Imperial College London

Sainsbury's

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Decarbonising a Retail Building within the UK Context

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INTRODUCTION

Food retailing companies' stores correspond to about 3% of the total consumed electricity and 1% of the total GHG emissions within the UK [1]. **Sainsbury's** aims to increase its store's portfolio while achieving demanding **carbon reduction targets**; 50% by 2030.

Thus, the only way for the company to continue its growth through a sustainable path is the development of **zero carbon stores** [2].

The creation of a zero carbon store requires **identifying** the origins of the carbon emissions and **classifying** them into scopes**,** according to the company's accountability.

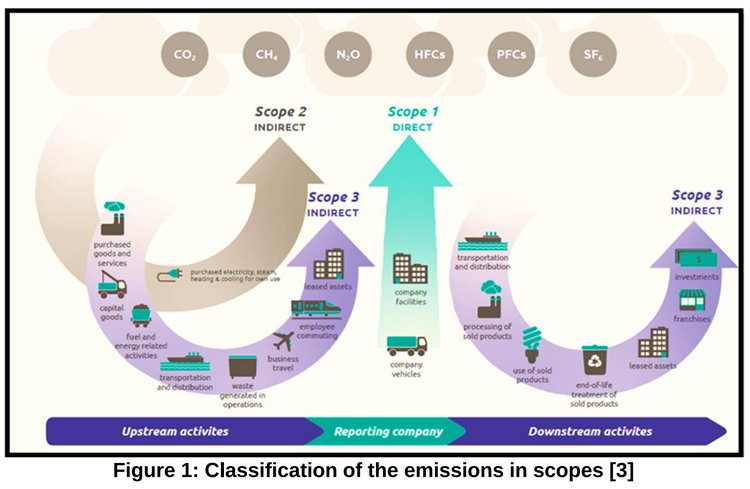


Figure 1: Classification of the emissions in scopes [3]

OBJECTIVES

The objective of this project is to create **a complete carbon inventory** of a 54,056 ft^2 supermarket store. This inventory defines the emissions problem and thus facilitates **the store's decarbonisation**. Understanding the origins and the quantity of the generated emissions enables the development of **cost-effective** decarbonizing solutions.

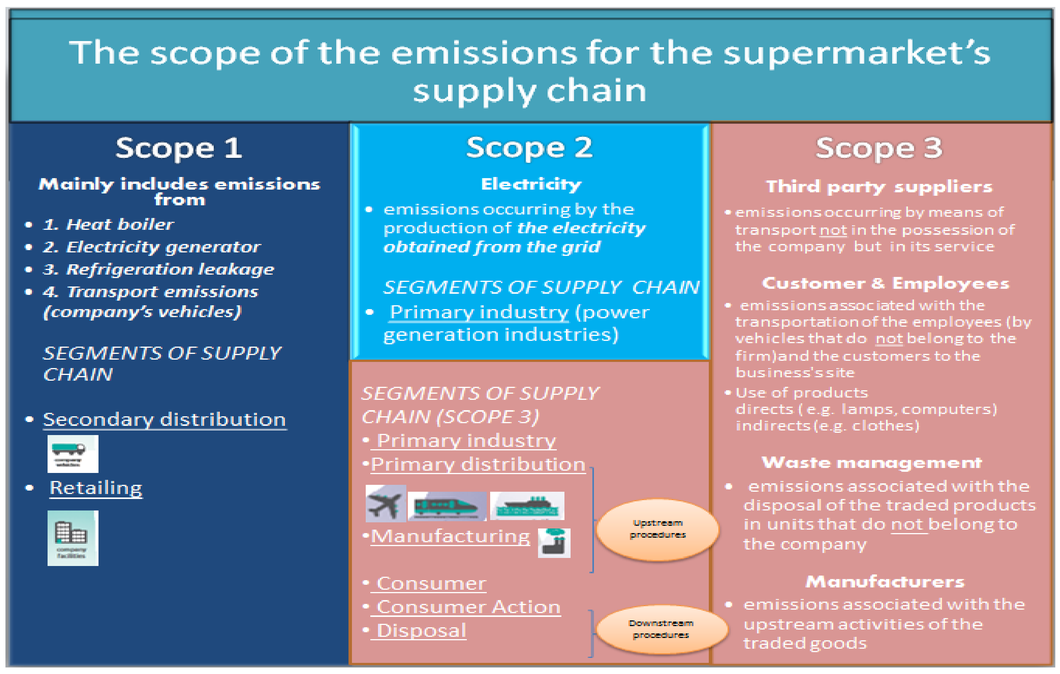


Figure 2: The categorization of the emissions across the supermarket's supply chain

