Development of a Low Carbon Investment Decision Making Tool

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Background

Energy use in the UK Food Retail market is examined in partnership with J Sainsbury Plc. and, from that perspective, conclusions are drawn about how large institutions can make sound financial decisions to meet their environmental targets.

Under pressure to decarbonise and reduce energy bills while expanding their estate, J Sainsbury Plc. has set ambitious targets to reduce absolute carbon emissions by 30% by 2020 and 50% by 2050, from a 2005 baseline [1].

The distribution of Electrical Intensity's within Sainsbury's estate is shown in Fig 1, and loose correlations against Store Opening Year and Store Size are shown in Figs 2 and 3.

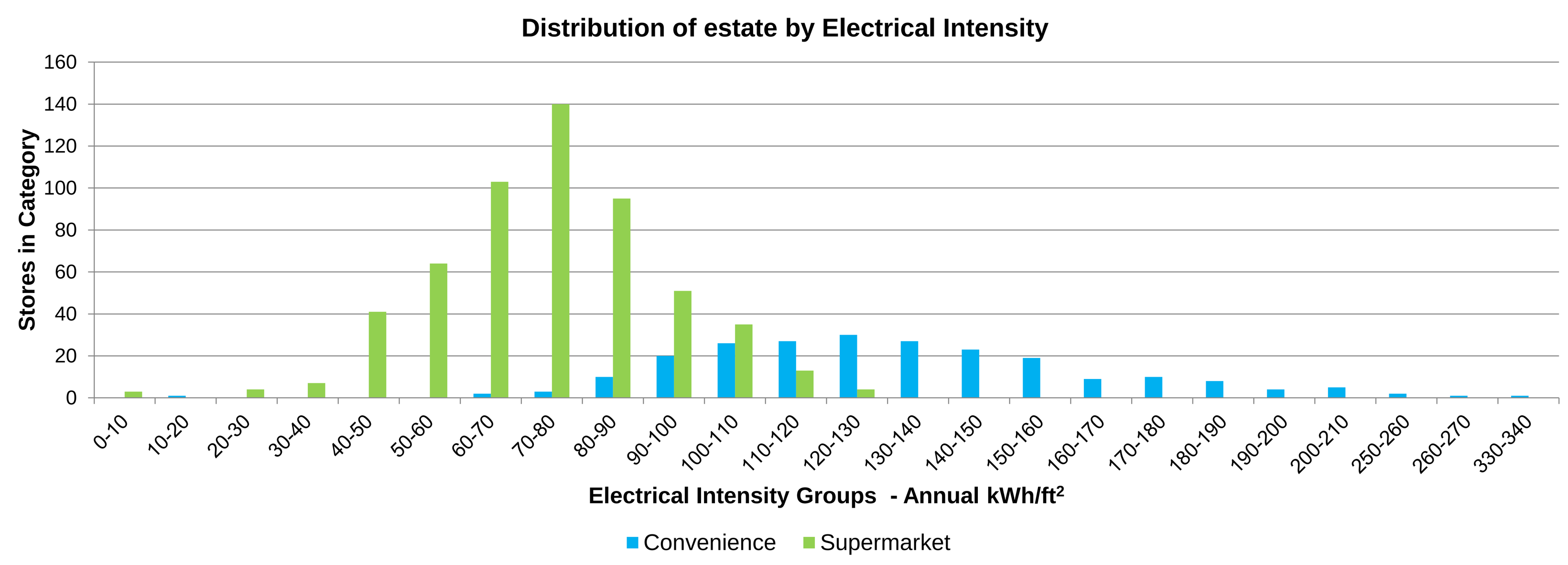

Figure 1: Electrical Intensity distribution of Sainsbury's estate.

