THESIS

IMPLEMENTATION OF ENERGY EFFICIENCY PRACTICES INTO U.S. RETAIL SECTOR BY FACILITIES MANAGERS

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ABSTRACT

IMPLEMENTATION OF ENERGY EFFICIENCY PRACTICES INTO U.S. RETAIL SECTOR BY FACILITIES MANAGERS

Review of literature indicated that an in-depth analysis of implementation status of energy efficiency practices into U.S. retail sector, their benefits, barriers that prevented their wider implementation, and potential solutions for increasing the sector's energy efficiency was missing. The research purpose was to explore the status of implementing energy efficiency practices into the U.S. food and non-food retail sectors utilizing an in-depth review of the literature and a survey. To accomplish the research purpose, the following four research questions were examined: 1) To what extent do facilities managers in the U.S. integrate sustainable practices to achieve energy-efficient retail facilities? 2) What are the realized and perceived benefits of implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.? 3) What are the realized and perceived barriers to implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.? and 4) What do facilities managers propose as viable solutions that could help wider implementation of energy-efficient practices in the U.S. retail sector? Ninety-six facilities management professionals responded to the survey. The gathered data were analyzed utilizing descriptive statistical methods, and statistical tests such as pooled two sample t-tests and Welch-Satterthwaite t-tests. The research findings indicated that a majority of facilities managers that participated in the survey integrated energy efficiency practices into their retail

facilities. Facilities managers perceived the integration of building systems such as energy efficient electrical lighting and energy efficient HVAC systems as effective practices in enhancing the energy efficiency of their facilities. Respondents that integrated energy efficiency practices perceived that reduced energy consumption and lower energy bills were beneficial. Similarly, respondents that never integrated energy efficiency practices perceived that integration of such practices could result in benefits such as reduced energy consumption and lower energy bills. However, respondents perceived no reduction of CO_2 emissions. Respondents that integrated energy efficiency practices perceived that financial constraints prevented them from implementing such practices. Respondents that never integrated energy efficiency practices perceived that teamwork inefficiencies, lack of negotiation skills, and lack of support for energy efficiency practices from upper management prevented the use of energy efficiency practices in their facilities. Facilities managers proposed incorporation of commissioning into the building's life cycle, and proactive operation and maintenance of sustainable building systems as viable solutions that could help wider implementation of energy-efficient practices in the retail sector.

The study is significant as the U.S. retail sector, among commercial buildings, accounts for the most energy consumption per year. Hence, identifying the most effective energy efficiency practices, their benefits, barriers that prevented wider implementation, and utilizing potential solutions proposed by facilities managers could enhance energy efficiency of this sector.

DEDICATION

This research is dedicated to my mother, Soodabeh Eliassi, my father, Dr. Mohammad Hassan Saadatian Farivar, my sister Dr. Arezoo Saadatian Farivar and particularly my dear wife – soon to be "Dr." Katelyn Saadatian Farivar.

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CHAPTER 1: INTRODUCTION

1.1 BACKGROUND

Facilities Management (FM) is one of the fastest growing, multidisciplinary sectors that has seen a tremendous growth and transformation since its start in the U.S. in 1980s (Nazeer et al., 2019). FM market in the United States was worth $329 billion in 2018 and it is forecast to see a 40% increase in its value by 2024 (Wood, 2019). Today, due to complexity of modern society and its excessive use of resources, FM services are no longer limited to routine upkeep of buildings (Elmualim et al., 2008). FM core services include operations, maintenance, and emergency management of facilities to ensure a high level of functionality, efficiency and sustainability of the built environment (IBM, 2020).

With an increasing demand for environmentally friendly buildings, and legislative pressure, adoption of sustainability in FM has gained momentum (Rock et al., 2019). Sustainable Facilities Management is driven by the need to reduce the negative impacts of the built environment by advancing the economic, environmental, and social sustainability agenda (Elmualim et al., 2010). In advancing the sustainability agenda, facilities managers have to be able to translate strategic, and tactical decisions into measurable operational objectives (Shah, 2007). Involvement of facilities managers is crucial for any sustainability aim to emerge in both existing buildings and new facilities (Elmualim et al., 2010).

In addressing economic, environmental and social pillars of sustainability, sustainable facilities management covers diverse areas of responsibilities such as ethical purchasing, waste management and recycling, and flexible working hours for employees (Elmualim et al., 2010). However, most facilities managers indicate operational energy management highest in their list of obligations (Elmualim et al., 2010). This holds true as U.S. Department of Energy (2019) stated that building sector accounts for 40% of primary energy use while approximately 75% of that energy is consumed during the operation phase. Considering that in the developed countries, at least 50% of the buildings that will be used in the next 30 years have already been built, focusing on optimization of buildings' operational energy use is of utmost importance (Elmualim et al., 2010). This can result in relatively more rapid advancement towards minimizing the negative impacts of the built environment (Miller et al., 2010).

While proper implementation of sustainable facilities management is emphasized, it should be noted that these practices are business sector specific and are not the same for all organizations (Chotipanich, 2004). For instance, in a study done by Rock et al. (2019), barriers to implementing sustainable facilities management in commercial office buildings are analyzed. In another study, Saleh et al. (2011) identified and analyzed sustainable facilities management practices in higher learning institutions. Furthermore, sustainability practices such as energy management and individual metering in the housing sector are identified in a study conducted by Nielsen et al. (2009). The mentioned literature showcases that FM sustainability practices are building type and business sector specific.

U.S. commercial buildings are responsible for the second largest energy-related CO_2 emissions (EIA, 2020). Among 5 million commercial buildings in the U.S., retail sector accounts for the most energy consumption, and the largest energy costs per year (EIA, 2012). Hence, integrating sustainability practices into management of the retail buildings is of significant importance.

1.2 PROBLEM STATEMENT

Despite the availability of sustainable technologies, policies and operations management strategies, retail stores such as Walmart fall short of meeting their energy efficiency goals (Walmart ESG Report, 2019). In spite of such significance attached to sustainable facilities management of the retail sector, review of the related literature disclosed several gaps. A few studies (Aishah Kamarazaly et al., 2013; Barth et al., 2007; Elmualim et al., 2010; Galvez-Martos et al., 2013; Ikediashi et al., 2012; Mylona et al., 2017; Rock et al., 2019; Ríos-Fernández, 2020; Sarpin et al., 2016; Støre-Valen & Buser, 2019; Yang et al., 2018; Zaatari et al., 2016) investigated the benefits, barriers and potential solutions for wider implementation of sustainability agenda into different building sectors with a few focusing on retail facilities. However, a study focusing specifically on the status of implementation of energy-related sustainable practices into the U.S. retail sector, their benefits, barriers that prevented wider implementation, and potential solutions for increasing the sector's energy efficiency was missing.

1.3 PURPOSE OF THE STUDY AND RESEARCH QUESTIONS

Recognizing the important role of facilities managers in enhancing the energy efficiency of facilities, the purpose of this study was to explore the status of implementing energy-related sustainable practices into the U.S. retail sector while further understanding their benefits, barriers that prevented wider implementation, and analyzing the associated potential solutions proposed by FM professionals.

To accomplish the research purpose, the following research questions were examined:

1. To what extent do facilities managers in the U.S. integrate sustainable practices to achieve energy-efficient retail facilities?
2. What are the realized and perceived benefits of implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.?
3. What are the realized and perceived barriers to implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.?
4. What do facilities managers propose as viable solutions that could help wider implementation of energy-efficient practices in the U.S. retail sector?

CHAPTER 2: LITERATURE REVIEW

2.1 SUSTAINABILITY AND SUSTAINABLE BUILT ENVIRONMENT

The concept of sustainability has gradually evolved and developed over the years (Opoku et al., 2019). However, the main goal of sustainability has always been the physical preservation of human societies (Caldwell, 1998). This is due to the fact that consumption of resources and excessive generation of waste by the world population exceeds the earth's capacity to reproduce those resources and to absorb the wastes (Akenji et al., 2015). While sustainability is used in various professions, in this research, the term sustainability refers to sustainable development and sustainable operation of the built environment.

The built environment includes facilities and infrastructure systems that humans use and are foundations to existence of a society (Srinivasan et al., 2003). In 1987, Worlds Commission on Environment and Development defined sustainability as means to meet the needs of the current generation without limiting the ability of future generations to meet their own needs (Brundtland, 1987). In the context of the built environment, the given definition puts an emphasis on environmental sustainability, social equity and economic development (U.S. Department of Energy, 2003). In other words, acting in an environmentally, socially, and economically responsible manner would benefit all stakeholders involved in the built environment (Opoku et al., 2019).

Implementing sustainability in building industry significantly reduces the consumption of natural resources. According to U.S. Environmental Protection Agency (2001), buildings account for about 30% of the total raw materials consumed in the United States. Production of building materials results in depletion of nonrenewable resources and causes severe environmental impacts. Furthermore, according to International Energy Agency (2019), buildings account for 40% of the final energy consumption. It should be noted that in 2018, the building sector was responsible for 39% of energy consumption and process-related carbon dioxide (CO_2) emissions, 11% of which originated from manufacturing building materials such as steel, cement and glass (IEA, 2019).

Social benefits of sustainability in the built environment can be assessed at different levels such as buildings, communities, and societies. At building level, incorporation of social sustainability enhances health, comfort and satisfaction of occupants (Heerwagen, 2005) while extension of sustainability features from buildings to communities results in overall healthier societies (U.S. Department of Energy, 2003). At community level, social sustainability features, such as walkability of the neighborhood, result in higher levels of physical activity and social interaction among residents (Dannenberg et al., 2011; Frank et al., 2004; Ding & Gebel, 2012; Saelens & Handy, 2008; Durand et al., 2011; Humpel et al., 2002; Lund, 2002; Kim & Kaplan, 2004; Leyden, 2003). Physical activity and positive social interactions enhance physical health, mental health, and trust among residents (Kawachi & Berkman, 2001; Putnam, 2000).

Furthermore, in a study done by Macnaughton et al. (2017), working in sustainable, well ventilated offices resulted in 101% increase in cognitive scores of the workers. In another study, Boubekri et al. (2014) stated that employees working in offices with windows slept 46 minutes more per night on average. In other words, as the occupants of sustainable building can benefit from enhanced comfort, and well-being, improved productivity and significant reduction of absenteeism are achieved (Singh et al., 2010).

Sustainable buildings provide significant economic benefits to their owners, occupants, operators and societies. Most sustainable buildings have lower operational costs as a result of lower energy consumption, longer building lifecycle and reduced maintenance requirements (U.S. Department of Energy, 2003). In a report to California's Sustainable Building Task Force, Kats et al. (2003) stated that the financial benefits associated with reduction in energy consumption, waste generation and maintenance cost in sustainable buildings are over ten times the required initial investment. It is reported that the total return on investment of new green buildings is about 9.9% (McGraw-Hill, 2010). Also, it is worth noting that incorporating sustainable features into existing buildings increases the return of investment by 19.2% (McGraw-Hill, 2010). Furthermore, operation cost of new and existing green buildings decreases by 13.6% and 8.5% respectively (McGraw-Hill, 2010). At a society level, economic benefits of sustainable buildings include reduced costs from air pollution damage and lower infrastructure costs as a result of reduction of landfills, power plants, transmission lines, and distribution lines (U.S. Department of Energy, 2003).

2.2 ENVIRONMENTAL IMPACTS OF THE BUILDING SECTOR

It has been claimed that the built environment is in the front line of the fight against climate change (UK-GBC, 2008). According to the United Nations Environment Program (2007), the construction industry has the greatest opportunity to affect environmental issues due to its major share in energy consumption and contribution to global warming. Hence, in achieving the sustainable commitments made in the Paris Agreement and the United Nations Sustainable Development Goals (SDGs), decarbonization of the buildings and construction sector by 2050 is crucial (Global Alliance for Buildings and Construction, 2019).

2.2.1 ENERGY EFFICIENCY OF COMMERCIAL BUILDINGS

According to the energy consumption data gathered by EIA (2020), industrial sector and transportation sector account for 32% and 28% of total energy consumption respectively. Furthermore, as stated earlier, commercial and residential building sectors account for about 40% of total energy consumption in the U.S. (EIA, 2020).

Energy consumption in both residential and commercial buildings is projected to grow by 0.2% per year from 2019 to 2050 (EIA, 2020). While both of the building sectors represent an ever-increasing share of U.S. energy consumption, commercial sector energy use has been increasing more rapidly (EIA, 2020). Comparing the data corresponding to total primary energy consumed in the commercial sector indicates a 7% rise from 2015 to 2019 (EIA, 2020). In 2019, commercial buildings in the U.S. accounted for 18% of total energy consumption (EIA, 2020).

According to the U.S. Energy Information Administration (2012), in recent years, a more rapid growth has been seen in square footage of commercial buildings as compared to the number of buildings in the sector. In commercial building sector, about one-third of total floor space is allocated to buildings with an area of more than 100,000 square-feet (EIA, 2012). Large size of these facilities can have a significant impact on energy efficiency of commercial buildings (EIA, 2012).

According to EIA’s Commercial Buildings Energy Consumption Survey conducted in 2012, 5.6 million commercial buildings in the United States contain about 87 billion square feet of floor space. It is worth noting that the commercial building floor space is expected to increase by about 34% by 2050 (EIA, 2020). This rate of growth of the commercial building sector in the U.S. provides a great insight into the importance of implementing sustainability agenda into this sector. Furthermore, it highlights some of the industry's important but still relatively small achievements towards sustainable built environment.

According to Global Status Report on buildings and construction (2019), final energy demand in buildings rose 1% from 2017 to 2018, and 7% from 2010 to 2018. These findings stand in stark contrast with the fact that decarbonization and enhancement of energy efficiency in buildings should occur at a rate of 3% a year (Global Alliance for Buildings and Construction, 2019). As the building stock is expected to double by 2050, in accordance with Sustainable Development Goal of Affordable and Clean Energy, there is a significant need for enhancing building's energy efficiency (Global Alliance for Buildings and Construction, 2019). Furthermore, as operational energy accounts for 80-90% of a building's life cycle energy consumption, it is important to focus on enhancing the building energy performance during operation phase (Ramesh et al., 2010).

Commercial sector covers a wide variety of buildings such as hospitals, schools, offices, retail stores, grocery stores, restaurants, etc. While these buildings all fall under the same category, energy use and energy intensity of each differs. As reported by U.S. Energy Information Administration (2012), the most energy is consumed in offices and retail stores. While online retail stores have gained momentum in recent years, after a 36.7% increase from the third quarter of 2019, despite COVID – 19 Pandemic, only 14.3% of total retail sales were made online in the third quarter of 2020 (U.S. Census Bureau, 2020). In the U.S., 5% of the total electricity is consumed by big-box retail stores, large grocery stores and malls (Weissman et al., 2016). Hence, analyzing the major energy consumers, available energy management practices and technologies within traditional retail stores is of significant importance.

2.3 ENERGY MANAGEMENT IN RETAIL SECTOR

Energy consumption in the retail industry occurs within the following three main categories: stores, distribution centers, and transportation (Accenture, 2012). Most of the energy consumed in the first two categories is related to lighting, heating, cooling, ventilation and refrigeration (Dixon-O'Mara & Ryan, 2018). However, it should be noted that the levels of energy consumption and emissions heavily depend on building features, type of building appliances, sources of energy (renewable and non-renewable), and occupant's behavior (Ramesh et al., 2010; Martek et al., 2019).

2.3.1 IMPACT OF BUILDING ENVELOPE ON BUILDING ENERGY EFFICIENCY

The building envelope is the main thermal barrier between the indoor and outdoor environments. As the building envelope consists of walls, roof, slab on grade and foundation system of a building, their insulating properties play an important role in determining the energy demand associated with heating and cooling of buildings (U.S. Department of Energy, 2015). For instance, about 60% of heating load in commercial buildings is generated by flows through walls, foundation and the roof (U.S. Department of Energy, 2014). Furthermore, solar heat gain through windows is entirely responsible for cooling loads in commercial buildings (U.S. Department of Energy, 2015). Hence, enhancing the building envelope can improve the overall energy efficiency of buildings by reducing their lighting, heating and cooling loads. While building envelope enhancement affects the energy efficiency of small retail stores, building envelope performance does not significantly affect the overall energy efficiency of typical big-box retail stores (Haves et al., 2008). In other words, in big-box retail stores, large floor area results in dominant energy-use loads that are not significantly affected by upgrades in building envelope (Eley Associates, 2004). Furthermore, according to a report by U.S. Department of Energy, the payback period for insulation upgrades in building envelopes is heavily dependent on cost as opposed to enhancement of building's energy performance (EERE, 2014).