METHODOLOGY

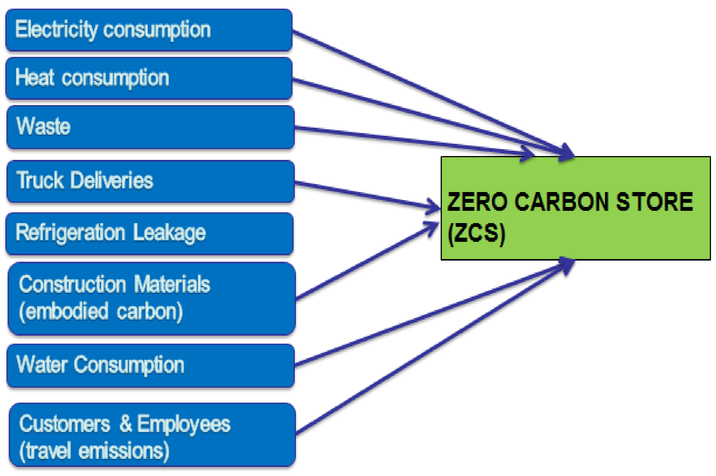


Figure 3: The carbon fields that were taken into account

- Both the **operational** and the **embodied** carbon were examined during the process of creating the store's carbon profile.
- The conversion of the energy consumption to the resulting emissions was done according to **DEFRA's Guidelines** [4].

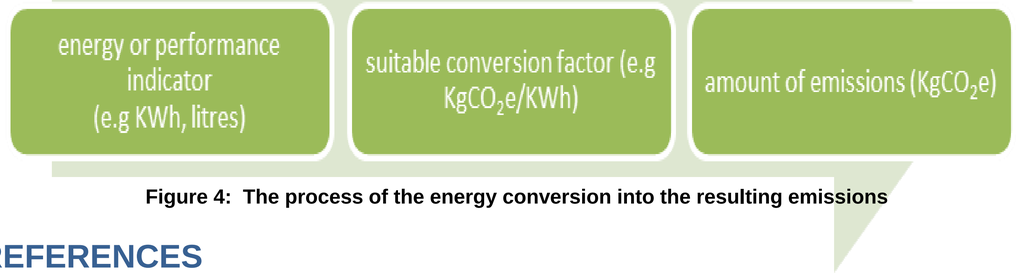
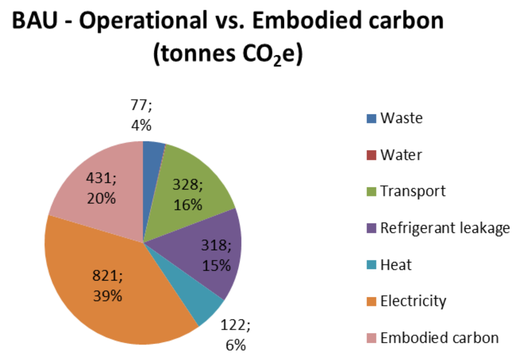


Figure 4: The process of the energy conversion into the resulting emissions

RESULTS



Three scenarios were formed, where the store's operational energy needs were met with different choices:

- **Business As Usual (BAU)** scenario
- Sustainable scenario:
  - **offsetting out of site** scenario
  - **offsetting on site** scenario.

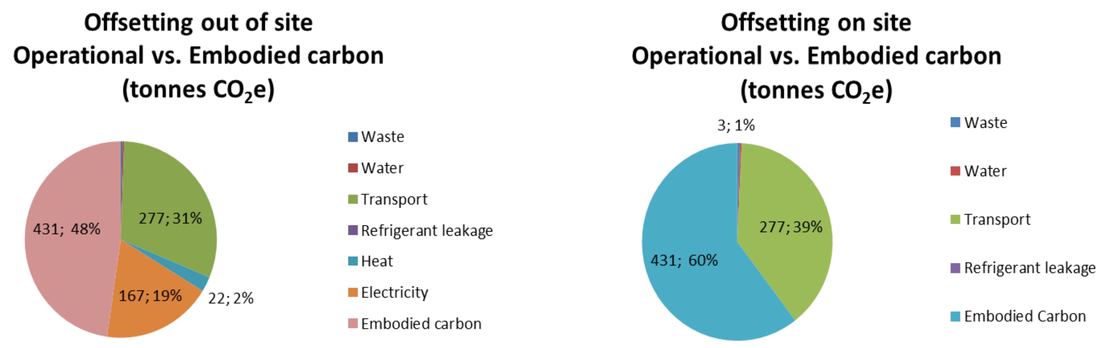


Figure 5: Comparison of the emissions across the different carbon fields

Financial analysis

2 economic scenarios compare:

- Combined Heat & Power (CHP) engines.
- Conventional way (gas boiler & grid electricity).