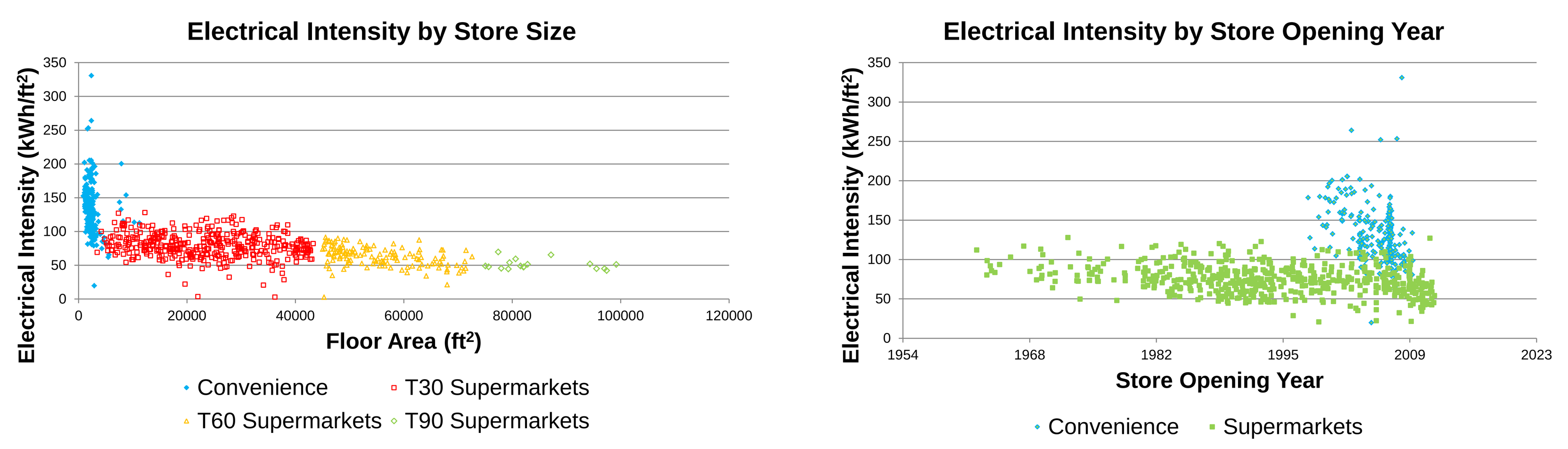

Figure 2 and 3: Electrical Intensity by floor area (2) and opening year(3).

Objectives

This thesis investigates the development of an investment tool in order to deepen understanding of energy investments and with the intended value of providing useful information to decision makers. This value rests on two objectives:

- Ease and speed of use of the investment tool
- Quality and usefulness of information provided by the investment tool

Methodology

The Python programming language, along with the PyQt User Interface framework, is a powerful toolkit for developing applications [2]. A build and patch methodology is followed and the program is developed in modules as shown in Fig 4.