Within building envelope assembly of big-box retail stores, reducing the air leakage and thermal bridging can result in energy efficiency enhancement (Richman & Simpson, 2016). Methods such as implementation of ideal vestibule configurations and overhead door strategies are stated as effective means to reduce air infiltration and thermal bridging (ASHRAE, 2011). Straube (2014) states that in commercial buildings, the majority of heat loss and air leakage is caused by thermal bridging around insulation materials.

2.3.1.1 IMPACT OF INTEGRATED ROOF SYSTEMS

Energy savings and other environmental benefits such as reduction of emissions are also attainable by implementation of green features such as green roof, cool roof and using renewable energy sources in retail stores. Green roofs as a vegetative layer grown on a rooftop have been proven to reduce the negative environmental effects of heat islands (Environmental Protection Agency, 2019). Green roofs can enhance energy efficiency of buildings by decreasing the absorption of solar radiation and enhancing the building insulation (Yang et al., 2018). In a case study conducted at a Walmart store in Chicago, researchers reported that use of green roof resulted in 2.2% overall energy savings (Moseley et al., 2013). In this study, use of green roof mainly reduced the energy demand for space heating and space cooling. Researchers concluded that the energy savings from green roof can range from 1% to 6% depending on the climate (Moseley et al., 2013). Additionally, as a result of lower energy consumption of buildings with green roof, and sequestration of carbon in plants, green roofs provide other environmental benefits such as reduction of CO_2 emissions (Kuronuma et al., 2018).

Cool (reflective) roof absorbs less sunlight than a conventional roof which results in lower surface temperature (EPA, n.d.). Reduction of roof surface temperature directly decreases the heat gain through the roof, and air conditioning demand which result in energy savings (EPA, n.d.). While the efficiency of cool roofs depends on different factors such as building type, roof insulation, and size and efficiency of HVAC system in place, a study by Konopacki and Akbari (2001) showed that significant energy savings can be achieved by implementing cool roofs in a large retail store in Austin, Texas. This study showed that using cool roof instead of conventional models resulted in 11% daily energy savings of the building air conditioning system (Konopacki & Akbari, 2001).

According to International Renewable Energy Agency (2018), about 90% of the required reduction in energy-related CO_2 emissions can be achieved by means of renewable energy sources. The United States has more than 102,000 big-box retail stores which in addition to malls and large grocery stores account for 5% of total electricity use in the country (Weissman et al., 2016). Big-box retail stores in the U.S. provide about 4.5 billion square feet of rooftop space that is suitable for solar energy systems (Environment America Research & Policy Center, 2016). Furthermore, installation of Solar PVs on these roofs could offset the annual electricity use of U.S. big-box retail stores by 42% which reduces CO_2 emissions by 57 million metric tons annually (Environment America Research & Policy Center, 2016). According to EPA (2020), utilization of solar power has enabled large size retail companies such as Patagonia Inc. to self-supply 100% of their electricity demand.

2.3.2. IMPACT OF LIGHTING ON ENERGY EFFICIENCY

Installation of more energy-efficient lighting devices and using daylighting when possible can result in 40% to 80% reduction in energy consumption associated with lighting (Fedrizzi & Rogers, 2002). According to Energy Star (n.d.), installation of energy efficient lighting systems in stores and parking lots of H-E-B Grocery resulted in reducing CO_2 emissions by 78 million pounds per year and saving more than $3 million in energy expenses (Energy Star, n.d.).

Further energy savings can be achieved if the use of energy-efficient lighting strategies such as energy-efficient devices, daylight integration and intelligent control is combined with an appropriate lighting strategy (Galvez-Martos et al., 2013). A case study by Galvez-Martos et al. (2013) showed that introducing a lighting control strategy for a store in Europe in addition to daylighting would result in 27% reduction of overall energy consumption.

In a case study conducted in Ontario, Canada, Richman and Simpson (2016) quantified energy savings in big-box retail stores. They stated that switching from an inefficient lighting system, High Intensity Discharge (HID) lamps, to T-8 fluorescent lamps resulted in 22% reduction of the total electricity used in the store.

In another study, Mylona et al. (2017) calibrated the EnergyPlus model of a frozen food supermarket in the UK with its operational data. Investigation of the calibrated model demonstrated that upgrading the lighting system to LED reduces the electricity demand by 30.2% which results in a 2.5% reduction in total energy consumption of the store (Mylona et al.,2017).

2.3.3 IMPACT OF HEATING, COOLING AND VENTILATION ON ENERGY EFFICIENCY

In large facilities such as big-box retail stores, approximately 32% of the total energy used in retail stores are consumed by heating, cooling and ventilation systems (EIA, 2012). However, integration of control strategies, and installation of more efficient HVAC systems can reduce this type of energy demand by as much as 50% (Fedrizzi & Rogers, 2002). For instance, in a case study conducted in Boulder, Colorado, significant energy savings were achieved by replacing standard the HVAC system with High Efficiency Rooftop Units (Energy Star, 2008).

In a recent study, Ríos-Fernández (2020) investigated the environmental effects of replacing traditional supermarket HVAC system with other systems of high efficiency. The study indicated that use of the high efficiency HVAC system can result in 56%-62% reduction in electricity consumption and more than 50% reduction in CO_2 emissions (Ríos-Fernández, 2020).

Ventilation is an important factor in addressing the issues related to Indoor Air Quality (IAQ) while it significantly affects the overall energy consumption of retail stores (Zaatari et al., 2016). In the retail sector, on average, the ventilation system accounts for 8.4% of the total energy use index (Benne et al., 2009). Hence, it is important to find the minimum ventilation rates that will result in lower energy consumption without sacrificing the IAQ.

In periods of low occupancy, over-ventilation is one of the biggest challenges faced in big-box retail stores (Krepchin et al., 2006). One of the methods of identifying the optimal ventilation rate is utilization of Demand Control Ventilation (DCV) systems. DCV systems function by modulating outdoor air dampers based on building's rate of occupancy and outdoor air conditions such as temperature, relative humidity, etc. (Lawrence, 2004). According to

Lawrence (2004), utilization of DCV systems provides a great energy saving opportunity for retail stores.

Furthermore, in determining the minimum ventilation rate that saves energy without compromising the IAQ, Zaatari et al. (2016) proposes Pollutant Exposure Control Ventilation (PECV) strategy. In this strategy, the optimal ventilation rate that leads to energy savings is determined based on assessing the level of different contaminants present in the store and choosing the ventilation rate accordingly (Zaatari et al., 2016).

2.3.4 IMPACT OF REFRIGRATORS ON ENERGY EFFICIENCY

In big-box retail stores and supermarkets, refrigerators are considered the largest energy consumer of the facility (Energy Star, 2008). According to data provided by U.S. Department of Energy (1999), 40% of the overall energy consumption in food retail stores are from refrigerators. In addition to significant energy consumption, refrigerators running on CFC and HFC gases significantly contribute to environmental hazards such as ozone depletion (Delai & Takahashi, 2013).

Upgrading existing refrigeration systems to Energy Star approved ones can significantly reduce the energy consumption of retail stores (Energy Star, 2008). Furthermore, in a case study conducted at Walmart by U.S. Department of Energy, innovative solutions such as upgrading the anti-sweat heater control, installation of glass doors to medium temperature fridges, and replacing permanent split capacitor evaporator fans with electronically commutated motor fans resulted in saving 234,000 kWh/year in electricity consumption (U.S Department of Energy, 2015).

2.3.5 IMPACT OF OCCUPANT'S BEHAVIOR ON ENERGY EFFICIENCY

Occupants play a major role in enhancing the energy efficiency of buildings. This is due to the fact that building occupants, both in a passive and an active manner influence the indoor environment (Ahn & Park, 2016; Darakdjian et al., 2018; Haldi & Robinson, 2011). While the passive impact refers to generation of heat and CO_2 by building occupant, the active impact refers to the physical interaction of humans with building components and systems such as windows, and HVAC controls (Naspi et al., 2018). Hence, it is important to note that energy efficiency goals can be achieved by implementing both state-of-the-art technologies and energy management practices (Cibinskiene et al., 2020). In a recent study, Ali et al. (2020) analyzed the role of building occupants in energy performance of energy-efficient office buildings. The study indicated that hosting energy events and posting energy related advertisements causes occupant's behavior change that results in energy savings (Ali et al., 2020). Simulation of the occupant behavior modification techniques in an office building showed that 25.4% reduction in overall energy consumption over a period of three years is feasible (Ali et al., 2020). While further research needs to be done to understand the impact of occupant's behavior on energy efficiency of retail stores, it is safe to assume that the behavior of long-term occupants of retail stores such as salespeople may impact the energy performance of retail buildings.

2.4 SUSTAINABILITY AND FACILITIES MANAGEMENT

Starting from the late 1980s, facilities management has been continuously growing as a progressive sector and profession within the construction and building industry (Jensen, 2009). Nowadays, the scope of work for facilities managers goes beyond activities in buildings that support the core business of organizations. Facilities managers are now responsible for both short-term and long-term operation and maintenance of buildings, energy management, financial management, occupant's health and safety, etc. (Jensen, 2009; Atkin and Brooks, 2009). Due to wide range of services offered by facilities managers, integration of sustainability agenda into their practices can bring substantial environmental benefits such as energy savings and waste reduction (Hodges, 2005; Lai and Yik, 2006; Nielsen et al., 2009). Sustainable facilities management is defined as a process that enables and improves the capability of organizations to achieve their main objectives while optimizing environmental, economic, and social factors (Koukiasa, 2011). Nielsen et al. (2009) state that the demand for integration of sustainability practices in building operations continues to increase as more building owners show interest in sustainability initiatives. Enhancement of sustainability agenda through the building life cycle with a particular attention given to the operational phase can be achieved by facilities managers (Elmualim et al., 2008). As facilities managers have a great influence over the processes that occur during the life cycle of a building, they have the capacity to define, examine and evaluate sustainability issues. According to Tertiary Education Facilities Management Association (2004), sustainability assessment of facilities management can help with understanding the organization's stance on sustainability as FM practitioners have the ability to affect the sustainability outcomes in a wide range of services. Hence, equipping facilities managers with proper knowledge and tools can bring lasting values for organizations by developing and implementing a sustainability agenda (Hodges, 2005). Furthermore, literature indicates that the impacts of sustainable facilities management on environment and life cycle cost analysis (LCCA) of buildings are significant (Hodges, 2005; Prasad and Hall, 2004; CIOB 2004).

2.4.1 UNSUSTAINABLE BUILDING OPERATIONS

The work of facilities managers can result in continuous improvements of building energy performance through low-cost maintenance strategies, proactive operation and maintenance, and retrofits and commissioning. However, there is overwhelming evidence that many buildings underperform in their energy efficiency goals (Aune et al., 2009; Hignite 2009; Lewis et al., 2010; Hodges, 2012; Finch and Zhang, 2013). For instance, a report published by OECD/IEA (2013) indicated that LEED Platinum buildings, which were designed and equipped with latest energy-efficient technologies such as the ones explained earlier in this thesis, consume more energy than anticipated due to inadequate commissioning of building operating systems.

Inadequate commissioning, lack of tools for measuring and managing the performance of buildings systems, and poor facilities management have been identified as key reasons behind poor building performance (Carbon Trust, 2012). Furthermore, lack of budget allocation to FM strategies such as preventive maintenance is another reason behind poor building performance (Lewis et al., 2010). Facilities managers state that the objectives of preventive maintenance are enhancing durability, reliability and efficiency of buildings (Lewis et al., 2010). However, financial decision makers do not deem these objectives valuable (Lewis et al., 2010).

It should also be noted that while installation of highly efficient systems provides a foundation towards energy efficiency of buildings, operation and maintenance of those systems have larger economic and environmental impacts (CIBSE, 2012). According to Lewis et al. (2010), a poorly designed building with proper operation and maintenance outperforms a well-designed and well-equipped building with improper operational and maintenance strategy.

Buildings energy consumption and GHG emissions can be reduced by commissioning (Mills, 2011). Although commissioning of new buildings enhances its energy efficiency, building performance may degrade by 10%-15% within two to three years (Natural Resources Canada, 2012; California Commissioning Guide, 2006). This is due to the fact that buildings frequently go through occupancy and operational changes obstructing the optimal performance of mechanical, electrical, and highly interactive building control systems (California Commissioning Guide, 2006). Hence, rather than a one-time event, building commissioning should be viewed as a process that is incorporated into the building's life cycle. Recommissioning of existing buildings is recommended as it can identify suboptimal operation states and system malfunctions that may result in 20% increase in energy consumption if not resolved (IPCC, 2014). Despite numerous advantages associated with commissioning and recommissioning of buildings, building decision makers do not give much attention to these practices (IPCC, 2014).

Properly trained facilities managers play an important role in achieving energy efficiency goals of buildings (Hodges, 2012). It is even argued that facilities managers may be able to enhance the energy efficiency of buildings without extensive involvement of building occupants and sophisticated technological systems (Aune et al., 2009). This can be done by monitoring users' behavior and energy consumption to enhance that interplay to achieve further energy efficiency (Aune et al., 2009).

2.5 BARRIERS TO IMPLEMENTING SUSTAINABLE FACILITIES MANAGEMENT

In review of literature, facilities management functions with regards to environmental sustainability were identified. In previous studies, energy management and waste management, in addition to water management, asset management and maintenance management are considered as high priority functions for FM practitioners (Manjula et al., 2016; Sekula & Hodges, 2014; Aaltonen et al., 2013; Nielsen et al., 2016; TEFMA, 2004; Elmualim et al., 2012; Junghans, 2011). Despite the opportunity to implement sustainability agenda and to make tangible changes, current FM practitioners do not have an easy access to the knowledge and tools, and do not get support from senior managers (Elmualim et al., 2009). Previous research has identified issues and challenges with integrating sustainability with facilities management practices.

In a study conducted by Rock et al. (2019), seven main barriers preventing the green operation of office buildings in Australia identified by FM are discussed. Barriers include financial, technological, regulatory, design related and conflict of interest among stakeholders (Rock et al., 2019). In this case study, the involved FM clients were covering the associated costs with green operation of their office buildings from the company's capital expenditure budget (Rock et al., 2019). Capital expenditure budgets are renewed every five years and the expected pay-back period is two years or less (Rock et al., 2019). Hence, it was challenging for facilities managers to make a case for implementation of sustainability measures where the pay-back period is usually over five years (Rock et al., 2019). Furthermore, Rock et al. (2019) stated that technological obstacles such as inexistence of building monitoring systems in old buildings, and outdated equipment that are costly to run impose significant challenges on FM professionals. Also, participants in this study stated that regulatory goals are often in opposition with each other, which causes confusion among FM practitioners (Rock et al., 2019). Additionally, due to the importance of building aesthetics, designers may refrain from using energy efficient lights which hinders facilities managers' abilities to implement lighting sustainability measures into the building (Rock et al., 2019). Conflicts of interest arising from distinct priorities and different levels of education of landlords and tenants were also mentioned as major barriers faced by FM practitioners (Rock et al., 2019).

In another study, Støre-Valen and Buser (2019) discuss that occupants' behavior is the main challenge in implementing sustainability agenda in facilities management of houses and offices in Scandinavian countries. Furthermore, in a study done by Ikediashi et al. (2012), three main barriers to sustainable facilities management in Nigeria are identified as lack of awareness, lack of policy and regulation to enforce existing laws on sustainability practices, and lack of training and tools for FM practitioners. Lack of sustainability awareness due to severe economic hardship in Nigeria makes it challenging for FM professionals to convince people about the benefits of sustainability despite its higher upfront cost (Ikediashi et al., 2012).

In studies done by Elmualim et al. (2010), Halim et al. (2017), Hodges (2005), Shafii et al. (2006), and Shah (2007), lack of professional capabilities and skills and lack of awareness of building whole-life value are mentioned as main capability challenges faced by FM practitioners. Furthermore, authors discuss that limited knowledge about sustainability is one of the key challenges in fostering competency and implementing sustainability agenda by facilities managers. Organizational challenges such as time constraints, lack of commitment to sustainability from senior management and lack of funding for FM related activities are also considered as major barriers faced by facilities managers.

