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Sustainable Store Replication

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1. INTRODUCTION

Around 3% of the UK total energy consumption comes from the retail food industry accounting for 1% of the UK's total GHG emissions [1]. Since more than 85% of these emissions comes from buildings, retail stores companies are likely to improve their building efficiency to reduce their carbon footprint. Retail stores possess thousands of stores and thus have to introduce large scale projects to reduce their emissions. The thesis is based on a case study conducted with a retail food company and studies the replication of zero carbon store (ZCS) achieved through bio-methane CHP. The analysis is divided in three main parts. The first one focuses on the exploration stage of the replication; the second one is a study of a specific region of the company and the last part evaluates the potential of sustainable store across the whole business.

2. METHODOLOGY

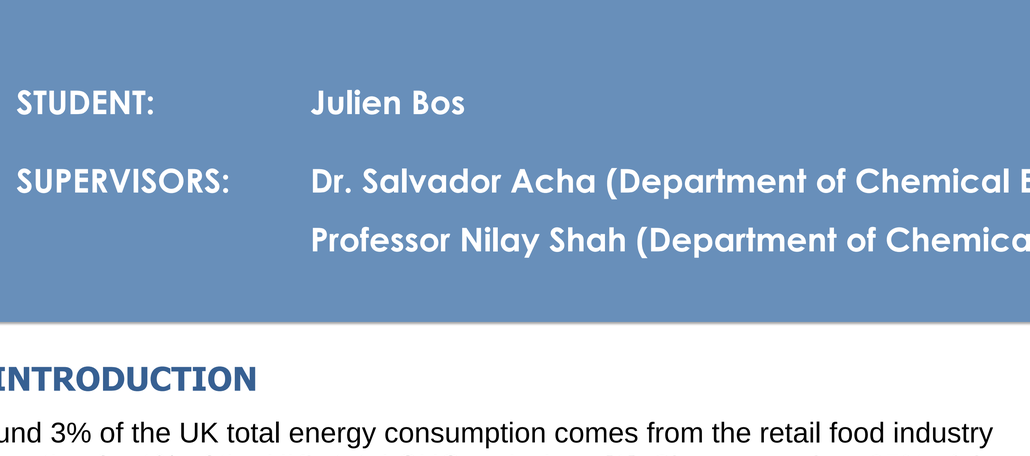

Figure 1: General representation of the ZCS model

Different heat recovery solutions are considered (e.g. absorption chiller, ORC, heat storage or district heating),

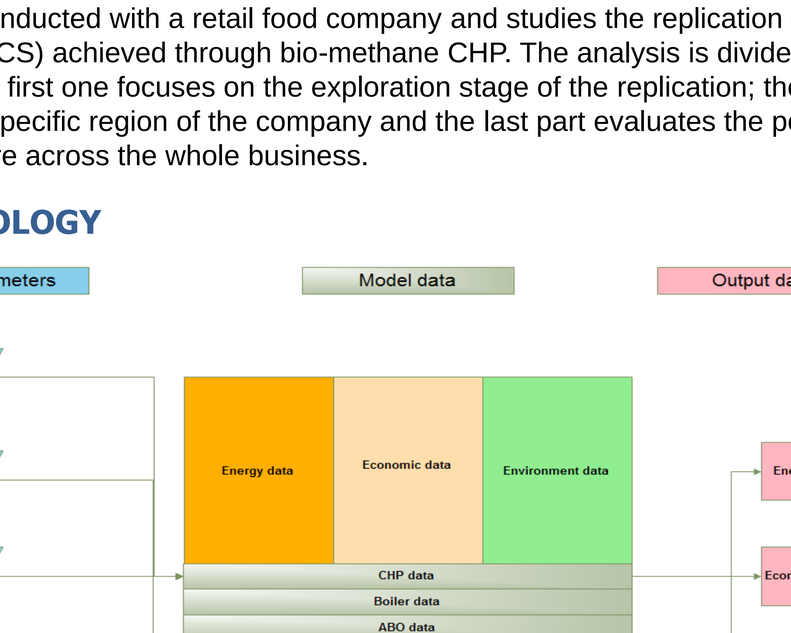

Figure 2: CHP & ORC configuration

3. EXPLORATION RESULTS

Results show that **CHP & district heating** is the most cost effective design for a sustainable supermarket. However, its implementation depends greatly on third parties and is not easy to replicate. For a store with a **heat to power ratio below 0.5** a **CHP & ORC** configuration should be used; otherwise it is not worth using a heat recovery system.