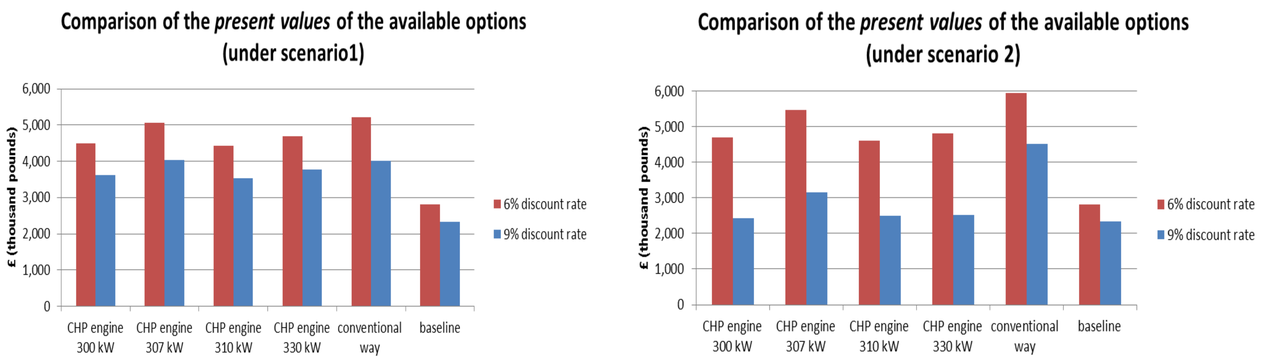


Figure 6: Financial Analysis of the CHP options and the conventional way

Environmental analysis

- Emissions' offset assessment includes:

1. Various sized CHP engines running on low carbon fuel.
2. The CHP engines produce excess electricity which is returned to the grid.
3. The emissions credits are identified by the emissions' difference if the excess returned electricity was provided by the grid rather than the CHP.

- Identification of which carbon fields can be offset with the calculated emissions' credits.

Labels:

- ***TRUE:*** carbon field was offset
- ***FALSE:*** carbon field was not offset

	under the BAU scenario	CHP unit 300 kW	CHP unit 330 kW	CHP unit 530 kW	CHP unit 640 kW	CHP unit 1MW	CHP unit 1.5 MW
	WE HAVE CREDIT TO OFFSET:						
	emissions (tonnes CO2e)						
scope 1	Refrigeration leakage	319	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 1	Truck deliveries	164	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Water consumption	3	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Waste	77	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Truck deliveries	164	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Customer and employees	6,567	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	REMAINING		29	3	802	1,248	2,980	4,695
	TO OFFSET (tonnes CO2e)						

Table 1: Emissions' offset under the BAU scenario

	under the sustainable scenario	CHP unit 300 kW	CHP unit 330 kW	CHP unit 530 kW	CHP unit 640 kW	CHP unit 1MW	CHP unit 1.5 MW
	WE HAVE CREDIT TO OFFSET:						
	emissions (tonnes CO2e)						
scope 1	Refrigeration leakage	0.081	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 1	Truck deliveries	123	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Water consumption	2	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Waste	3	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Truck deliveries	154	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
scope 3	Customer and employees	6,567	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
	REMAINING		281	402	1,201	1,647	3,379	5,094
	TO OFFSET (tonnes CO2e)						

Table 2: Emissions' offset under the sustainable scenario

CONCLUSIONS

- This project facilitates the construction of a zero carbon store by defining the emissions' problem. The measuring and comparison of the emissions across all carbon fields leads to the development of an integrated carbon reduction strategy.
- The **created carbon tool** can be used to select the carbon fields whose emissions can be offset by implementing **economical low carbon strategies**. As the grid's electricity prices increase, the financial viability of low carbon solutions increases as well.
- As the **operational needs** of the store are gradually met with less carbon intensive options, additional focus should be given to the **embodied carbon** and the emissions from **truck deliveries**.

REFERENCES

[1] Tassou et al. (2010) Energy consumption and conservation in food retailing. Applied Thermal Engineering.31 (2-3) 147-156

[2] Frances et al. (2010) Towards a zero energy store – a scoping study (ZEST) [Online]

[3] WRI, WBSCD (2011) Corporate Value Chain (Scope 3) Accounting and Reporting Standard. USA [Online]

[4] DEFRA (2013) 2013 Government GHG Conversion Factors for Company Reporting. UK [Online]

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