2.6 POTENTIAL SOLUTIONS FOR WIDER IMPLEMENTATION OF SUSTAINABLE FACILITIES MANAGEMENT

In addressing the financial and organizational challenges, Aishah Kamarazaly et al. (2013) suggested that optimizing assets utilization and demonstration of return on investment (ROI) may help facilities managers overcome financial issues. Presenting a compelling business plan and proof of optimized asset utilization increases the success rate of capital investment funding application (Aishah Kamarazaly et al., 2013). Furthermore, facilities managers should be able to present business plans that demonstrate good ROI when submitting proposals for any capital investment (Aishah Kamarazaly et al., 2013). In other words, FM professionals should be able to quantify the impact of sustainable facilities management on a business in monetary terms (Aishah Kamarazaly et al., 2013).

In addition to interpersonal capabilities such as the ability to work with other disciplines, facilities managers should enhance their understanding of sustainability practices, life-cycle cost (LCC) and total cost of ownership (Sarpin et al., 2016). This minimizes any capability-related challenges in implementing a sustainability agenda into FM practice (Sarpin et al., 2016). Furthermore, solving sustainability related issues and creating sustainability opportunities in the FM industry requires strong teamwork capabilities and negotiation skills with all stakeholders involved (Barth et al., 2007; Sarpin et al., 2016). Also, it is essential for FM professionals to be able to identify short-term and long-term consequences of their actions when integrating sustainability into their practice (Sarpin et al., 2016). This foresighted thinking enables facilities managers to identify new opportunities and to minimize risk (Sarpin et al., 2016).

2.7 SUMMARY

Despite the availability of sustainable technologies, policies and operations management strategies, retail stores such as Walmart fall short of meeting their energy efficiency goals (Walmart ESG Report, 2019). While facilities management functions are business sector specific and are not the same for all organizations (Chotipanich, 2004), the latest available research has primarily focused on benefits, opportunities, and barriers faced in sustainable facilities management field broadly with a few studies concentrating on specific sectors such as healthcare, offices and houses (Elmualim et al., 2010; Hodges, 2005; Nazeer et al., 2019; Nielsen et al., 2009; Shah, 2007; Wyatt et al., 2000). In recognition of this gap in the existing body of literature, this research aimed to identify the status of implementation of energy-related sustainable practices into the U.S. retail sector, their benefits, barriers that prevented wider implementation, and analyzing the associated potential solutions proposed by FM professionals.

CHAPTER 3: RESEARCH METHODOLOGY

This chapter presents the research methodology. The research consisted of four interconnected phases (see Figure 1). These phases included Literature Review (Chapter 2), Creating Survey Instrument (Section 3.1), Data Collection (Section 3.2), and Data Analysis (Section 3.3.).

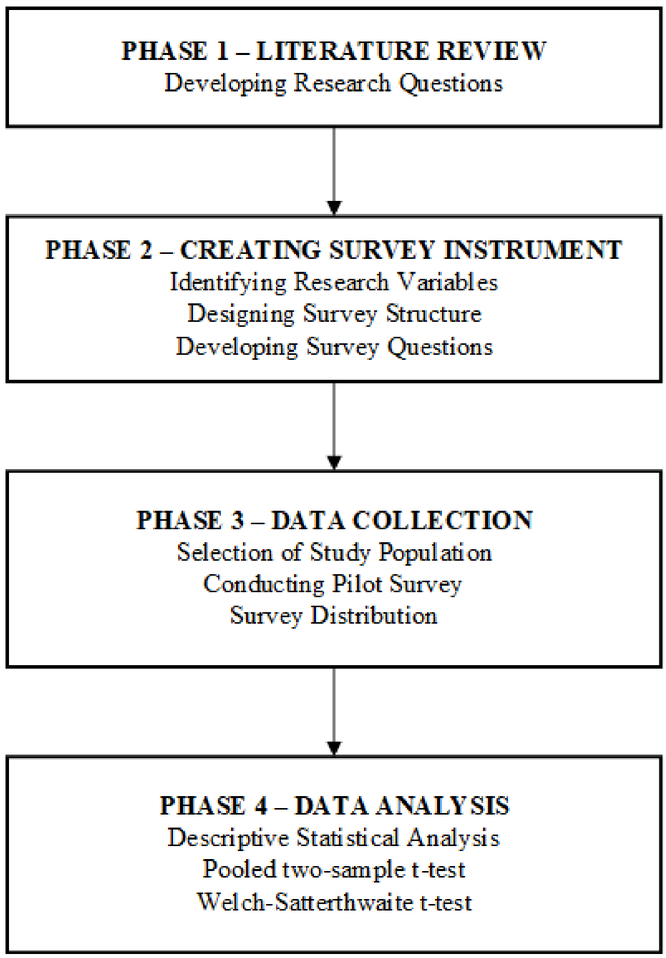

Figure 1. Research Methodology

3.1 LITERATURE REVIEW

An in-depth review of existing literature (see Chapter 2) revealed that despite availability of sustainable technologies, policies and operations management strategies, retail facilities fell short of meeting their energy efficiency goals. Furthermore, the literature review disclosed a gap in understanding the status of implementing energy-related sustainable practices into the U.S. retail sector, their benefits, barriers that prevented wider implementation, and potential solutions for increasing the sector's energy efficiency. This finding informed the development of four research questions that investigate the aforementioned gap in the literature. Consecutively, utilizing the literature review, the researcher identified the study variables associated with each research question. The researcher tailored these variables to the type of retail facilities (food and non-food). Study variables and survey instrument design are further discussed in the following section.

3.2 CREATING SURVEY INSTRUMENT

The study variables included energy efficiency practices, benefits of energy efficiency practices, barriers that prevented their wider implementation, and solutions for increasing the sector's energy efficiency. Subsequently, the researcher created a logic map to lay out the survey structure for four distinct groups of respondents (see Figure 2). These groups included: 1) respondents that integrated energy efficiency practices into their food retail facilities, 2) respondents that did not integrate energy efficiency practices into their food retail facilities, 3) respondents that integrated energy efficiency practices into their non-food retail facilities, and 4) respondents that did not integrate energy efficiency practices into their non-food retail facilities.

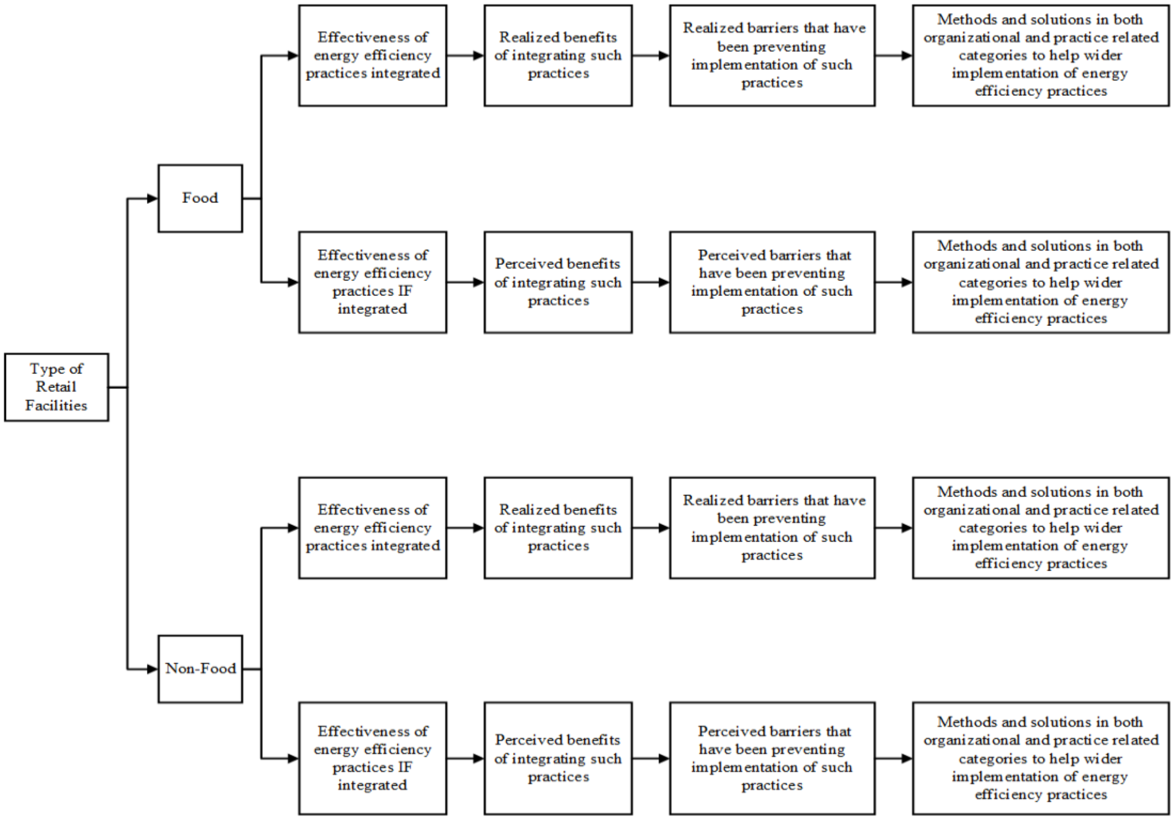

Figure 2. Survey Logic

Utilizing the identified variables and the survey logic map**,** an online, self-administered survey (see Appendix 1) was developed in an effort to answer the research questions. The survey included multiple choice questions, Likert scale questions as well as open-ended questions. The first set of questions helped the researcher gather demographic information such as respondents' level of education, type of organization, industrial category, and size of the facilities they managed. In this set of questions, respondents were asked to state the type of retail facilities they managed. Furthermore, respondents were asked to indicate if they integrated energy efficiency practices into their retail facilities. Based on their responses, respondents were directed to the remaining four sets of questions specifically tailored to the type of retail facilities they managed (see Figure 2).

The second set of questions helped the researcher understand the effectiveness of sustainability practices, specifically related to energy efficiency of retail facilities. Respondents who integrated energy efficiency practices into their retail facilities were asked to rate the effectiveness of these practices for increasing energy efficiency of their retail facilities. Subsequently, they were directed to the third set of questions, which helped the researcher identify respondents' level of agreement with realized benefits of integrating energy efficiency practices. The fourth set of questions helped the researcher understand respondents' level of agreement with the realized barriers that have been preventing implementation of energy efficiency practices in their retail facilities. The last set of questions required respondents to propose other building systems and/or building structural features to achieve energy-efficient retail facilities. Furthermore, respondents were asked to propose other professional development methods and/or sustainable management strategies for facilities management personnel to achieve energy-efficient retail facilities.

Respondents who did not integrate energy efficiency practices into their retail facilities were asked to rate how effective these practices could be for increasing energy efficiency of their retail facilities. Subsequently, the respondents in this group were asked to rate their level of agreement with benefits that the integration of the energy efficiency practices in their retail facilities could bring. Additionally, the respondents in this category were asked to rate their level of agreement with the barriers that have been preventing the use of energy efficiency practices in their retail facilities. The last set of questions required respondents to propose other building systems and/or building structural features to achieve energy-efficient retail facilities. Furthermore, respondents were asked to propose other professional development methods and/or sustainable management strategies for facilities management personnel to achieve energy-efficient retail facilities.

3.3 DATA COLLECTION

Prior to beginning of the research, the developed survey was reviewed and approved by Colorado State University's Institutional Review Board (IRB) to protect human research participants. Participation in this survey was voluntarily. Prior to the start of the survey, information such as survey duration, potential risks and benefits, and data security were provided to the participants. All survey responses were anonymous and no identifying information about the respondents were collected.

This survey was designed to be completed by facilities managers with prior experience in managing retail facilities. Prior to the start of data collection phase, the survey was distributed to two facilities management professionals to pilot test the survey instrument. These professionals were asked to take the survey and provide feedback on flow of the survey, clarity of questions, and survey duration. The feedback received from these professionals was used to revise and improve the survey instrument.

On September 21, 2021, the final version of the survey was sent to 9,132 members of International Facility Management Association (IFMA) using the organizations' online email directory. Furthermore, the survey was distributed among researcher's 84 LinkedIn connections. An online post including information about the survey and the survey link was also shared publicly on the researcher's LinkedIn profile. Furthermore, survey recipients were asked to forward the survey invitation to other facilities management professionals who may be interested in participating in this study. This online survey was open until December 7, 2021 (11 weeks).

On every Tuesday during this time period, a reminder email was sent to survey recipients. These reminders were sent on October 5, 2021, October 12, 2021, October 19, 2021, October 26, 2021, November 2, 2021, and November 9, 2021.

3.4 DATA ANALYSIS

It should be noted that IFMA is represented by members in over 106 countries. Therefore, five facilities management professionals who participated in this study indicated managing the largest number of their retail facilities outside of the United States. These responses are included in the data analysis of this thesis. However, 95% of respondents managed the largest number of their retail facilities in the United States. Hence, the study findings primarily represent the perspectives of facilities managers managing retail facilities in the United States.

The gathered data were analyzed using descriptive statistical method to provide a general overview of the results. This method was used to provide basic information such as distribution of responses and means of all variables (for sample size (N) larger than 1), and to highlight potential relationships between those variables. The descriptive statistical analysis conducted in this research were displayed graphically and/or in tabular format. In addition, the collected data were further analyzed to understand the difference in respondent perceptions about effectiveness of energy efficiency practices, benefits of energy efficiency practices, barriers that prevented their wider implementation, and solutions for increasing the sector's energy efficiency within each group of respondents discussed above. To understand the differences in respondent perceptions, pooled two sample t-tests and Welch-Satterthwaite t-tests were conducted to compare rating means. In this research, each variable was collected from a randomly selected portion of the total population. Hence, the assumption of having independent random samples was satisfied. Equality or inequality of variances was checked prior to running the test. For samples with equal variance, a pooled two-sample t-test was performed. For samples with unequal variance, Welch-Satterthwaite t-test was performed. Sample sizes equal to or greater than 30 were considered sufficient for the Central Limit Theorem to hold. In other words, in this research, samples with more than 30 responses were considered normally distributed. These tests were also performed for samples sizes smaller than 30. This approach was adopted because according to de Winter (2013) there are no principal objections to using a t-test for small samples. However, in this study, t-tests were only performed for sample sizes larger than or equal to five. Furthermore, the researcher paid attention to potential false positive outcome of statistical analyses performed. The credibility of findings of this study was individually judged by the researcher. As part of the statistical analyses performed in this research, specific p-values are presented and discussed in Chapter 4. In this research, p-values represent the probability that the difference between the calculated means of responses is at least as large as the reported value. In this research, the level of significance (alpha, α) of all statistical analyses performed was set at 0.05. Hence, in this study, p-values less than or equal to 0.05 indicated that the difference between means of responses for two variables was statistically significant. On the other hand, p-values larger than 0.05 indicated that the difference between means of responses for two variables was not statistically significant.

3.5 RELATIONSHIP AMONG RESEARCH QUESTIONS, SURVEY QUESTIONS & METHOD OF ANALYSIS

Table 1 summarizes the research questions and their corresponding survey questions. Method of statistical analysis used for each survey question is also presented in Table 1.