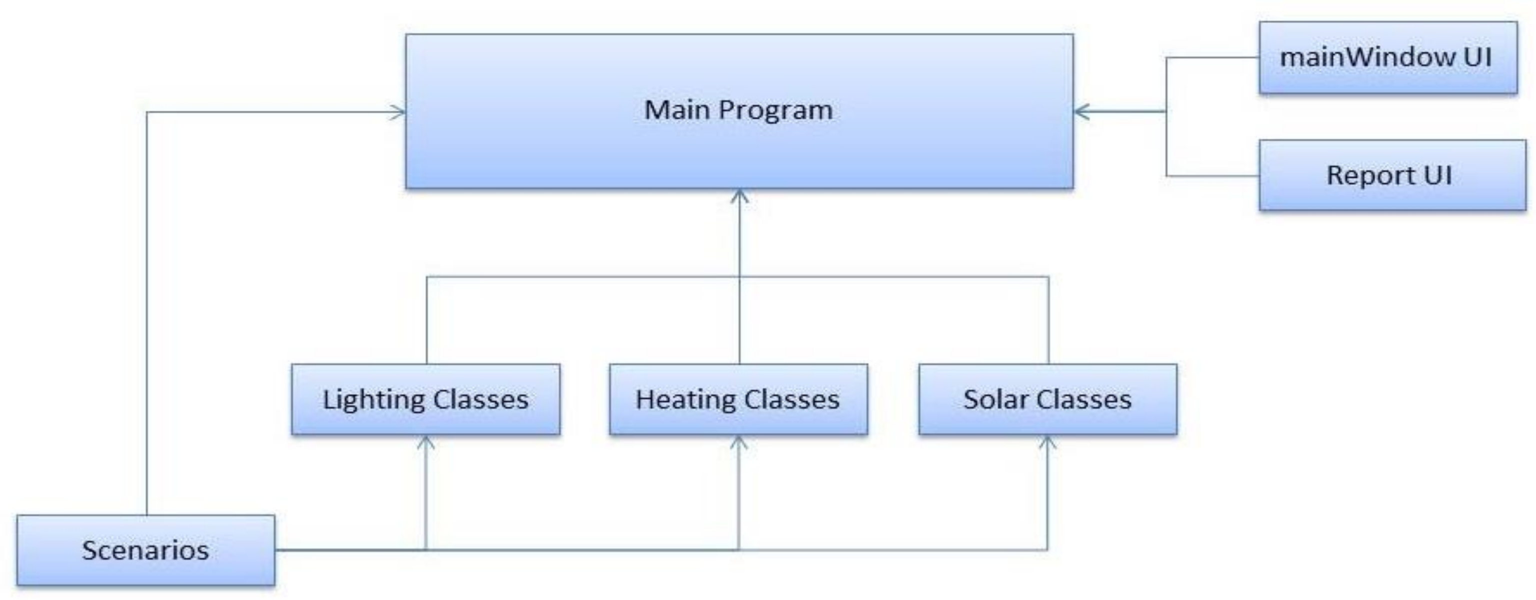

Figure 4: The modular structure of the investment tool program.

Results

The completed investment tool displays Key Performance Indicators (KPIs) to the user in a dynamic user interface, for each potential investment. These KPIs are Capital Expenditure, Net Present Value, Internal Rate of Return, Simple Payback Period, Annual Energy Savings and Lifetime Carbon Savings, as shown in Fig 5.