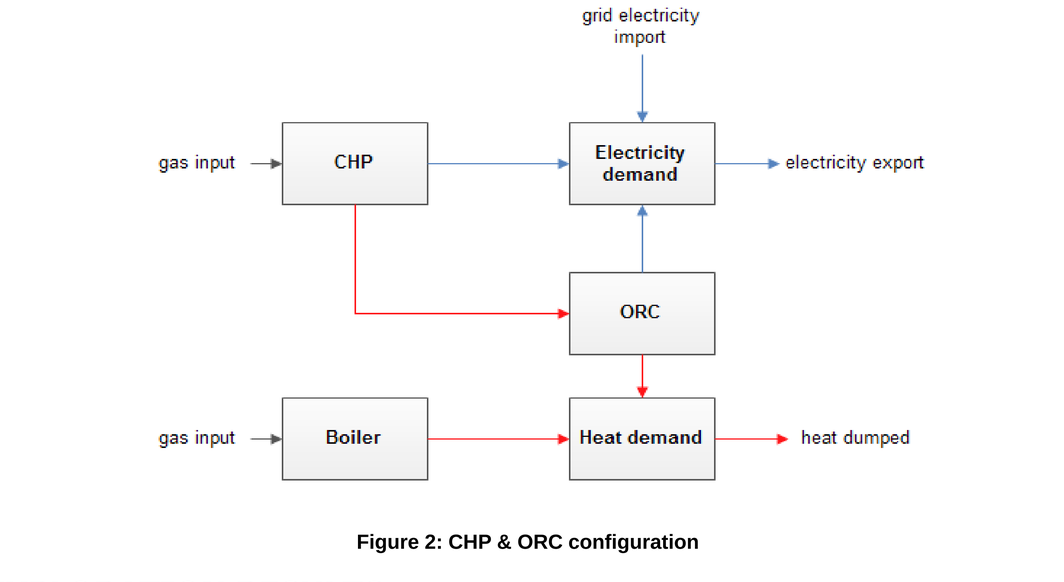

Figure 3: Abatement costs compared to the BAU for different heat to power ratio with two technological configuration using their best CHP night load

Apart from the heat to power ratio, the other store parameters (energy intensities, location and size) do not influence the technological solution but it might **change the CHP capacity** and/or **operational strategy**.

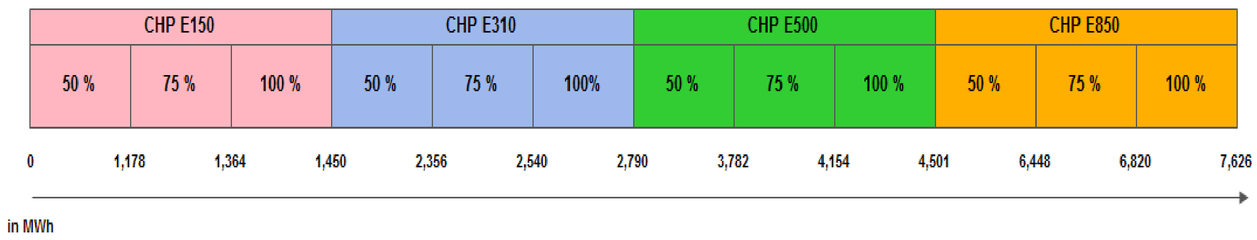

Figure 4: Most cost effective CHP unit and daily strategy for a typical supermarket (heat to power ratio 0.36) – The percentages represent the load of the CHP during the night

The most cost effective ZCS projects are the ones implemented in stores with

- high heat to power ratio
- high energy intensities
- large surface floor area
- DNO with high power import prices

4. REGIONAL ANALYSIS RESULTS

The regional analysis shows that ZCS enable the company meeting a regional target and so validate the regional strategy. However, the **regional context imposes new limits** to ZCS projects and the preferred configuration might be altered to enable the region to be cost effectively decarbonised.