Table 1. Relationship among Research Question, Survey Questions & Method of Analysis

Research Question	Corresponding Survey Question(s)	Method of Analysis
No RQ	OC - Do you consent to participate in this survey?	Frequency of distribution
	EP - Have you worked as a facility manager in the retail sector?	Frequency of distribution
	PDQ1 - Which of the following options best describes your role in your facilities management company?	Frequency of distribution
	PDQ2 - What level of education do you have?	Frequency of distribution
	PDQ3 - Which of the following professional development credentials did you complete? (select all that apply)	Frequency of distribution
	PDQ4 - Which environmental sustainability-related training did you complete? (select all that apply)	Frequency of distribution
	ODQ1 - In which country do you manage retail facilities? (If your facilities are located in multiple countries, choose the country in which you manage the largest number of facilities):	Frequency of distribution
	ODQ1.1 - If you manage retail facilities in the USA, please select the state. (If your facilities are located in multiple states, choose the state in which you manage the largest number of facilities):	Frequency of distribution
	ODQ2 - What is the type of your facilities management organization?	Frequency of distribution
	ODQ2.1 - What is the average size of the facilities you manage?	Frequency of distribution
	ODQ3 - What is your company's annual revenue?	Frequency of distribution
	ODQ4 - What is the average age of the buildings you manage?	Frequency of distribution
	F-NF1 - What type of retail facilities do you manage?	Frequency of distribution
	F-NF2 - Please select the type of your non-food retail store:	Frequency of distribution
	ARS2 - Does your company* offer incentives to the facilities management department to integrate energy-efficiency practices into your retail facilities? *End-user facilities management organization	Frequency of distribution
	ARS3 - What kind of incentives are offered to the facilities management department to integrate energy-efficiency practices into your retail facilities?	Summary of responses
	ARS4 - Does your facility management company* offer incentives to the facilities managers who integrate	Frequency of distribution

Research Question	Corresponding Survey Question(s)	Method of Analysis
No RQ	energy-efficiency practices into retail facilities? *Outsourced providers of FM services to clients	
	ARS5 - What kind of incentives are offered to the facilities managers who integrate energy-efficiency practices into retail facilities?	Summary of responses
RQ1 - Extent	ARS1 - Do you implement energy efficiency practices in the facilities you manage?	Frequency of distribution
	FRS-NO-1 How effective the integration of the following energy efficiency practices could be for increasing energy efficiency in your retail facilities?	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-NO-2 If there are other energy efficiency practices that you would use in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	FRS-YES-1 Based on your experience with integrating energy efficiency practices in your retail facilities, please indicate how effective the following practices have been for increasing energy efficiency:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-YES-2 If there are other energy efficiency practices that you use in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-NO-1 How effective the integration of the following energy efficiency practices could be for increasing energy efficiency in your retail facilities?	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-NO-2 If there are other energy efficiency practices that you would use in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-YES-1 Based on your experience with integrating energy efficiency practices in your retail facilities, please indicate how effective the following practices have been for increasing energy efficiency:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-YES-2 If there are other energy efficiency practices that you use in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses

Research Question	Corresponding Survey Question(s)	Method of Analysis
RQ2 - Benefits	FRS-NO-3 Please rate your level of agreement with the following benefits that the integration of the energy efficiency practices in your retail facilities could bring:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-NO-4 If there are other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	FRS-YES-3 Based on your experience with integrating energy efficiency practices in your retail facilities, please rate your level of agreement with the following realized benefits they have brought:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-YES-4 If there are other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-NO-3 Please rate your level of agreement with the following benefits that the integration of the energy efficiency practices in your retail facilities could bring:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-NO-4 If there would be other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-YES-3 Based on your experience with integrating energy efficiency practices in your retail facilities, please rate your level of agreement with the following realized benefits they have brought:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-YES-4 If there are other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
RQ3 - Barriers	FRS-NO-5 Please select your level of agreement with the following barriers that have been preventing the use of energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-NO-6 If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses

Research Question	Corresponding Survey Question(s)	Method of Analysis
RQ3 - Barriers	FRS-YES-5 Please indicate your level of agreement with the following realized barriers that have been preventing implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-YES-6 If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-NO-5 Please select your level of agreement with the following barriers that have been preventing the use of energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison
	NFRS-NO-6 If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
	NFRS-YES-5 Please indicate your level of agreement with the following realized barriers that have been preventing implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-YES-6 If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:	Summary of responses
RQ4 - Solutions	FRS-NO-7 Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	FRS-NO-8 What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	FRS-NO-9 What other professional development methods and/or sustainable management strategies for facilities management personnel would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	FRS-YES-7 Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)

Research Question	Corresponding Survey Question(s)	Method of Analysis
RQ4 - Solutions	FRS-YES-8 What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	FRS-YES-9 What other professional development methods and/or sustainable management strategies for facilities management personnel would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	NFRS-NO-7 Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-NO-8 What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	NFRS-NO-9 What other professional development methods and/or sustainable management strategies for facilities management personnel would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	NFRS-YES-7 Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:	Descriptive statistical analysis (frequency of responses, mean of responses); + pooled two sample t-tests and/or Welch-Satterthwaite t-tests for mean comparison (if applicable)
	NFRS-YES-8 What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?	Summary of responses
	NFRS-YES-9 What other professional development methods and/or sustainable management strategies for facilities management personnel would you suggest to achieve energy-efficient retail facilities?	Summary of responses

CHAPTER 4: RESULTS AND DISCUSSION

A total of 333 responses to the survey were received. Twenty responses were incomplete as respondents did not consent to participate in the survey. Of 313 respondents who consented to participate in the survey, 305 proceeded with the survey questions. However, a majority (209) of respondents were eliminated from this study since they indicated never working as a facility manager in the retail sector. The remaining 96 responses were used in the result analysis.

4.1 PARTICIPANTS DEMOGRAPHIC INFORMATION

A majority (86, 90%) of respondents answered a question about their role in their facilities management company. A large majority (82, 95%) of respondents' roles fell under 10 categories offered in the survey (see Figure 3). Thirty-five (41%) and 30 (35%) respondents worked as Facilities Managers and Facilities Directors respectively. Four respondents selected "other" type of role in their facilities management company. These respondents included one remodel manager, one property manager, one account manager, and one Chief Executive Officer (CEO) of a facilities management company. According to the distribution of responses, a majority of respondents worked as Facilities Managers or Facilities Directors.

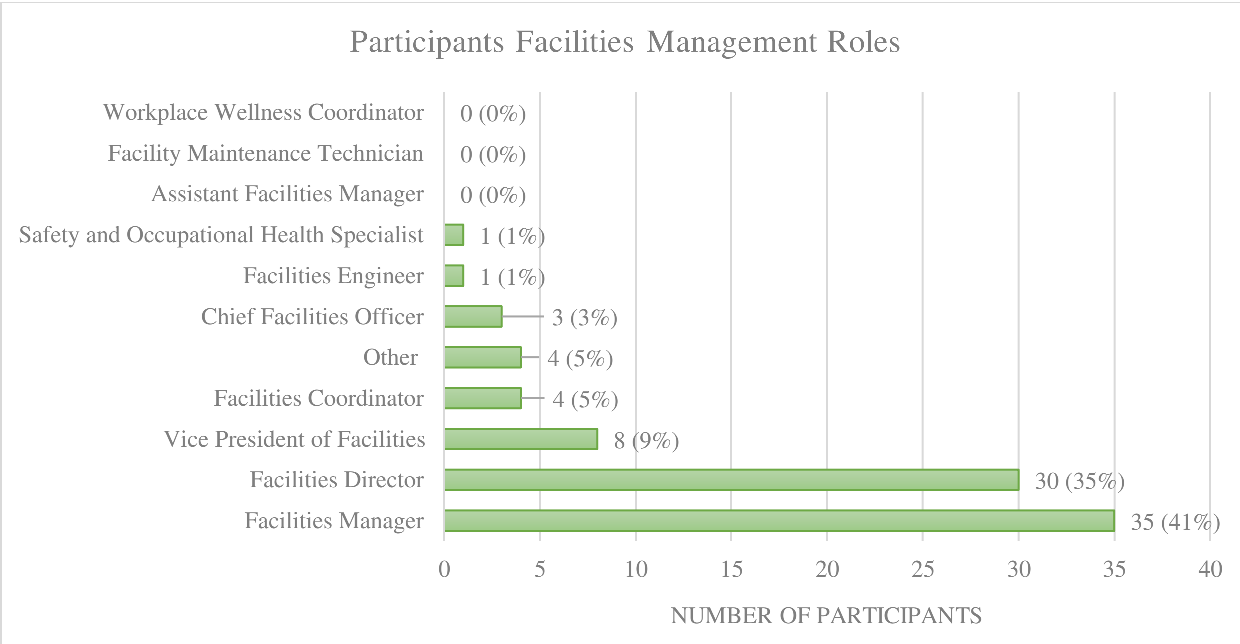

Figure 3. Distribution of Responses: Participant Roles (N=86)

Similarly, a majority (86, 90%) of respondents answered a question about their level of education. A large majority (76, 88%) of respondents received university-level education. Of those with university-level education, 42 (55%) held a bachelor's degree, and 22 (29%) held graduate degrees. Of those with graduate degrees, 18 indicated that they held a master's degree, and four held a doctorate degree. Three respondents completed some college courses while nine received an associate degree (see Figure 4). Ten respondents indicated that they had high diploma or equivalent. According to the distribution of responses, more than two-thirds of respondents either held a bachelor's degree or a master's degree.

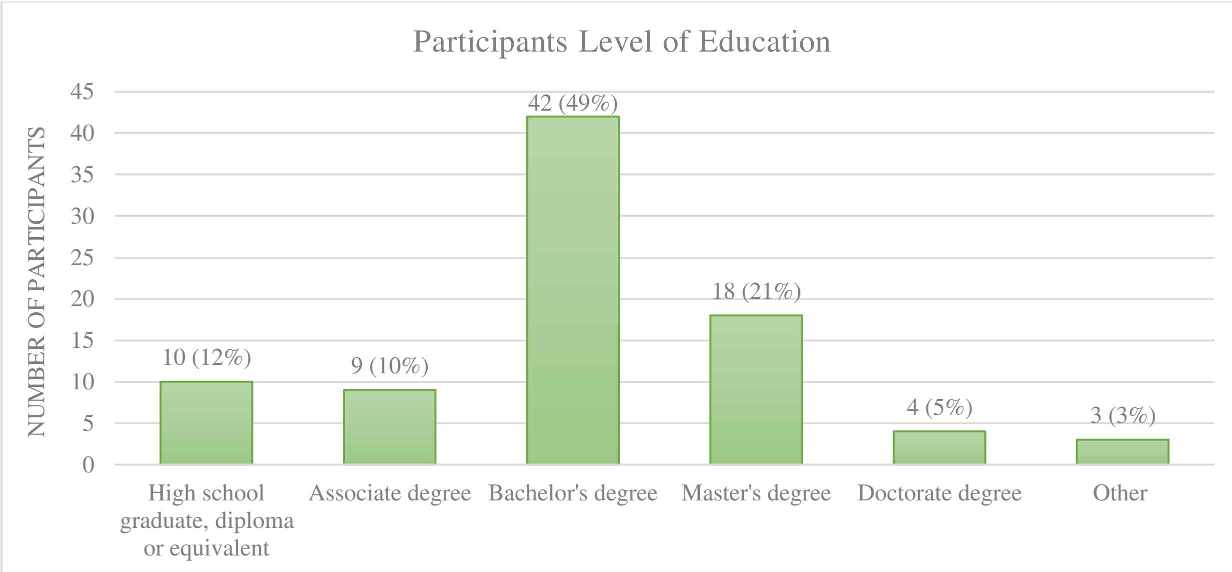

Figure 4. Distribution of Responses: Participant Level of Education (N=86)

A majority (84, 88%) of respondents answered a question about the type(s) of professional development credential that they completed. It should be noted that respondents were asked to select all options that applied when answering this question. Options included Sustainability Facility Professional (SFP), Facility Management Professional (FMP), and Certified Facility Manager (CFM). Respondents who completed other professional development credentials were asked to specify them. A total of 108 responses were collected (see Figure 5). Approximately half of responses (55, 51%) were distributed among FMP, CFM, and SFP credentials. Twenty-one (19%) responses specified other professional development credentials completed by respondents. Of these 21 responses, eight respondents completed only one professional development credential. These professional development credentials included Real Property Administrator, Certified Construction Manager, Project Management Professional, Certified Energy Manager, and Certified Property Manager. About one-third (32, 30%) of respondents indicated that they did not complete any professional development credentials. It is worth noting that same number of responses were distributed among Facility Management Professional (FMP), and Certified Facility Manager (CFM) credentials.

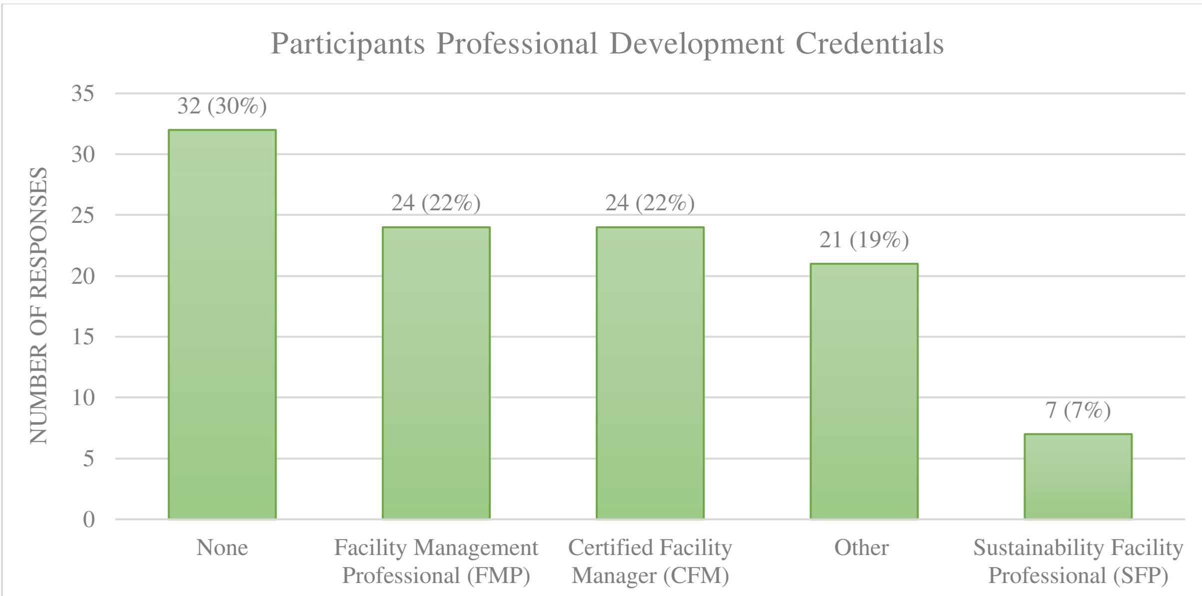

Figure 5. Distribution of Responses: Participants Professional Development Credentials (N=84)

Of 19 respondents that indicated having multiple professional development credentials, seven completed more than one professional development credential offered in the survey, and 12 completed a combination of given professional development credentials and others (see Figure 6). Six respondents who held CFM credentials stated that they completed credentials such as Green Building Engineer (GBE), Lean Six Sigma Black Belt (LSSBB), and ASHRAE Associate. Similarly, four respondents who held FMP credentials stated that they completed other credentials such as Cultural Institution Property Manager (CIPM), and American Association of Airport Executives (AAAE). Other credentials included Certified Energy Manager (CEM), Certified Healthcare Facility Manager (CHFM), and ProFM.

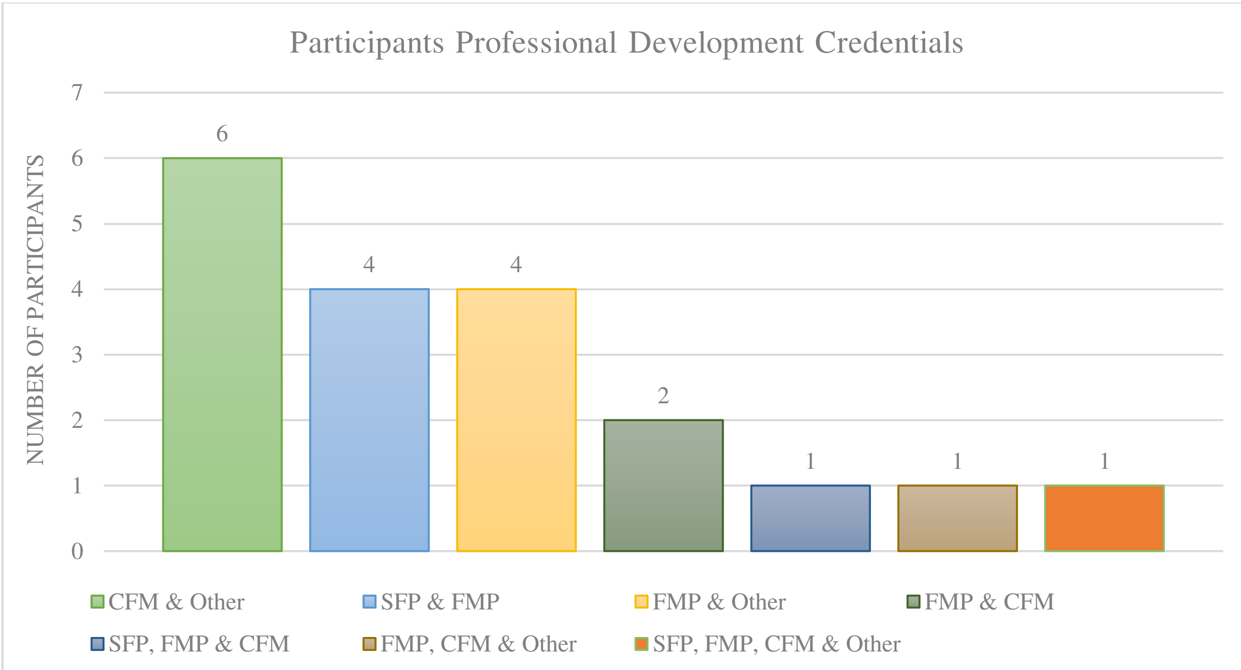

Figure 6. Distribution of Responses: Participants Professional Development Credentials (N=19)

Next, a majority (79, 82%) of respondents answered a question about the type(s) of environmental sustainability-related training that they completed. It should be noted that respondents were asked to select all options that applied when answering this question. Options included LEED Green Associate, LEED Accredited Professional Operation and Maintenance (LEED AP O+M), LEED Accredited Professional (other than LEED AP O+M), Living Future Accreditation (LFA), and WELL Accredited Professional (WELL AP). Respondents who completed other environmental sustainability-related training were asked to specify them. A total of 82 responses were collected (see Figure 7). Sixty-three respondents (80%) stated that they did not complete any environmental sustainability-related training. Ten respondents indicated that they completed training related to LEED Green Associate certification. One respondent completed training related to LEED Green Associate, LEED AP O+M, and LEED AP certifications. Three respondents reported that they completed other environmental sustainability-related trainings. These trainings were related to Sustainable Building Operation and Building Energy Management. None of the respondents completed environmental sustainability trainings related to Living Future Accreditation (LFA) or WELL Accredited Professional (WELL AP).

