Mapping and Analyzing Energy Use and Efficiency in a Modified Hydroponic Shipping Container

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ABE 301

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Rachel grew up in Valparaiso, Indiana. She earned her B.S. in Agricultural Engineering from Purdue in 2014. She then joined the Ecological Sciences & Engineering program in fall 2014 and has since worked as a teaching assistant and researcher in the Agricultural & Biological Engineering department in pursuit of her M.S.E. Her research focuses on energy and resource use in vertical farms and hydroponic food systems. During her time as a graduate student, she has enjoyed serving as Recruitment Chair on the 2015-2016 ABEGSA board and Marketing Chair for the 2015 ESE Symposium Committee. Her interests outside research include drawing, cycling, attending concerts, and playing volleyball.

Vertical farming is becoming a popular alternative to conventional agriculture in an effort to increase local food production using hydroponic methods in controlled indoor spaces. More specifically, one method involves growing crops inside refurbished shipping containers, which offers a flexible, mobile, and scalable means of year-round food production in a variety of climates. Despite benefits of producing food locally, some of the concerns associated with vertical farming systems include high energy consumption and expensive capital investments. Therefore, this study investigated the viability and effectiveness of a shipping container farm through analysis of energy requirements and resulting crop yields. A Modified Hydroponic Shipping Container (MHSC) was designed and tested during an experimental lettuce growth period. Additionally, theoretical energy use of major system components was modeled and quantified for one year of production at full scale. A baseline crop production efficiency value was determined, and scenarios for improving energy efficiency from the baseline value were analyzed. Alternative energy scenarios reduced yearly consumption up to 53 percent from the baseline. Improvements to the MHSC design through suggested energy reduction strategies will allow for the creation of a viable and sustainable alternative food production system for use in urban communities.