

## ABSTRACT

Jeon, Bonggil. Ph.D., Purdue University, December 2016. HVAC Retrofit Solutions for Existing Small- and Medium-Sized Commercial Buildings. Major Professor: W. Travis Horton, School of Civil Engineering.

The primary purpose of the present study is to develop a framework and methodology for evaluating appropriate Heating, Ventilating, and Air Conditioning (HVAC) retrofit solutions that can be effectively retrofitted into different types of small- and medium-sized commercial buildings (SMSCB). Additionally, development of an advanced data-driven decision-making tool is introduced as a benefit of proposed framework.

In recent years, considerable attention has been focused on retrofits of existing commercial buildings (IBE, 2013b). In fact, the Commercial Building Energy Consumption Survey (CBECS) 2003 (EIA, 2006) indicates that over 70% of existing commercial buildings across the United States are more than twenty years old and these old buildings consume about 20% of the primary energy in the United States. Also, 99% of commercial buildings are within 1,001 – 200,000 square feet and these buildings consume about 75% of the energy used by all commercial buildings. Consequently, there is a great opportunity to save energy on SMSCB accompanied with integrated retrofit technologies, such as HVAC and envelope integration, and window and lighting integration.

Since this study focuses on developing a framework to evaluate proper HVAC retrofit solutions for SMSCB, each of the following aspects of the proposed framework is discussed: (1) the development of prototypical SMSCB models; (2) the identification of appropriate HVAC retrofit solutions for prototypical SMSCB types; (3) the analysis of selected HVAC retrofit solutions to each of the prototypical SMSCB types and climate zones; and (4) the assessment of both the energy savings and cost-effectiveness of the proposed HVAC retrofit solutions for prototypical SMSCB. Certainly, utilizing this methodology will provide stakeholders and contractors with a promising reduction in project cost including both installation and operating cost. Also, by employing the developed decision-making tool, building owners, contractors, and architects may have benefits of reduced time and effort for selecting appropriate HVAC retrofit solutions.

A case study is presented that utilizes this methodology in office, mercantile, education, food service, lodging, and food sales building types in several regions across the United States, and shows how the proposed framework may be used to adapt to different circumstances concentrating on HVAC retrofit solutions for prototypical small- and medium-sized commercial buildings (SMSCB).