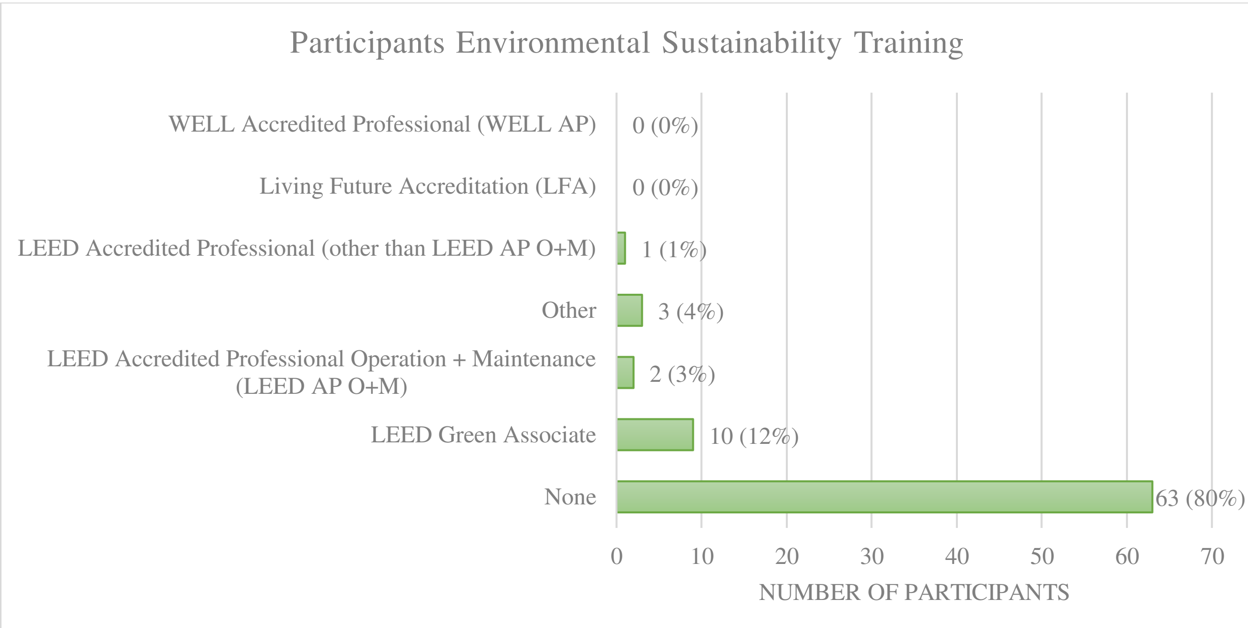

Figure 7. Distribution of Responses: Participants Environmental Sustainability Training (N=79)

4.2 FACILITIES MANAGEMENT ORGANIZATION DEMOGRAPHIC INFORMATION

A large majority of respondents (86, 90%) answered a question about the country in which they managed the largest number of retail facilities. Eighty-one (94%) respondents managed the largest number of retail facilities in United States, and five managed the largest number of retail facilities in Canada, Australia, Italy, Turkey, and United Arab Emirates. Respondents from United States were asked to select the state in which they managed the largest number of facilities. According to the distribution of responses, nine (11%) respondents managed the largest number of facilities in Texas, seven (9%) in California, and seven (9%) in state of

Washington. Consecutively, five (6%) respondents managed the largest number of facilities in Florida, four (5%) in Colorado, and four (5%) in Oregon. A map chart of recorded responses is presented in Figure 8. As shown in the map chart, respondents managed the largest number of facilities in the west coast of the United States. No responses were received from the states shown in grey.

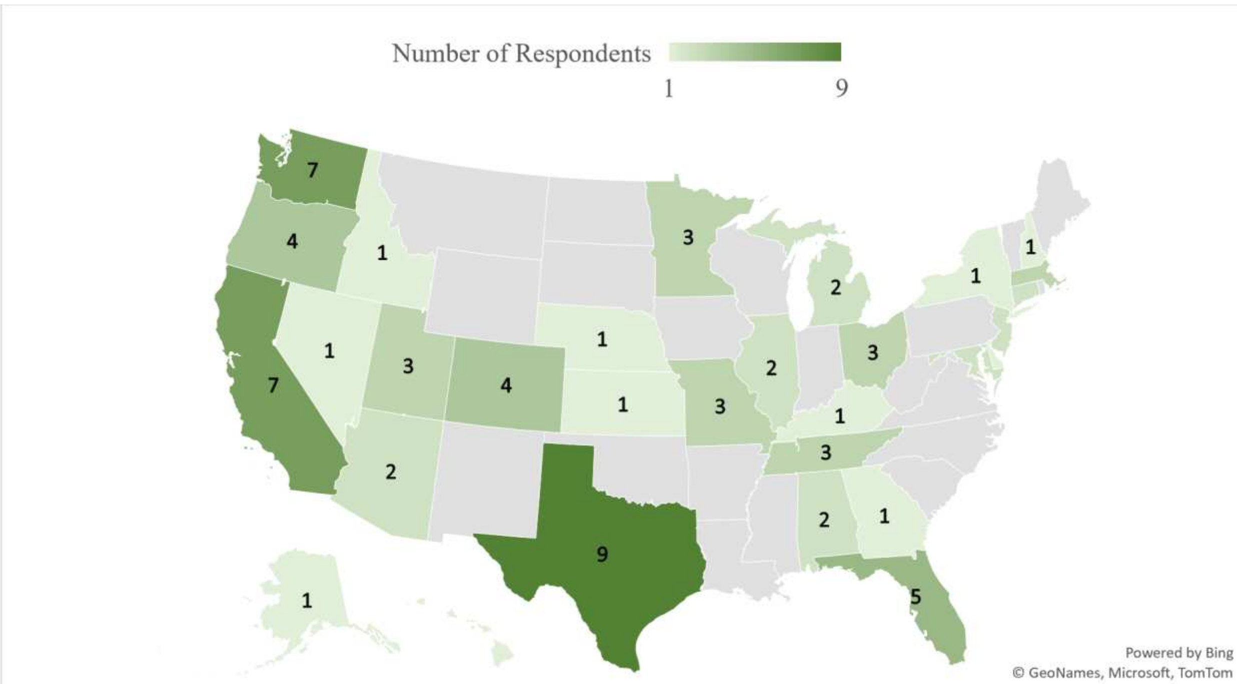

Figure 8. Distribution of Responses: States with Largest Number of Facilities Managed by Respondents (N=81)

Majority of respondents (85, 89%) answered a question about the type of their facilities management organization. Seventy-one respondents (84%) worked at end-user facilities management organizations, and 14 (16%) worked at independent facilities management companies providing full service facilities management services to clients. In other words, the majority of respondents were part of in-house facilities management departments.

When asked about their company's annual revenue, of 71 respondents, four (6%) did not provide this information (see Figure 9). Fourteen (19%) respondents reported that their company's annual revenue was between $1 million to $10 million. Additionally, 51 respondents (72%) stated that their company's annual revenue was more than $10 million.

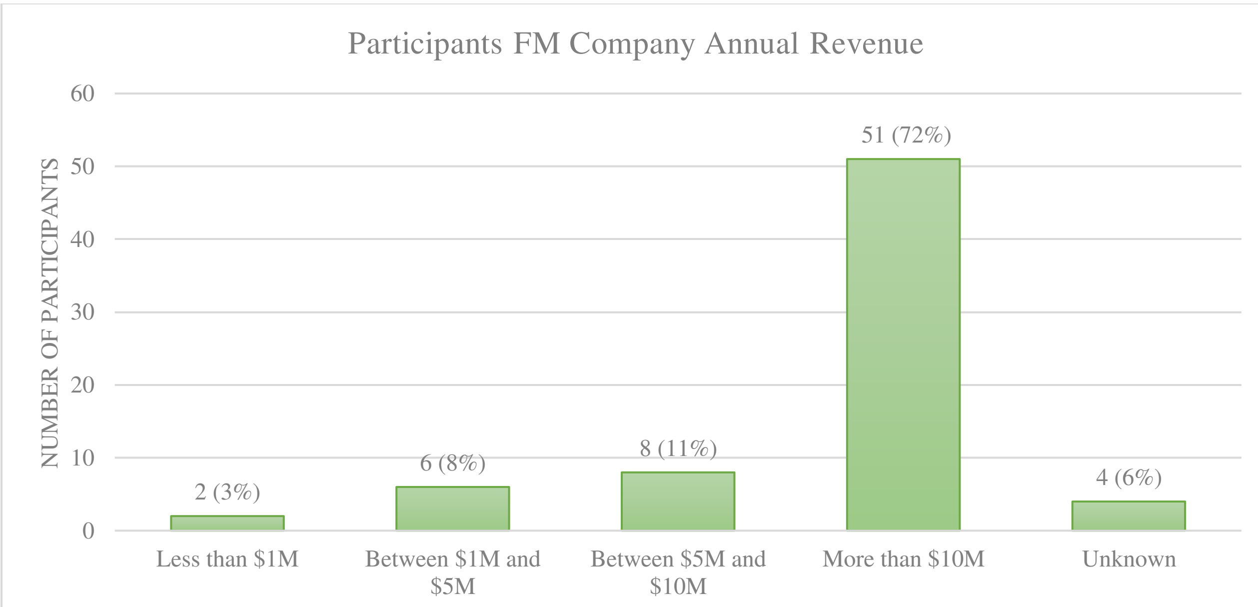

Figure 9. Distribution of Responses: Annual Revenue of Respondents' Facilities Management Company (N=71)

Eighty-three (86%) respondents answered a question about the average size of the facilities they managed. Nineteen (23%) respondents indicated that the average size of facilities they managed was more than one million square feet (see Figure 10). Approximately the same number of respondents reported managing retail facilities under 50,000 square feet and over 1,000,000 square feet.

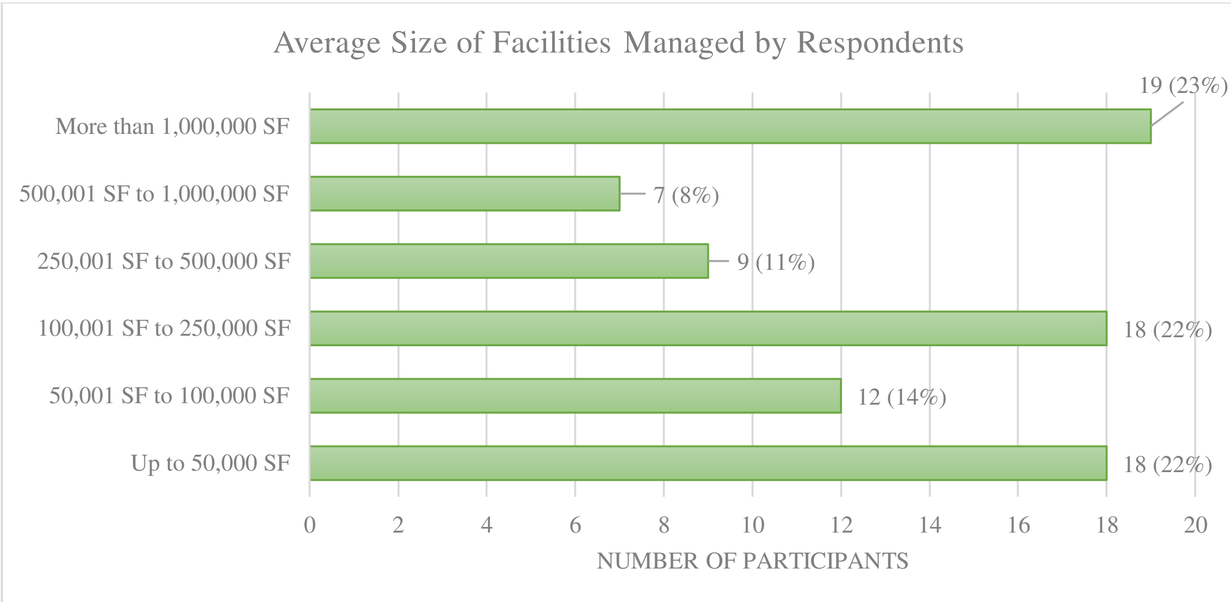

Figure 10. Distribution of Responses: Average Size of Facilities Managed by Respondents (N=83)

Eighty-two (85%) respondents answered a question about the average age of the buildings they managed. Twenty-three (28%) respondents stated that they managed buildings with an average age of five to 15 years (see Figure 11). Nineteen (23%) respondents reported that the average age of the buildings they managed was in the range of 16 to 20 years. Furthermore, 17 (21%) respondents indicated that the average age of the buildings they managed was in the range of 21 to 30 years. However, only four respondents managed buildings with an average age of less than five years. Similarly, only three respondents managed buildings with an average age of more than 100 years. According to the distribution of responses, a majority of respondents managed buildings that were 16 to 30 years old.

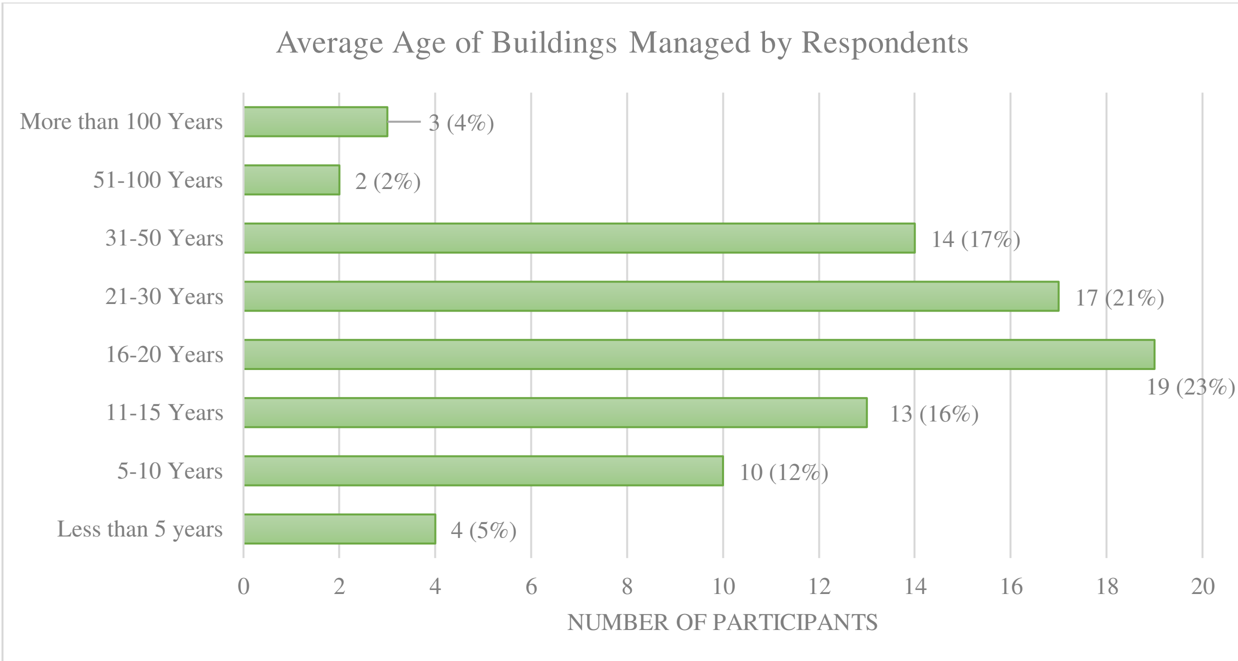

Figure 11. Distribution of Responses: Average Age of Buildings Managed by Respondents (N=82)

4.2.1 TYPES OF RETAIL FACILITIES MANAGED BY RESPONDENTS

In this study, non-food retail facilities refer to buildings and/or stores utilized for the sale and display of goods other than food. This category includes florists, office supply, rental centers, etc. Food retail facilities refer to buildings and/or stores utilized for retail and wholesale of food and beverages. This category includes grocery stores, convenience stores, bakeries, etc.

