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Low energy catering strategy: insights from a novel carbon-energy calculator

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Abstract

This paper presents a highly original carbon-energy calculator, designed with the aim of realistically and holistically evaluating the carbon and energy impacts of different food preparation options in delivering a restaurant menu. Its design (based on life-cycle principles) brings the customer demand (number, type and timings of meals served) during typical, peak and special weeks together with the food storage, warewashing, ventilation, cooking and hot holding appliance capacities, carbon emissions and energy usage in various states. An assessment of separate and specific behavioural, equipment maintenance, preparation and cooking strategies are performed. The baseline energy use results were validated to within 0.65% of the findings from an extensive and detailed monitoring study of a leading operator of UK public houses and restaurants [1]. Seven energy reduction scenarios were then assessed using the developed calculator. Potential energy savings of 58% (195 MWh) and emissions savings of 46% (55,224 kgCO_2e) per year were indicated from replacing the chargrill, fryers and microwave combi ovens with two combi steam ovens and reducing freezing demand in the case study restaurant. This scenario projects reductions in energy use of 37.77 million kWh (£2 million) per year for the whole restaurant chain and up to 346 million kWh (£18.3 million) if applied to the whole case study organisation.

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Keywords: Catering; Energy Reduction; LCA; Carbon-Energy Calculator.

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1. Introduction

Catering businesses feature in virtually every town and city in the world and are vital establishments to be considered in any low carbon plan. Commercial kitchens are some of the most profligate users of gas, water and electricity in the UK. Recent statistics indicate that 42 TWh (11%) of all UK service sector energy consumption was described as being used during "catering" activities [2]. Despite high and wasteful energy usage, very little has been achieved in reducing the energy used in food preparation in these facilities. Commercial catering appliances have increased in efficiency in recent decades, adding features such as lower idle and warm up energies, insulation, thermostatic controls and cooking activity sensors. However, procurement of these modern appliances is still uncommon, due in part to high capital costs, long replacement cycles and difficulty in relating possible energy savings to the operator's frequently changing menu specifications and food throughput.

A recent and substantial energy monitoring study quantified the energy use of common commercial catering appliances in their typical states [1]. It was concluded that operator behavior, management planning choices and over specification of appliances are large sources of energy waste in the foodservice operation. However, the quantification of overall energy and environmental impact reductions remained largely unresolved due to the diverse range and volume of food served, different appliance configurations and capacities, and variable behavioral strategies employed within different kitchens.

Life cycle assessment (LCA) and carbon calculators are established methods to assess the energy and environmental impacts of products and services. While many LCA type studies exist which involve food products, focus on the commercial or contract foodservice sector is particularly scarce. This is partially due to difficulties associated with modelling the multiple and intangible behavioral determinants of user interaction with appliances and the complexity of large restaurant menus. The physical principles of cooking are overridden by the manner in which the appliances are used by the staff. Of the few studies which include cooking and consumption of food, it is interesting to note that cooking contributes almost half of the overall emissions of the product [3]. A rare study that focused on varying food preparation methods in a foodservice context (pasta cooking) concluded that the "best" option would depend on many factors aside from lowest energy, including overall equipment flexibility, efficiency, costs and convenience [4]. Furthermore, processes upstream and downstream of the actual cooking activities, namely chilled and frozen food storage, warewashing and extraction and ventilation (E&V) are also impacted by the operational management decisions involving cooking options. It was therefore recommended that these parameters be considered in future studies. Key improvements upon existing methodologies also include the requirement for full menus, ingredients and realistic portions to be modelled [6].

The true evaluation of such complexity found within the commercial kitchen operation calls for the development of a novel catering energy, cost and carbon calculator, to simplify the assessment of these operational choices and impacts and link realistic food diversity and volume to energy consumption. Given the staggering range of options available to a commercial caterer concerning the delivery of a diverse menu, this tool must be highly flexible to account for the variety of factors which may impact upon energy use. The aim of the present study is to realistically and holistically model and evaluate the carbon and energy impacts of different food preparation options in delivering a restaurant menu.

2. Methods

Using a bottom up approach and the principles of LCA, the carbon and energy calculator is built to model energy, cost and emission reduction in various food preparation scenarios. This paper refers to the "case study" site, which the baseline and energy reduction scenarios are based upon. The site is a gastro-pub representing a wider chain of 194 restaurants serving a varied menu. It is the most typical, "average" restaurant from the 14 monitored sites detailed in [1] and represents the median energy use, number of meals and typical suite and configuration of kitchen appliances. The overall design and approach of the tool was informed by consultation and collaboration with stakeholders, including the UK Carbon Trust, the Catering Equipment Suppliers Association (CESA) and the case study kitchen operators. Within the case study organization, heads of department from the Energy, Environment and Sustainability, Operations, Building, Procurement and Food Development teams, as well as the kitchen manager and head chef at the case study site provided regular input.