Heat and Power Generation and the Challenges Experienced in the Commercialising of this System in Ireland

- Review the current state of fuel cell technology
- Examine the role of government policies, incentives
- Carry out case studies on successful/unsuccessful installation of fuel cell CHP systems in industrial/residential settings
- Gather information on the topic
- Analyse results from data gathered

Fuel Cell CHP Systems

Even though the first fuel cell was created in 1839, fuel cell development is still in its early stages. Fuel cells are a clean, pollution-free, highly efficient, adaptable, and promising energy source that requires more focus in terms of research and development. . Fuel cells outperform gas turbines in terms of efficiency and emissions, but they are still more expensive and have a shorter lifespan.

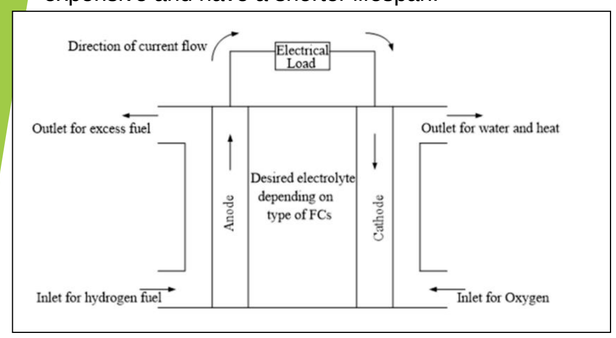

Figure 1: Fuel Cell Operation

Fuel cell technologies consist of four major components: cathode, anode, electrolyte, and external circuit. There are six types of fuel cell technologies available on the market: solid oxide, phosphoric acid, molten carbonate, direct methanol, alkaline, and proton exchange.

Case Studies

Verizon established an energy team in 1999 and 2001 in response to multiple expensive power outages, with the goal of enhancing their electric reliability through alternative means. The energy team recommended using the UTS Powers PC25C Phosphoric acid fuel cell CHP system. Verizon installed a 1.4 MW phosphoric acid fuel cell system in 2005. The system was made up of seven 200 KW units. The seven CCHP systems with fuel cells have shown a 96.57% availability.

Figure 2: Phosphoric Acid Fuel Cell CHP System Installed at Verizon Central Office

Methodology

The methodology carried out for this project involved carrying out the following:

- Case Studies
- Survey
- Interviews

	No. of Units	Operational Capacity MWe
Natural Gas	274	300.3
Solid Fuels	1	2.6
Biomass	3	6.6
Oil Fuels	20	1.0
Biogas	21	11.9
Total	**319**	**322.3**

Figure 3: Operational CHP Units in Ireland

Results

The survey was answered by experienced professionals working in an area that is related to the topic.. The interviews were carried out with three different combined heat and energy professionals; each interview contained the same questions so the answers could be measured.

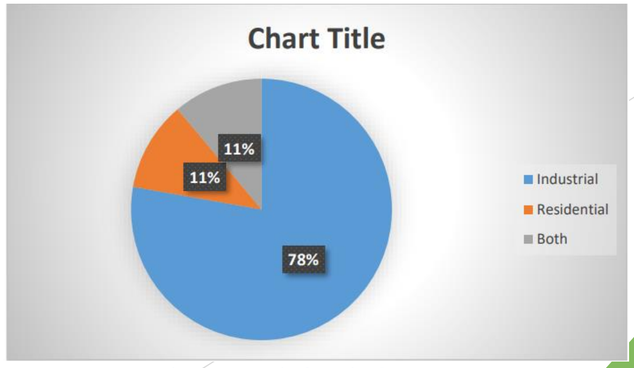

Figure 4: Results from the Survey

Conclusion

The findings from the research carried out resulted in some findings on the topic, these findings were as follows:

- The capital cost of fuel cell systems needs to be reduced to make the system have a larger market.
- Biogas CHP systems are currently more appealing than fuel cell CHP systems, even though both are renewable energy sources.
- Solid oxide fuel cell CHP systems shows the most promise of all the fuel cell types.
- Government incentives need to be established that will enhance this type of renewable energy system.
- Proton exchange membrane fuel cell CHP systems are best suited for domestic/residential use.

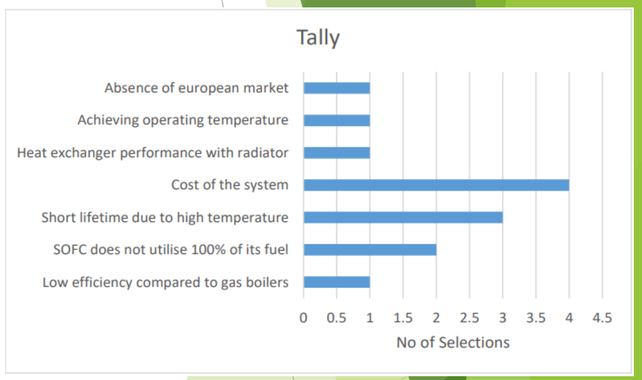

Figure 5: Key Challenges Faced with SOFC CHP System

Recommendations would be to lay out a clear plan for the role fuel cell CHP systems will have towards helping Ireland meet their goal of achieving 80% of electricity from renewable energy. Fuel cell CHP systems could meet this demand with some research and development. if the high temperature PEMFC CHP system could be improved this could really enhance the commercialisation of this product.

References

- Brown, M. A., & Herrera, V. S. (2021). Combined heat and power as a platform for clean energy systems. Applied Energy,