A majority (80, 83%) of respondents answered a question about the type of retail facilities they managed (see Figure 12). Sixty-eight (85%) respondents reported that they managed non-food retail stores while 12 (15%) respondents managed food retail stores.

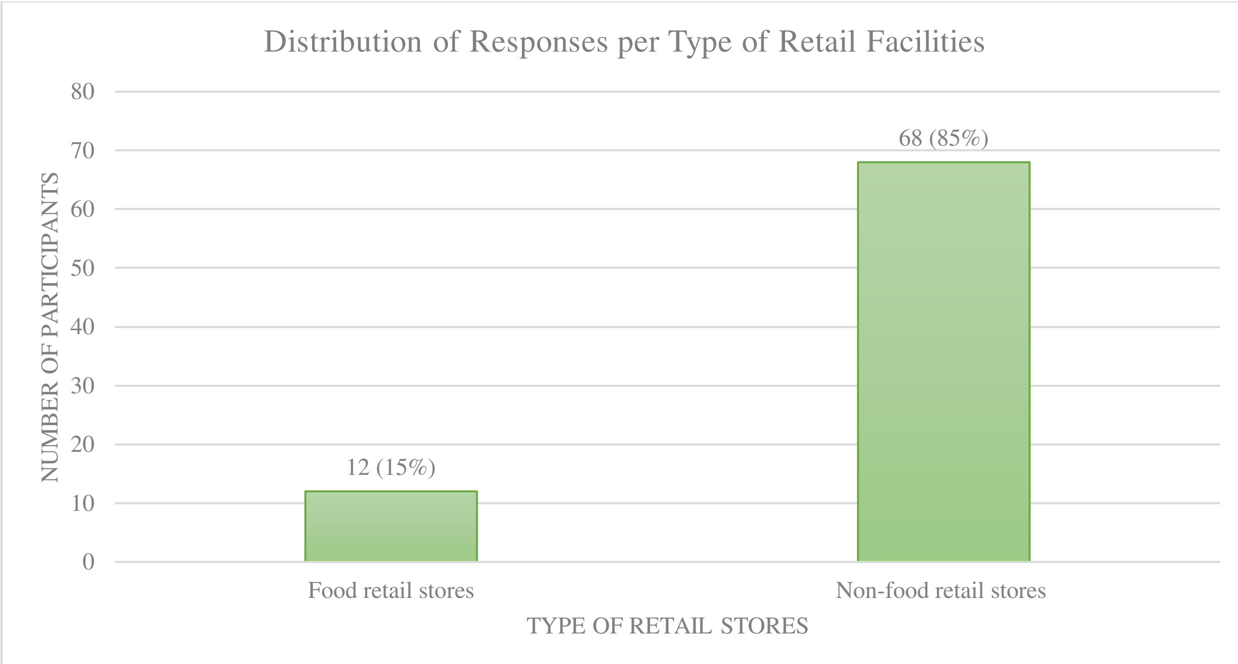

Figure 12. Distribution of Responses: Type of Retail Facilities (N=80)

Sixty-two (91%) respondents in non-food retail sector responded to a question about the type of non-food retail stores they managed. Seven categories of non-food retail stores along with their examples or definitions were provided in the survey. The categories included specialty stores (e.g., florists, locksmiths), category specialist stores (e.g., home goods, office supply), department stores (i.e., stores selling apparel and bedding), discount stores (i.e., stores selling name brand items at a lower price), variety stores (i.e., small stores selling inexpensive general merchandise), extreme value retailers (i.e., selling limited merchandise assortment at very low prices), and off-price stores (i.e., stores selling high quality products at lower prices). A majority (33, 53%) of respondents' facilities type fell under these categories offered (see Figure 13). Among the offered categories, specialist stores (11, 18%) and departments stores (10, 16%) accounted for the highest number of responses. None of the respondents managed discount stores or facilities dedicated for extreme value retailers.

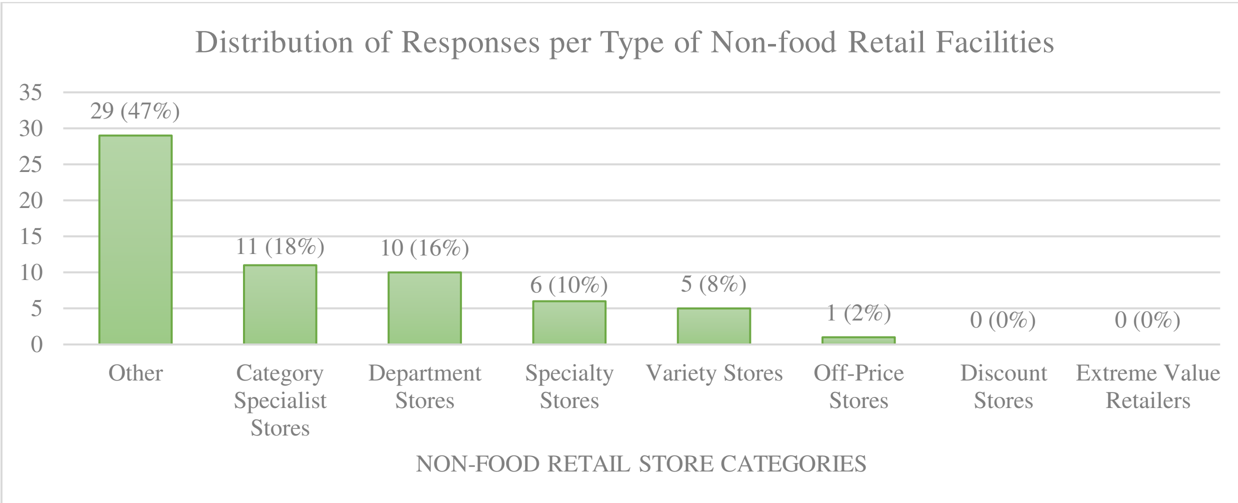

Figure 13. Distribution of Responses: Type of Non-food Retail Facilities (N=62)

The remainder of respondents (29, 47%) reported the other type of non-food retail facilities they managed. These responses included retail stores at airports, colleges, and wellness centers. The remainder of responses were omitted from this section due to incompleteness and/or irrelevance of the entries.

4.3 EXTENT OF INTEGRATING SUSTAINABLE PRACTICES INTO RETAIL FACILITIES

A majority of respondents (74, 77%) answered a question about status of implementing energy efficiency practices into the retail facilities they managed. A majority of these respondents (64, 86%) indicated that they implemented energy efficiency practices in the facilities they managed while remaining 10 (14%) respondents did not implement energy efficiency practices.

A large majority of respondents (63, 89%) who worked at end-user facilities management organizations answered a question about incentives offered to their department to integrate energy-efficiency practices into retail facilities. Forty-eight (76%) respondents stated that their company did not offer incentives to the facilities management department to integrate energy-efficiency practices into their retail facilities. Furthermore, five respondents reported that they did not know if such incentive programs existed in their company. Ten (16%) respondents who worked for companies with incentive programs for integration of energy-efficiency practices into retail facilities answered a question about the type(s) of incentives that were offered to their departments. The incentives included allocation of additional funding for future projects, and monetary bonuses for facilities department members.

Majority of respondents (11, 79%) who worked at independent facilities management companies answered a question about incentives offered to their facilities managers to integrate energy-efficiency practices into retail facilities. Eight respondents stated that their company did not offer incentives to their facilities managers to integrate energy-efficiency practices. One respondent did not know if such incentive programs existed at their facilities management company. Two respondents who worked for companies with incentive programs for integration of energy-efficiency practices into retail facilities answered a question about the type(s) of incentives that were offered to their facilities managers. The incentives included monetary bonuses to the facilities managers.

4.3.1 EXTENT OF INTEGRATING SUSTAINABLE PRACTICES INTO FOOD & NON-FOOD RETAIL FACILITIES

Of 12 (15%) respondents that managed food retail stores, 10 (83%) reported that they integrated energy efficiency practices into the stores they managed (see Figure 14). Of 68 (85%) respondents that managed non-food retail stores, 54 (79%) indicated that they integrated energy efficiency practices into the stores they managed. Six respondents in non-food category did not disclose if they integrated energy efficiency practices into the stores they managed and were removed from further analysis.

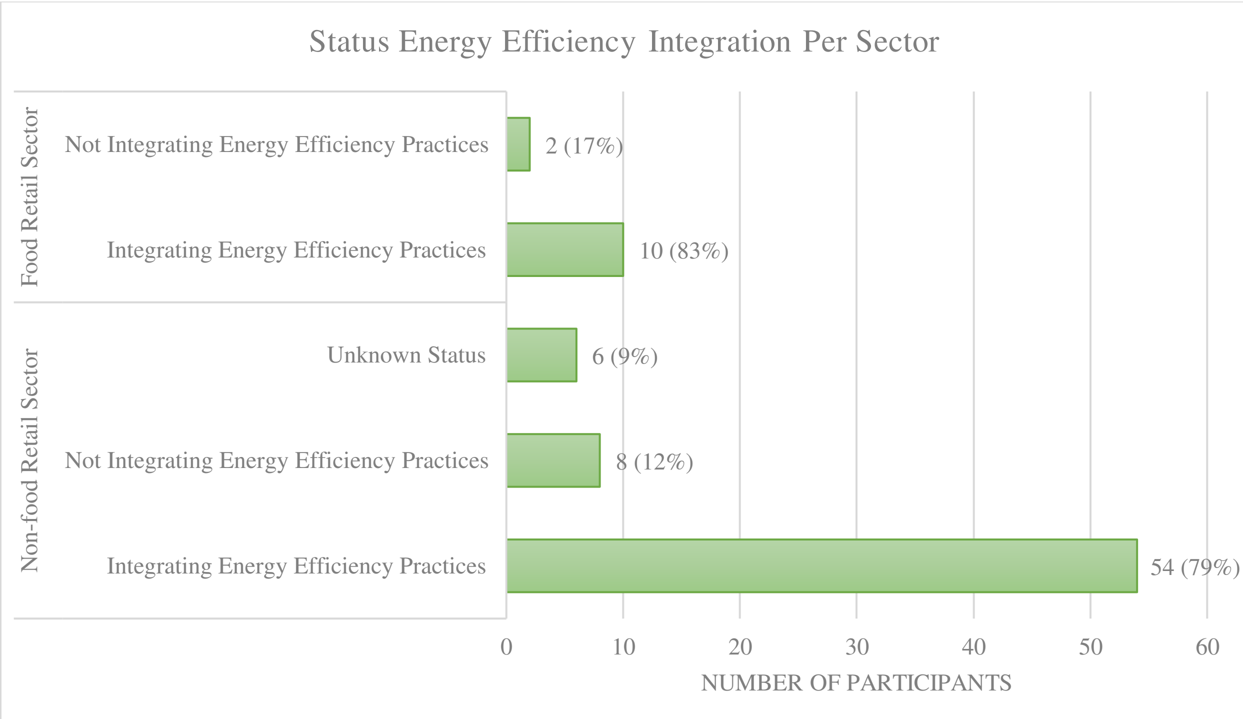

Figure 14. Distribution of Responses: Status of Energy Efficiency Integration in U.S. Retail Sector (Food and Non-food, N=80)

4.4 EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Respondents were asked to rate the level of effectiveness of 15 energy efficiency practices using a 5-point Likert scale ranging from not effective at all (1) to extremely effective (5). In this study, the following analysis scale was applied. Practices with calculated means of responses that fell between 1 and 1.5 were considered not at all effective, between 1.5 and 2.5 slightly effective, between 2.5 to 3.5 moderately effective, 3.5 to 4.5 very effective, and 4.5 to 5 extremely effective.

4.4.1 PERCEIVED EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Of two respondents that never integrated energy efficiency practices into their food retail facilities, one answered a question about effectiveness of 15 energy efficiency practices that could be integrated into their retail facilities. The distribution of responses related to 15 energy efficiency practices is presented in Table 2.

Table 2. Perceived Effectiveness of Integrating Energy Efficiency Practices in Food Retail Sector: Distribution of Responses

	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)
1	Cool roof (N=1)	0	0	0	1	0
2	Energy-efficient HVAC systems (N=1)	0	0	0	1	0
3	Green roof (N=1)	0	0	1	0	0
4	Building envelope enhancement by implementing better overhead door strategies (N=1)	0	0	1	0	0
5	Demand Control Ventilation (DCV) systems (N=1)	0	1	0	0	0
6	Building envelope enhancement to reduce air leakage (N=1)	0	1	0	0	0
7	Building envelope enhancement to reduce thermal bridging (N=1)	0	1	0	0	0
8	Energy efficient refrigerators (N=1)	1	0	0	0	0
9	Anti-sweat heater controls (N=1)	1	0	0	0	0
10	Energy efficient electrical lighting (N=1)	1	0	0	0	0
11	Skylights (N=1)	1	0	0	0	0
12	High-performance windows (N=1)	1	0	0	0	0
13	Pollutant Exposure Control Ventilation (PECV) systems (N=1)	1	0	0	0	0
14	Renewable energy systems (N=0)	-	-	-	-	-

	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)
15	Building envelope enhancement by implementing better vestibule configurations (N=0)	-	-	-	-	-

As shown in Table 2, the respondent indicated that integration of cool roof and energy-efficient HVAC systems could be very effective in enhancing the energy efficiency of their retail facilities. Furthermore, the respondent reported that integration of green roof, and implementation of better overhead door strategies to enhance the building envelope could be moderately effective in enhancing facilities' energy efficiency. The respondent did not rate the effectiveness of renewable energy systems and implementation of better vestibule configurations for building envelope enhancement. In addition to the given energy efficiency practices, respondents were asked to state other energy efficiency practices that they would use in their retail facilities. However, the respondent did not answer this question.

The respondent stated that practices such as use of energy efficient refrigerators, and anti-sweat heater controls were not at all effective in enhancing the energy efficiency of their facilities. This finding does not align with those of U.S. Department of Energy (2015) and Energy Star (2008) that integration of anti-sweat heater controls and energy efficient refrigerators can significantly reduce the energy consumption of retail stores. Furthermore, the respondent indicated that cool roof could be very effective in enhancing the energy efficiency of their retail facilities. As stated in Section 2.3.1.1.1 Integrated Roof Systems, efficiency of cool roof is dependent on factors including building envelope and efficiency of building's HVAC system (Konopacki & Akbari, 2001). Similar to the findings of Ríos-Fernández's (2020) study, this respondent also stated that energy efficient HVAC systems could be very effective in enhancing the energy efficiency of their retail facilities. However, this respondent perceived practices related to building envelope enhancement as either not at all effective or slightly effective. This finding aligns with those of Haves et al. (2008) that building envelope performance does not significantly affect the overall energy efficiency of typical big-box retail stores. Additionally, the respondent stated that Pollutant Exposure Control Ventilation (PECV) systems were not at all effective in enhancing the energy efficiency of their facilities. This finding contradicts those of Zaatari et al. (2016) that determining the optimal ventilation rate by integrating PECV systems leads to energy savings.

4.4.2 REALIZED EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Of 10 respondents that integrated energy efficiency practices into their food retail facilities, depending on the question, one to seven answered a question about the realized effectiveness of 15 energy efficiency practices that were integrated into their retail facilities. The distribution of responses and the calculated means of respondent perceptions about effectiveness of 15 energy efficiency practices are presented in Table 3.

Table 3. Realized Effectiveness of Integrating Energy Efficiency Practices in Food Retail Sector: Distribution of Responses, and Means

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
1	Building envelope enhancement to reduce air leakage (N=3)	0 (0%)	1 (33%)	0 (0%)	1 (33%)	1 (33%)	3.67
2	Energy efficient electrical lighting (N=7)	0 (0%)	1 (14%)	1 (14%)	5 (72%)	0 (0%)	3.57
3	Energy efficient HVAC systems (N=6)	0 (0%)	1 (17%)	1 (17%)	4 (66%)	0 (0%)	3.50

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
4	Demand Control Ventilation (DCV) systems (N=3)	0 (0%)	0 (0%)	2 (67%)	1 (33%)	0 (0%)	3.33
5	Energy efficient refrigerators (N=5)	0 (0%)	2 (40%)	2 (40%)	0 (0%)	1 (20%)	3.00
6	High-performance windows (N=3)	0 (0%)	1 (33%)	1 (33%)	1 (33%)	0 (0%)	3.00
7	Building envelope enhancement to reduce thermal bridging (N=2)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	3.00
8	Building envelope enhancement by implementing better vestibule configurations (N=2)	1 (50%)	0 (0%)	0 (0%)	0 (0%)	1 (50%)	3.00
9	Anti-sweat heater controls (N=4)	0 (0%)	3 (75%)	0 (0%)	0 (0%)	1 (25%)	2.75
10	Renewable energy systems (N=2)	0 (0%)	1 (50%)	1 (50%)	0 (0%)	0 (0%)	2.50
11	Green roof (N=2)	1 (50%)	0 (0%)	1 (50%)	0 (0%)	0 (0%)	2.00
12	Skylights (N=4)	1 (25%)	2 (50%)	1 (25%)	0 (0%)	0 (0%)	2.00
13	Cool roof (N=3)	2 (67%)	1 (33%)	0 (0%)	0 (0%)	0 (0%)	1.33
14	Pollutant Exposure Control Ventilation systems (N=1)	1	0	0	0	0	-
15	Building envelope enhancement by implementing better overhead door strategies (N=1)	1	0	0	0	0	-

As shown in Table 3, respondents indicated that energy efficient electrical lighting (6 respondents, 86%) and integration of energy efficient HVAC systems (5 respondents, 83%) are either moderately effective or very effective in enhancing energy efficiency of food retail stores. Four respondents (80%) stated that use of energy efficient refrigerators is either slightly effective or moderately effective. Respondents reported that integration of cool roof (3 respondents, 100%) and skylights (3 respondents, 75%) are either not at all effective or slightly effective in enhancing the energy efficiency of these facilities. Respondents rated building envelope enhancement to reduce air leakage (mean of 3.67), energy efficient electrical lighting (mean of 3.57), and energy efficient HVAC systems (mean of 3.50) as the most effective energy efficiency practices. Based on the calculated means of responses, these practices are considered very effective in enhancing energy efficiency of these facilities. Among 15 energy efficiency practices that were rated by at least three respondents, skylights (mean of 2.00) and cool roof (mean of 1.33) had the two lowest means of responses and were considered not at all effective and slightly effective in enhancing the energy efficiency of food retail facilities. According to means of responses, a majority of the practices (10 out of 15) were either slightly effective or moderately effective in enhancing the energy efficiency of these facilities.

In addition to the given energy efficiency practices, respondents working in food retail sector who indicated integrating energy efficiency practices into their facilities were asked to identify other energy efficiency practices that they would use in their retail facilities. Of 10 respondents, one added coil cleaning to the list of energy efficiency practices that they would use in their retail facilities.

According to means of responses, cool roofs were less effective than other energy efficient building systems such as Demand Control Ventilation (DCV) systems, energy efficient electrical lighting, energy efficient HVAC systems, and energy efficient refrigerators. Furthermore, respondents perceived that skylights (mean of 2.00) were less effective than energy efficient electrical lighting (mean of 3.57) for increasing energy efficiency of their facilities. Additionally, the respondents perceived that practices such as building envelope enhancement to reduce air leakage (mean of 3.67) and energy efficient HVAC systems (mean of 3.50) were very effective for increasing energy efficiency of food retail facilities. This finding does not align with those of Haves et al. (2008) that building envelope performance does not significantly affect the overall energy efficiency of typical big-box retail stores. This may imply that these respondents managed smaller (less than 20,000 square-feet) food retail facilities (Haves et al., 2008).

Previous studies (Konopacki & Akbari, 2001; Mylona et al., 2017; Richman and Simpson, 2016) found that energy efficient electrical lighting was at least twice as effective as cool roof in enhancing the energy efficiency of retail stores. This aligns with our finding that energy efficient electrical lighting is more effective than cool roof. This study found that energy efficient refrigerators and anti-sweat heater controls are moderately effective in enhancing energy efficiency of food retail stores. However, this finding does not align with those of U.S. Department of Energy (2015) and Energy Star (2008) that integration of anti-sweat heater controls and energy efficient refrigerators can significantly reduce the energy consumption of retail stores.

4.5 EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Respondents were asked to rate the level of effectiveness of 13 energy efficiency practices using a 5-point Likert scale ranging from not effective at all (1) to extremely effective (5).

4.5.1 PERCEIVED EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Of eight respondents that never integrated energy efficiency practices into their non-food retail facilities, depending on the question, one to four answered a question about effectiveness of 13 energy efficiency practices that could be integrated into their retail facilities. The distribution of responses and the calculated means of respondent perceptions about effectiveness of 13 energy efficiency practices are presented in Table 4.

Table 4. Perceived Effectiveness of Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Means

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
1	Building envelope enhancement by implementing better vestibule configurations (N=1)	0	0	0	1	0	-
2	Building envelope enhancement by implementing better overhead door strategies (N=1)	0	0	0	1	0	-
3	Energy efficient electrical lighting (N=4)	0 (0%)	1 (25%)	0 (0%)	2 (50%)	1 (25%)	3.75

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
4	Cool roof (N=3)	0 (0%)	0 (0%)	1 (33%)	2 (67%)	0 (0%)	3.67
5	Energy-efficient HVAC systems (N=3)	0 (0%)	0 (0%)	1 (33%)	2 (67%)	0 (0%)	3.67
6	Skylights (N=2)	0 (0%)	0 (0%)	1 (50%)	1 (50%)	0 (0%)	3.50
7	High-performance windows (N=2)	0 (0%)	0 (0%)	1 (50%)	1 (50%)	0 (0%)	3.50
8	Renewable energy systems (N=1)	0	0	1	0	0	-
9	Demand Control Ventilation (DCV) systems (N=1)	0	0	1	0	0	-
10	Pollutant Exposure Control Ventilation (PECV) systems (N=1)	0	0	1	0	0	-
11	Building envelope enhancement to reduce air leakage (N=1)	0	0	1	0	0	-
12	Building envelope enhancement to reduce thermal bridging (N=1)	0	0	1	0	0	-
13	Green roof (N=1)	1	0	0	0	0	-

As shown in Table 4, three respondents indicated that integration of energy efficient electrical lighting could be either very effective or extremely effective in enhancing the energy efficiency of non-food retail facilities. Three respondents indicated that integration of cool roof and energy-efficient HVAC systems could be either moderately effective or very effective. One respondent reported that integration of green roof is not at all effective in enhancing the energy efficiency. One respondent rated building envelope enhancement by implementing better vestibule configurations and better overhead door strategies as very effective practices. Also, integration of cool roof and energy-efficient HVAC systems (means of 3.67) were considered very effective in enhancing the energy efficiency of these retail facilities.

In addition to the given energy efficiency practices, respondents were asked about other energy efficiency practices that they would use in their retail facilities. One respondent added auto-tinting smart glasses to the list of energy efficiency practices that could increase energy efficiency.

Our study found that integration of energy efficient electrical lighting is extremely effective in enhancing the energy efficiency of non-food retail facilities. This finding aligns with those of Mylona et al. (2017), and Richman and Simpson (2016) that switching from inefficient lighting systems to LED and T-8 fluorescent lamps reduced the electricity consumption of retail facilities by 30% and 22% respectively. One respondent rated green roof as not at all effective in enhancing the energy efficiency of their facilities. This finding does not align with those of Moseley et al. (2013) that integration of green roof could result in 1% to 6% energy savings. However, this could be due to the fact that green roof performance is dependent on the climate and/or geographical location of the facility. Previous research studies found that integration of energy efficient HVAC systems was more effective than cool roof for increasing the energy efficiency of retail stores (Fedrizzi & Rogers, 2002; Konopacki & Akbari, 2001; Ríos-Fernández, 2020). This is in contrast with findings of our study as three respondents reported that cool roof and energy efficient HVAC systems were very effective for increasing the energy efficiency of retail stores. Similar to Richman and Simpson (2016) study, one respondent in our study perceived building envelope enhancement to reduce air leakage and to reduce thermal bridging as moderately effective practices in enhancing the energy efficiency of their retail facilities.

4.5.2 REALIZED EFFECTIVENESS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Of 54 respondents that integrated energy efficiency practices into their non-food retail facilities, depending on the question, 15 (28%) to 43 (80%) answered a question about realized effectiveness of 13 energy efficiency practices that were integrated into their retail facilities. The distribution of responses and the calculated means of respondent perceptions about effectiveness of 13 energy efficiency practices are presented in Table 5.

Table 5. Realized Effectiveness of Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Means

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
1	Energy efficient lighting (N=47)	0 (0%)	0 (0%)	3 (6%)	21 (45%)	23 (49%)	4.43
2	Energy-efficient HVAC systems (N=44)	0 (0%)	3 (7%)	9 (20%)	15 (34%)	17 (39%)	4.05
3	Demand Control Ventilation (DCV) systems (N=24)	1 (4%)	0 (0%)	5 (21%)	10 (42%)	8 (33%)	4.00
4	Building envelope enhancement to reduce air leakage (N=30)	0 (0%)	0 (0%)	13 (43%)	9 (30%)	8 (27%)	3.83
5	High-performance windows (N=34)	0 (0%)	3 (9%)	10 (29%)	11 (32%)	10 (29%)	3.82

#	Energy Efficiency Practices (N=number of responses)	Not at all effective (1)	Slightly effective (2)	Moderately effective (3)	Very effective (4)	Extremely effective (5)	Mean (out of 5)
6	Building envelope enhancement to reduce thermal bridging (N=25)	0 (0%)	1 (4%)	9 (36%)	10 (40%)	5 (20%)	3.76
7	Pollutant Exposure Control Ventilation (PECV) systems (N=18)	1 (6%)	3 (17%)	3 (17%)	6 (33%)	5 (28%)	3.61
8	Building envelope enhancement by implementing better overhead door strategies (N=25)	0 (0%)	4 (16%)	6 (24%)	11 (44%)	4 (16%)	3.60
9	Building envelope enhancement by implementing better vestibule configuration (N=29)	1 (3%)	2 (7%)	10 (34%)	11 (38%)	5 (17%)	3.59
10	Renewable energy systems (N=23)	4 (17%)	1 (4%)	2 (9%)	10 (43%)	6 (26%)	3.57
11	Cool roof (N=20)	1 (5%)	3 (15%)	7 (35%)	6 (30%)	3 (15%)	3.35
12	Skylights (N=30)	2 (7%)	5 (17%)	13 (43%)	7 (23%)	3 (10%)	3.13
13	Green roof (N=15)	1 (7%)	4 (27%)	6 (40%)	3 (20%)	1 (7%)	2.93

Majority of respondents indicated that energy efficient electrical lighting (44 respondents, 94%) and energy efficient HVAC systems (32 respondents, 73%) are either very effective or extremely effective in enhancing energy efficiency of non-food retail stores. Majority of respondents (22, 73%) indicated that building envelope enhancement to reduce air leakage is either moderately effective or very effective. Five respondents reported that integration of green roof is either not at all effective or slightly effective in enhancing energy efficiency of their retail stores. Respondents rated energy-efficient electrical lighting (mean of 4.43), energy-efficient HVAC systems (mean of 4.05), and Demand Control Ventilation (DCV) (mean of 4.00) as the most effective energy efficiency practices. Among 13 energy efficiency practices, skylights (mean of 3.13) and green roofs (mean of 2.93) had the two lowest means of responses but were still considered moderately effective in enhancing the energy efficiency of non-food retail stores. Building envelope enhancement to reduce thermal bridging (mean of 3.76), building envelope enhancements by implementing better vestibule configuration (mean of 3.59) and better overhead door strategies (mean of 3.60) were considered very effective practices in enhancing the energy efficiency of non-food retail facilities. According to means of responses, the majority of the practices (10 out of 13) were either very effective or extremely effective in enhancing the energy efficiency of these facilities.

In addition to the 13 energy efficiency practices offered in the survey, respondents were asked to add other energy efficiency practices that they used in their retail facilities. There were nine responses to this question. Practices such as Integration of Building Automation Systems (BAS), HVLS recirculation fans, Ultraviolet (UV) hoods, and window tinting films were each stated once. One participant added geothermal systems to the list. However, this participant stated that these systems were not effective in enhancing the energy efficiency of their retail facilities. The remaining four responses were not related to this question.

Calculated means of respondent perceptions about effectiveness of 13 energy efficiency practices shown in Table 5 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' perceptions about effectiveness of these practices. Energy efficiency practices with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 6. The difference between the means of responses related to effectiveness of energy efficient electrical lighting and skylights was statistically significant (p-value = 1.82×10^{-9}). In other words, the respondents perceived that energy efficient electrical lighting was significantly more effective than skylights for increasing energy efficiency of their facilities. Similarly, respondents perceived that energy efficient electrical lighting (mean of 4.43) was significantly more effective than renewable energy systems (mean of 3.57) (p-value = 2.96×10^{-4}). With p-value of 0.01, respondents perceived that cool roof (mean of 3.35) was significantly less effective than energy efficient HVAC systems (mean of 4.05). Mean comparison of respondent perception about the remaining energy efficiency practices did not show a statistically significant difference. For instance, there was no statistically significant difference (p-value = 0.31) between the means of responses for high performance windows (mean of 3.82) and energy efficient HVAC systems (mean of 4.05). In other words, respondents perceived that these two practices were not significantly different in regard to their effectiveness for increasing store energy efficiency. With p-values of 0.32, respondents did not perceive a significant difference between the level of effectiveness of building envelope enhancement to reduce air leakage (mean of 3.83) and energy efficient HVAC systems (mean of 4.05).

Table 6. Mean Comparison of Respondent Perceptions about Realized Effectiveness of Energy Efficiency Practices in Non-food Retail Sector

Energy Efficiency Practice	Energy Efficiency Practice	p-value
Energy efficient electrical lighting (M=4.43)	Green roof (M=2.93)	4.59×10^{-9}
Energy efficient electrical lighting (M=4.43)	Cool roof (M=3.35)	2.79×10^{-6}
Energy efficient electrical lighting (M=4.43)	Renewable energy systems (M=3.57)	2.96×10^{-4}
Energy efficient electrical lighting (M=4.43)	Skylights (M=3.13)	1.82×10^{-9}

Energy Efficiency Practice	Energy Efficiency Practice	p-value
Energy efficient electrical lighting (M=4.43)	High performance windows (M=3.82)	1.01×10^{-3}
Energy efficient electrical lighting (M=4.43)	Pollutant Exposure Control Ventilation (PECV) systems (M=3.61)	7.95×10^{-4}
Energy efficient electrical lighting (M=4.43)	Building envelope enhancement to reduce air leakage (M=3.83)	6.14×10^{-4}
Energy efficient electrical lighting (M=4.43)	Building envelope enhancement to reduce thermal bridging (M=3.76)	2.54×10^{-4}
Energy efficient electrical lighting (M=4.43)	Building envelope enhancement by implementing better vestibule configurations (M=3.59)	1.83×10^{-5}
Energy efficient electrical lighting (M=4.43)	Building envelope enhancement by implementing better overhead door strategies (M=3.60)	3.28×10^{-5}
Energy efficient HVAC systems (M=4.05)	Cool roof (M=3.35)	1.13×10^{-2}
High performance windows (M=3.82)	Skylights (M=3.13)	7.88×10^{-3}
Energy efficient HVAC systems (M=4.05)	Skylights (M=3.13)	1.97×10^{-4}
Demand Control Ventilation (DCV) systems (M=4.00)	Skylights (M=3.13)	2.94×10^{-3}
High performance windows (M=3.82)	Green roof (M=2.93)	5.55×10^{-3}
Energy efficient HVAC systems (M=4.05)	Green roof (M=2.93)	2.89×10^{-4}
Demand Control Ventilation (DCV) systems (M=4.00)	Green roof (M=2.93)	2.50×10^{-3}
Building envelope enhancement by implementing better vestibule configurations (M=3.59)	Green roof (M=2.93)	4.63×10^{-2}

This study found that energy efficient electrical lighting was significantly more effective than other energy efficient building system practices such as renewable energy systems, cool roof, and skylights. Based on the study's scale of analysis, renewable energy systems and energy efficient electrical lighting are very effective for increasing energy efficiency of these facilities. However, the significant difference in their level of effectiveness does not align with findings of previous studies. According to Environment America Research and Policy Center (2016), integration of renewable energy systems such as Solar PVs could reduce the consumption of fossil-fuel generated electricity of U.S. big-box retail stores by at least 10% more than energy efficient electrical lighting (Mylona et al.,2017; Richman & Simpson, 2016).