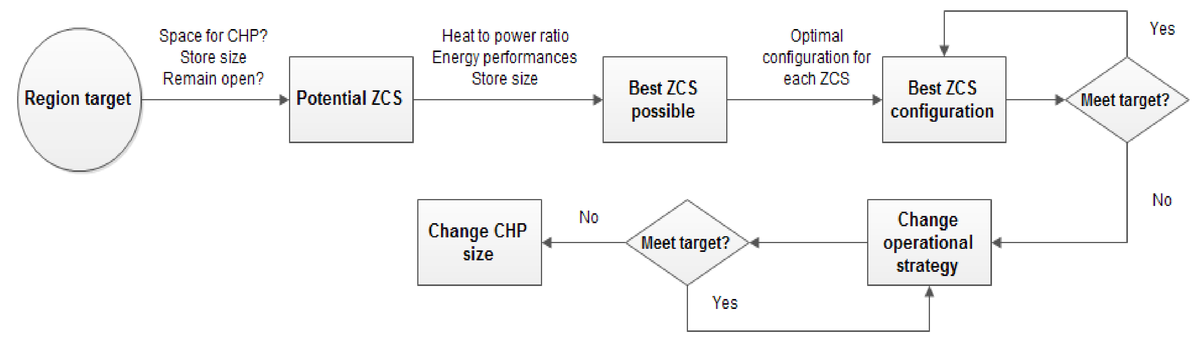

Figure 5: Regional decarbonisation strategy (step by step decisions)

5. 2020 PROJECTION RESULTS

The food retailer company estimates being able to purchase about **450 GWh of bio-methane** by 2020. With this figure in mind, projections show that only **26.5% of reduction** can be achieved and **71 GWh of wind electricity** are needed to make sure the organisations 30% target is reached.

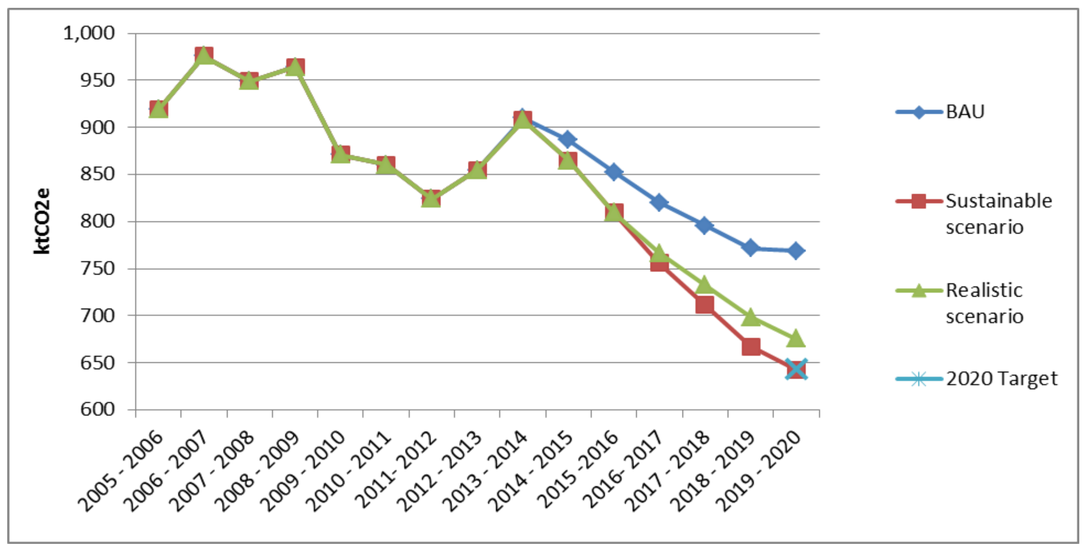

Figure 6: Business total energy emissions – projection for 2020

6. Conclusion

Further work is needed to assess locally the different UK regions where these ZCS projects would be most relevant. Nonetheless, key results show **ZCS projects are a cost-effective manner to reduce the emissions** of a large organisation. This is mainly due to the fact that electricity prices in the upcoming years will continue to rise and it will be **more economical to produce electricity on-site** if the fuel can be purchased at an adequate cost.

References

[1] Tassou, S. A., Ge, Y., Hadaway, A. & Marriot, D. (2011) Energy consumption and conservation in food retailing. *Applied Thermal Energy*, 147-156

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