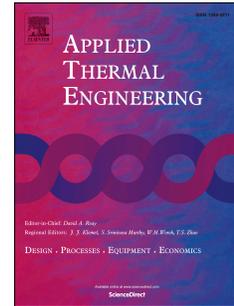


Accepted Manuscript

Dependency of production planning on availability of thermal energy in commercial green houses - A case study in germany

Barbara Sturm, Marina Maier, Mohammad Royapoor, Sharon Joyce



PII: S1359-4311(14)00471-2

DOI: [10.1016/j.applthermaleng.2014.05.095](https://doi.org/10.1016/j.applthermaleng.2014.05.095)

Reference: ATE 5698

To appear in: *Applied Thermal Engineering*

Received Date: 23 April 2014

Accepted Date: 28 May 2014

Please cite this article as: B. Sturm, M. Maier, M. Royapoor, S. Joyce, Dependency of production planning on availability of thermal energy in commercial green houses - A case study in germany, *Applied Thermal Engineering* (2014), doi: 10.1016/j.applthermaleng.2014.05.095.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

DEPENDENCY OF PRODUCTION PLANNING ON AVAILABILITY OF THERMAL ENERGY IN COMMERCIAL GREEN HOUSES - A CASE STUDY IN GERMANY

Barbara Sturm^{1,2}, Marina Maier¹, Mohammad Royapoor¹, Sharon Joyce³

1 Newcastle Institute for Research on Sustainability, Newcastle University, Newcastle upon Tyne, NE1 7RU, UK
2 Department of Agricultural Engineering, University of Kassel, 37213 Witzenhausen, Germany

3 Engineering Design Centre, School of Chemical Engineering and Advanced Materials, Newcastle University, Newcastle Upon Tyne, NE1 7RU

BarbaraSturm@daad-alumni.de

ABSTRACT

Commercial greenhouses are often referred to as the optimum heat dump for very low grade waste heat from a variety of sources. However availability, temperature levels and fluctuations in the availability necessitate a very different approach towards production planning as compared to traditional systems where energy supply is adapted to production demand and not the converse.

In this study, a commercial ornamental plant nursery that had switched its heat supply from natural gas to utilizing the waste heat of a commercial CHP system in 2007 was analysed. The differences between production planning and temperature regimes before and after switching to waste heat were compared. Furthermore, the degree of utilization of the waste heat available was evaluated.

The study undertaken showed three main results: Firstly, greenhouses present a good opportunity for the use of the low grade waste heat. However production needs to be planned very carefully to facilitate the production of high quality plants, for which traditional cultivation planning is unsuitable. Secondly, when planning on utilizing the heat (7.1 GWh_{th}/a) of a CHP system which is sized based on electricity output (6.7 GWh_e/a), to the full capacity, additional users need to be found and ideally heat storage integrated. Currently heat utilization amounts to less than 45 % (3.1 GWh_{th}) in total. Especially in summer most of the heat is discarded. Thirdly, several scenarios for utilization optimization were considered. The scenarios described allow for an increase of heat utilization to 62 % or 4.4GWh_{th} using some of the heat to run absorption chillers to provide cooling in summer and storing excess heat in long term heat stores (300 MWh_{th}) to reduce the additional gas demand. The results of the economic evaluation show that the integration of a cold store, supplied by the coolth by using an absorption chiller is financially attractive with a resulting payback period of 2.9 years, whilst consideration of integration of a PCM heat store is far from being viable with a payback period of almost 300 years.

Keywords: Green houses, CHP, Trigenation, production planning, waste heat, AD

1. INTRODUCTION

Low grade waste heat often cannot directly be reused within a process without being upgraded. One of the frequently cited solutions to this problem is to use it to warm greenhouses [1]. Intensive horticulture is an important part of the agricultural sector throughout the EU. In Germany 3,700 ha are used for protected horticulture, 91 % thereof for the production of vegetables and ornamental plants [2]. About 40 % of all buildings are older than 25 years and only 20 % being newer than 10 [2]. The typical make up of the buildings

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات