



Modelling energy consumption in supermarkets to reduce energy use and greenhouse gas emissions using EnergyPlus

In this paper, a methodology was developed to model the total energy consumption of a supermarket and to study the impact of some technologies that can reduce energy consumption and GHG emissions. A medium sized supermarket in Paris was modelled using EnergyPlus™. The impact of climate change on ambient temperature and the impact of changes to the grid conversion factor were predicted for the store in Paris from 2020 to 2050.

The Paris store was simulated with a R744 booster system for refrigeration, chilled cabinets with doors, and electrical resistive heating. The real store consumed 540,000 kWh/year. The model predicted 544,161 kWh/year (an error of 0.76%).

	Annual consumption (kWh/year)
Heating	26 633
Cooling	19 417
Interior lighting	103 525
Interior equipment	160 603
Fans	37 372
Pumps	197
Water systems	16 686
Refrigeration	179 731
Total annual energy	544 161
TEWI	31 t CO _{2e} /year

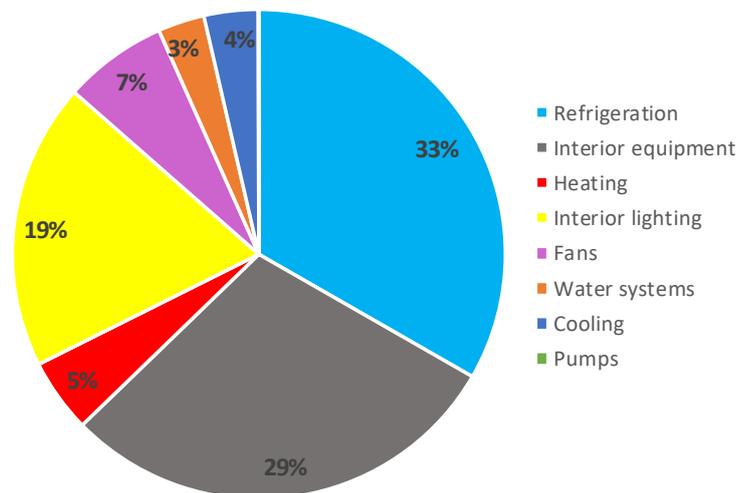


Fig. Energy consumption and TEWI for the validated Paris store

Influence of using electrical heating, a R744 booster refrigeration system, and doors on chilled cabinets

Electrical heating in Paris reduced CO_{2e} emitted by 31% compared to gas heating. When R744 was applied compared to R448A, 36% of the CO_{2e} emitted savings were achieved. Doors on cabinets had a major impact reducing energy consumption by 26%. By adding doors to cabinets, the heating required in the store was reduced, but this also resulted in the need for air conditioning in the summer months.

Prediction of energy use and CO₂ emissions between 2020 and 2050

- **Climate change had little impact on the total annual energy consumption of the supermarket in Paris.**

The simulation showed that heating was reduced by 22%, HVAC cooling and refrigeration increased by 25% and 1.7%, respectively. However, the total energy consumption increased by only 0.37%.

- **The electrical grid carbon conversion factor will decrease by 60% in France between 2020 and 2050**

France has a low electrical carbon factor because a large proportion of nuclear power is used to generate electricity. The predicted CO_{2e} emissions for the store reduce from 31 t CO_{2e}/year in 2020 to 12.7 t CO_{2e}/year in 2050 (a reduction of 60%). Additional technologies will need to be applied to achieve absolute or close carbon neutrality.

Find more about this study from the original publication: <http://dx.doi.org/10.18462/iir.icr.2023.0360>



ENOUGH webpage: <https://enough-emissions.eu/>
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