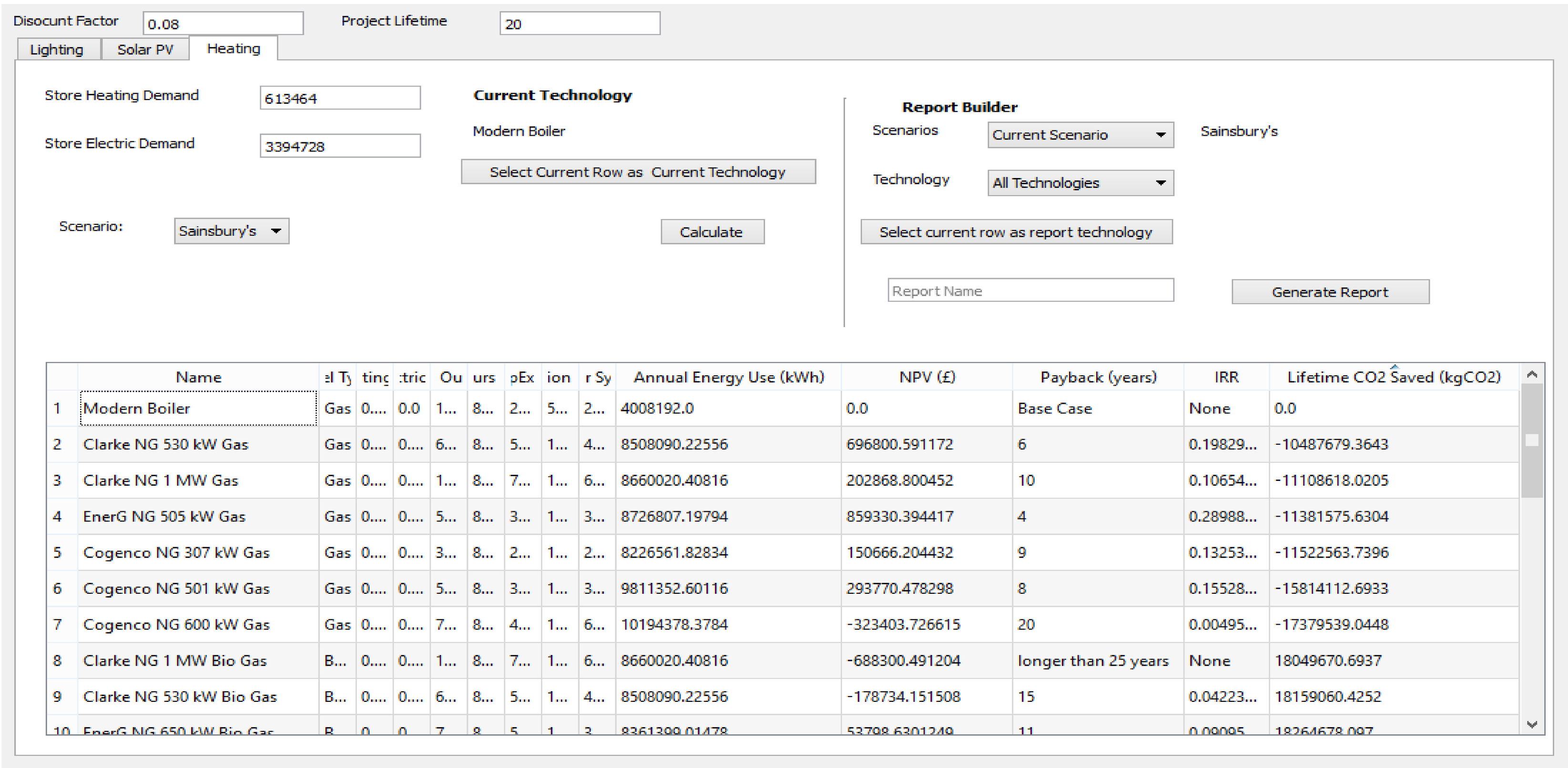

Figure 5: Screenshot of the investment tool user interface.

Case Studies

The investment tool has a reporting functionality that allows for the export of financial and social projections, allowing for deep analysis of investments.

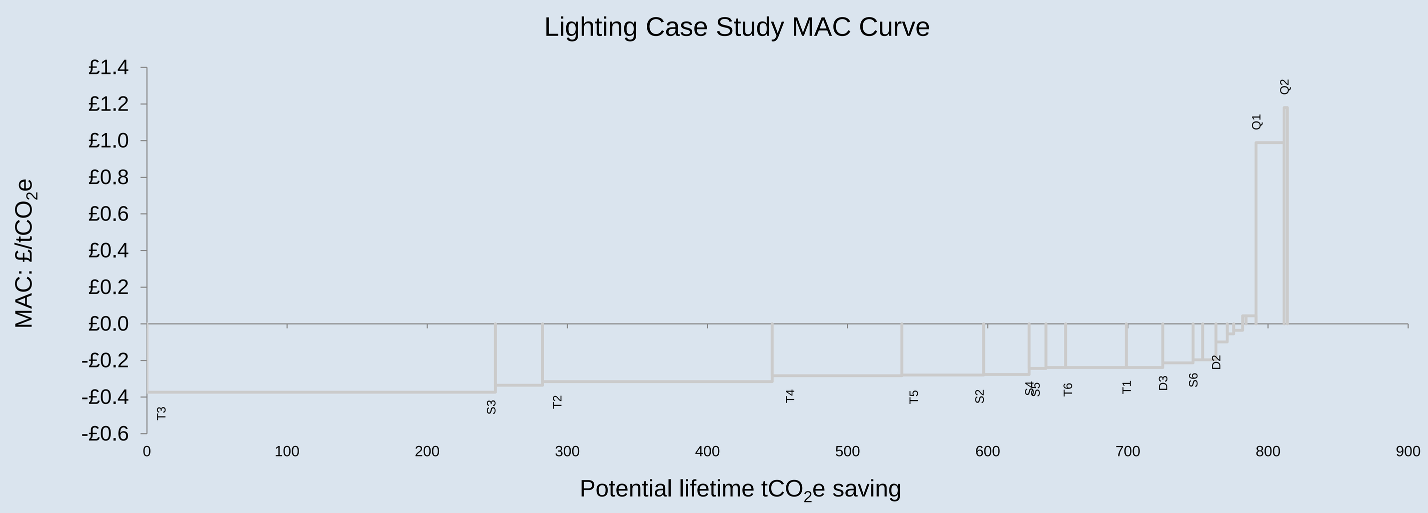

Figure 6: Marginal Abatement Cost (MAC) Curve for lighting investments.

