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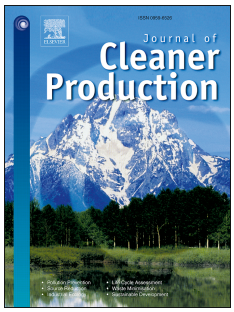

Highlights on energy efficiency improvements: a case of a small brewery

Anna Kubule, Liga Zogla, Janis Ikaunieks, Marika Rosa

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Anna Kubule, Liga Zogla, Janis Ikaunieks, Marika Rosa
Institute of energy systems and environment, Riga Technical University, Azenes Str.12-1, Riga, Latvia, LV-1048
Anna.Kubule@rtu.lv, Liga.Zogla@rtu.lv, Janis.Ikaunieks_1@rtu.lv, Marika.Rosa@rtu.lv
Corresponding author: Anna Kubule, Riga Technical University, Azenes Str.12-1, Riga, Latvia, LV-1048, Tel: +371 26357568, Anna.Kubule@rtu.lv

Abstract

The aim of the study is to provide a deep analysis of the potential impact of energy efficiency improvements by focusing on the evaluation of energy consumption and efficiency in various sub-departments at a small brewery - the locus of our research. To thoroughly analyse the specific energy consumption, an analysis of the historical energy consumption data, as well as an electricity consumption monitoring was carried out. The acquired knowledge significantly adds to the existing body of research, particularly by providing detailed data on energy consumption by different types of packaging equipment and through an in-depth analysis of energy efficiency in brewing and, uniquely, by analysing the barriers to implementation of energy efficiency measures over time. The analysis of the brewery's energy consumption, shows that it significantly exceeds recommended benchmarks, so an in-depth analysis of heat losses in the brew house and energy monitoring in the packaging department were performed to identify the source of the inefficiency and the potential improvements. The aim of the electricity monitoring was also to acquire detailed consumption data to enhance company's stakeholders' awareness and scope for decisions regarding energy efficiency. The results of electricity monitoring show large variation of specific energy consumption for various types of packaging, with much lower specific consumption for packaging in metal barrels than previously reported in literature. As separate measurements were performed for subsections of packaging lines, it is possible to identify causes for under-implementation of energy efficiency and to propose specific improvements for each of the subsections. In addition to technological aspect, also the energy efficiency barriers were considered. Building on the typical energy efficiency barrier studies, a distinctive approach to analyse the barrier dynamics over time is applied. It is concluded that in the case brewery the main perceived barriers have not changed over five-year period, even though some successful energy efficiency interventions have been implemented. The provided results from electricity monitoring in the packaging department of brewery may be further applied for development of individual process, industry and national benchmarks.

Highlights
Specific electricity consumption is measured for three different types of bottling.
Temporal dynamics of energy efficiency barriers are analysed.
Electricity monitoring results may be applied for development of peculiar benchmarks.

Keywords
Energy intensity; small brewery; heat losses; energy monitoring, benchmarking

1. Introduction

Industrial energy efficiency is actively pursued at a global and European Union (EU) level. In EU it is enforced through Energy Efficiency Directive, which provides measures for achieving EU's 20% energy efficiency target by 2020 (European Parliament, 2012). In addition to aiding these general objectives, improved industrial energy efficiency reduces the companies' cost of goods sold and therefore increase competiveness and productivity (Thollander et al., 2013), while reducing