Fig 6 compares investments in lighting technologies across different stores, showing the Marginal Abatement Costs, a combination of Net Present Value and Lifetime Carbon Savings.

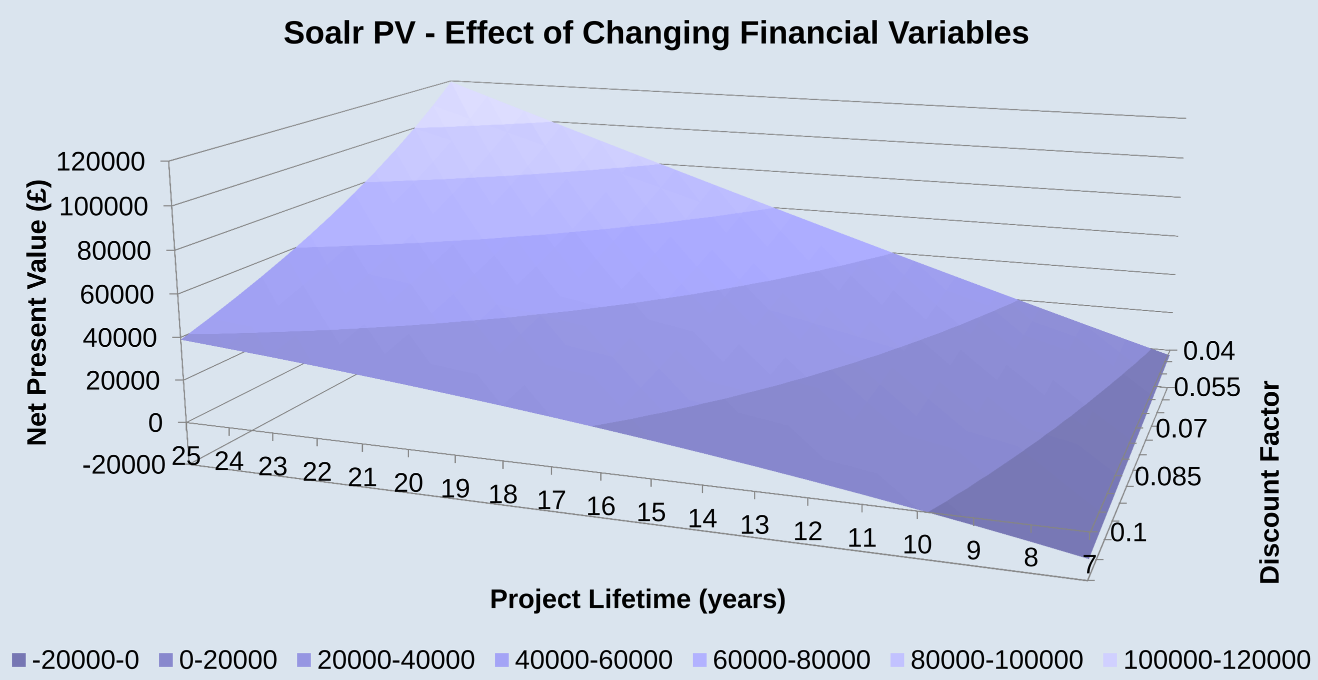

Figure 7: Analysis of financial variables for Solar PV investments.

The choice of discount factor and project lifetime are found to have a significant effect on the Net Present Value of Solar PV investments, as shown in Fig 7.

Conclusions

As a proof of concept, the investment tool can provide value to decision makers, particularly in respect to the speed, formalisation and depth of analysis.

The concept of Energy Service Demand is found to be helpful when developing this kind of program, defined as:

$$Energy\ Service\ Demand = E_1\eta_1 = E_2\eta_2 = E_3\eta_3$$

Where E_i = Energy use of technology i

η_i = Efficiency of i

Acknowledgements

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References

[1] J SAINSBURY PLC, 2012. *20 x 20. Our 20 commitments to help us all live well for less. Our progress so far.* J Sainsbury Plc.

[2] SUMMERFIELD, M., 2007. *Rapid GUI programming with Python and Qt: the definitive guide to PyQt programming.* Pearson Education.