4.6 BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with three benefits that integration of energy efficiency practices in their food retail facilities could bring. The benefits were lower levels of CO_2 emissions, reduced energy consumption, and lower energy bills. Respondents were asked to rate these benefits using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). In this study, the following analysis scale was applied. Benefits with calculated means of responses that fell between 1 and 1.5 were considered as strongly disagree, between 1.5 and 2.5 as disagree, between 2.5 to 3.5 as neither agree nor disagree, 3.5 to 4.5 as agree, and 4.5 to 5 as strongly agree.

4.6.1 PERCEIVED BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Of two respondents that never integrated energy efficiency practices into their food retail facilities, one answered a question about benefits that integration of the energy efficiency practices could bring. This respondent indicated strong disagreement with all three benefits provided in the survey question. In addition to the given benefits, respondents were asked about other benefits that the integration of the energy efficiency practices in their retail facilities could bring. However, the respondent did not answer this question.

The answers given were matched to the corresponding respondent to ensure validity of discussion. As discussed in Section 4.4.1 Perceived Effectiveness of Integrating Energy Efficiency Practices into Food Retail Facilities, this participant reported that integrating the majority of energy efficiency practices (9 out of 15) could be either not at all effective or slightly effective for enhancing the energy efficiency of their retail facilities. Hence, it can be implied that this respondent never integrated energy efficiency practices into their retail facilities as they did not perceive them to be beneficial. This finding contradicts those of Energy Star (n.d.) that integration of one energy efficiency practice, energy efficient electrical lighting, in stores and parking lots of H-E-B Grocery resulted in reduced energy consumption, saving more than $3 million in energy expenses, and reduced CO_2 emissions by 78 million pounds per year. Also, it can be implied that this respondent did not perceive energy efficiency practices to be beneficial because they never integrated these practices.

4.6.2 REALIZED BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Of 10 respondents that integrated energy efficiency practices into their food retail facilities, six answered a question about realized benefits of energy efficiency practices that were integrated into their retail facilities (see Table 7). Four respondents reported that they neither agreed nor disagreed that integration of energy efficiency practices into their retail facilities lowered levels of CO_2 emission. Of those that responded, three indicated that they strongly agreed that integration of energy efficiency practices reduced their energy consumption. Five respondents stated that they either agreed or strongly agreed that integration of energy efficiency practices into their retail facilities lowered their energy bills. Based on the calculated means of responses, respondents rated reduced energy consumption (mean of 4.33) and lower energy bills (mean of 4.17) as being the largest benefits of integrating energy efficiency practices into their retail facilities. Hence, respondents agreed that integration of energy efficiency practices into their facilities was associated with these two benefits.

Table 7. Realized Benefits of Integrating Energy Efficiency Practices in Food Retail Sector: Distribution of Responses, and Means

Benefits (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
Reduced energy consumption (N=6)	0 (0%)	0 (0%)	1 (17%)	2 (33%)	3 (50%)	4.33
Lower energy bills (N=6)	0 (0%)	0 (0%)	1 (17%)	3 (50%)	2 (33%)	4.17
Lower levels of CO_2 emission (N=6)	0 (0%)	1 (17%)	4 (67%)	0 (0%)	1 (17%)	3.17

In addition to the given benefits, respondents were asked about other benefits that the integration of the energy efficiency practices in their retail facilities could bring. Of six respondents, one responded to this question. However, this response was not related to this question and was not reported.

Calculated means of respondent perceptions about all benefits shown in Table 7 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these benefits. However, the calculated p-values indicated no statistically significant difference between the means of respondents level of agreement with these benefits. In other words, respondents' level of agreement with these benefits was not significantly different from each other.

Our study found that integration of energy efficiency practices into food retail facilities reduced their energy consumption and resulted in lower energy bills. This finding aligns with those of other studies mentioned in Section 2.3 Energy Management in Retail Sector. For instance, our finding aligns with those of Ríos-Fernández (2020) that integration of one energy efficiency practice, energy efficient HVAC system, in a supermarket resulted in 56%-62% reduction in the facility's electricity consumption. However, according to the mean of responses, our study did not conclude that integration of energy efficiency practices into these retail facilities lowered their levels of CO_2 emission. This finding contradicts those of Ríos-Fernández (2020) that integration of the energy efficiency practice reduced levels of CO_2 emission by 50%.

This might be due to the fact that tracking levels of CO_2 emission requires specific tools and skills that may not be available to all facilities managers.

4.7 BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with three benefits that integration of energy efficiency practices in their non-food retail facilities could bring. The benefits were lower levels of CO_2 emissions, reduced energy consumption, and lower energy bills. Respondents were asked to rate these benefits using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

4.7.1 PERCEIVED BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Of eight respondents that never integrated energy efficiency practices into their non-food retail facilities, five answered a question about benefits that integration of the energy efficiency practices in their retail facilities could bring (see Table 8). All five respondents stated that they either agreed or strongly agreed that integration of energy efficiency practices into their retail store could reduce their energy consumption. Four respondents reported that they either agreed or strongly agreed that integration of energy efficiency practices into their retail store could lower their energy bills. Three respondents either agreed or strongly agreed that integration of energy efficiency practices into their retail store could lower levels of CO_2 emission. However, based on the calculated means of responses, respondents neither agreed nor disagreed that integration of energy efficiency practices into their retail store could lower levels of CO_2

emission (mean of 3.40). Respondents rated reduced energy consumption (mean of 4.20) and lower energy bills (mean of 4.20) as being the largest benefits that integrating energy efficiency practices could bring; participants agreed that integration of energy efficiency practices into their retail store could be associated with these two benefits.

Table 8. Perceived Benefits of Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Means

Benefits (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
Reduced energy consumption (N=5)	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	4.20
Lower energy bills (N=5)	0 (0%)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	4.20
Lower levels of CO_2 emission (N=5)	1 (20%)	0 (0%)	1 (20%)	2 (40%)	1 (20%)	3.40

In addition to the given benefits, respondents were asked about other benefits that the integration of the energy efficiency practices in their retail facilities could bring. However, no respondents answered this question.

Calculated means of respondent perceptions about all benefits shown in Table 8 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these benefits. However, the calculated p-values indicated no statistically significant difference between the means of respondents level of agreement with these benefits. In other words, respondents' level of agreement with these benefits was not significantly different from each other.

Our study found that integration of energy efficiency practices into non-food retail facilities could reduce their energy consumption and result in lower energy bills. This finding aligns with those of other studies mentioned in Section 2.3 Energy Management in Retail Sector. For instance, our findings align with those of U.S. Department of Energy (2015) that integration of energy efficiency practices could result in lower electricity consumption. Furthermore, majority of respondents either agreed or strongly agreed that integration of energy efficiency practices could lower levels of CO_2 emission. However, according to the mean of responses, our study did not conclude that integration of energy efficiency practices into these retail facilities could lower levels of CO_2 emission. This finding contradicts those of Environment America Research and Policy Center (2016) that integration of energy efficiency practices could reduce levels of CO_2 emission of retail stores.

4.7.2 REALIZED BENEFITS OF INTEGRATING ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Of 54 respondents, depending on the question, 44 (82%) to 46 (85%) answered a question about realized benefits of energy efficiency practices that were integrated into their non-food retail facilities (see Table 9). Twenty (45%) respondents either agreed or strongly agreed that integration of the energy efficiency practices into their retail facilities resulted in lower levels of CO_2 emission. However, almost the same number of respondents (18, 41%) stated that they neither agreed nor disagreed that integration of energy efficiency practices resulted in lower levels of CO_2 emission. Forty-two (91%) and 43 (93%) respondents either agreed or strongly agreed that integration of energy efficiency practices was associated with reduced energy consumption and lower energy bills respectively. Based on the calculated means of responses, respondents neither agreed nor disagreed that integration of energy efficiency practices into their retail store lowered levels of CO_2 emission (mean of 3.43). Respondents rated reduced energy consumption (mean of 4.22) and lower energy bills (mean of 4.22) as being the largest benefits of integrating energy efficiency practices; participants agreed that integration of energy efficiency practices into their retail store was associated with these two benefits.

Table 9. Realized Benefits of Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Means

Benefits (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
Reduced energy consumption (N=46)	1 (2%)	1 (2%)	2 (4%)	25 (54%)	17 (37%)	4.22
Lower energy bills (N=46)	1 (2%)	1 (2%)	1 (2%)	27 (59%)	16 (35%)	4.22
Lower levels of CO_2 emission (N=44)	3 (7%)	3 (7%)	18 (41%)	12 (27%)	8 (18%)	3.43

In addition to the given benefits, respondents were asked about other benefits that the integration of energy efficiency practices in their retail facilities brought. Four respondents answered this question. One respondent stated that lower energy bills meant increased profitability for their retail facilities. Another respondent stated that integration of energy efficiency practices resulted in enhanced employee productivity. The remaining responses were omitted from this section due to incompleteness and/or irrelevance of the entries.

Calculated means of respondent perceptions about all benefits shown in Table 9 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these benefits. Realized benefits with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 10. The difference between the means of respondents perception about benefits of lowering levels of CO_2 emissions and reducing energy consumption was statistically significant (p-value = 0.0002). Furthermore, with p-value of 0.0002, the difference between the means of respondents level of agreement with lower levels of CO_2 emissions versus lower energy bills was deemed statistically significant. In other words, respondents perceived that reduced energy consumption and lower energy bills were significantly more beneficial than lower levels of CO_2 emission.

Table 10. Mean Comparison of Respondent Perceptions about Realized Benefits of Integrating Energy Efficiency Practices in Non-food Retail Sector

Benefits	Benefits	p-value
Reduced energy consumption (M=4.22)	Lower levels of CO_2 emission (M=3.43)	0.0002
Lower energy bills (M=4.22)	Lower levels of CO_2 emission (M=3.43)	0.0002

Our study found that integration of energy efficiency practices into non-food retail facilities reduced their energy consumption and resulted in lower energy bills. This finding aligns with those of other studies mentioned in Section 2.3 Energy Management in Retail Sector. For instance, our findings align with those of Richman and Simpson (2016) that integration of one energy efficiency practice, energy efficient electrical lighting, resulted in reduction of the total electricity used in the store. More than half of respondents in our study either disagreed, or neither agreed nor disagreed that integration of energy efficiency practices lowered levels of CO_2 emission. This finding contradicts with those of Environment America Research and Policy Center (2016), and Ríos-Fernández (2020) that integration of energy efficiency practices into retail facilities reduced levels of CO_2 emission. Factors such as lack of appropriate tools and required skills to track levels of CO_2 emission may justify respondents low level of agreement with this benefit.

4.8 BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with 16 barriers that prevented the use of energy efficiency practices in their retail facilities. Respondents were asked to rate these barriers using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). In this study, the following analysis scale was applied. Barriers with calculated means of responses that fell between 1 and 1.5 were considered as strongly disagree, between 1.5 and 2.5

as disagree, between 2.5 to 3.5 as neither agree nor disagree, 3.5 to 4.5 as agree, and 4.5 to 5 as strongly agree.

4.8.1 PERCEIVED BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN FOOD RETAIL FACILITIES

Of two respondents that did not integrate energy efficiency practices into their food retail facilities, one answered a question about barriers that prevented the use of energy efficiency practices in their facilities. The distribution of responses of 16 barriers is presented in Table 11.

Table 11. Perceived Barriers to Integrating Energy Efficiency Practices in Food Retail Sector: Distribution of Responses

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)
1	Unavailability of building automation systems (N=1)	0	0	0	0	1
2	Teamwork inefficiencies (N=1)	0	0	0	0	1
3	Lack of negotiation skills (N=1)	0	0	0	0	1
4	Lack of leadership skills for facilities managers (N=1)	0	0	0	0	1
5	Time constraints (N=1)	0	0	0	0	1
6	Incompatibility of building automation systems with other building systems (N=1)	0	0	0	1	0
7	Lack of awareness of lifecycle cost of retail facilities (N=1)	0	0	0	1	0
8	Absence of energy efficiency related regulations (N=1)	0	0	0	1	0
9	Misalignment of historic preservation codes and energy efficiency requirements (N=1)	0	0	0	1	0
10	Unavailability of effective metering systems (N=1)	0	0	1	0	0
11	Difficulty with maintaining the aesthetic attributes of the building (N=1)	0	0	1	0	0
12	Misalignment of building safety regulations and energy efficiency requirements (N=1)	0	0	1	0	0

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)
13	Lack of professional writing skills (e.g., writing proposals) (N=1)	0	1	0	0	0
14	Financial constraints (N=1)	0	1	0	0	0
15	Lack of sustainability training for facilities managers (N=1)	1	0	0	0	0
16	Lack of support for energy efficiency practices from upper management of retail stores (N=1)	1	0	0	0	0

This respondent strongly agreed that unavailability of building automation systems prevented them from using energy efficiency practices in their retail facilities. Furthermore, this respondent indicated strong agreement that barriers such as teamwork inefficiencies, lack of negotiation skills, and lack of leadership skills for facilities managers prevented the use of energy efficiency practices in their retail facilities. Respondent strongly disagreed that lack of sustainability training for facilities managers, and lack of support for energy efficiency practices from upper management of retail stores prevented the use of energy efficiency practices.

In addition to the given barriers, respondents were asked about other barriers that prevented implementation of the energy efficiency practices in their retail facilities. However, the respondent did not answer this question.

Our study found that barriers such as teamwork inefficiencies, lack of negotiation skills, and lack of leadership skills of facilities managers prevented the use of energy efficiency practices in their retail facilities. This finding aligns with those of Elmualim et al. (2010), Halim et al. (2017), Hodges (2005), Shafii et al. (2006), and Shah (2007) that lack of professional capabilities and skills are some of the main challenges preventing facilities managers from integrating energy efficiency practices into their retail facilities. Furthermore, this study found that lack of sustainability training for facilities managers, and lack of support for energy efficiency practices from upper management of retail stores did not prevent facilities managers from integrating energy efficiency practices. This finding is in contrast with previous studies that identified limited knowledge about sustainability and organizational challenges such as lack of support from senior managers as main barriers preventing facilities managers from integrating energy efficiency practices (Elmualim et al., 2009; Halim et al., 2017; Hodges, 2005; Shafii et al., 2006; Shah, 2007).

4.8.2 REALIZED BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN FOOD RETAIL FACILITIES

Of 10 respondents that integrated energy efficiency practices into their food retail facilities, five answered a question about barriers that prevented implementing energy efficiency practices in their retail facilities (see Table 12).

All five respondents either agreed or strongly agreed that financial constraints prevented them from implementing energy efficiency practices in their retail facilities. Four participants neither agreed nor disagreed that unavailability of building automation systems, incompatibility of building automation systems with other building systems, and lack of support for energy efficiency practices from upper management of retail stores prevented them from implementing energy efficiency practices in their retail facilities. Three respondents reported they neither agreed nor disagreed that misalignment of historic preservation codes and energy efficiency requirements prevented them from implementing energy efficiency practices. The same number of respondents neither agreed nor disagreed that lack of leadership skills for facilities managers and lack of awareness of lifecycle cost of retail facilities prevented them from implementing energy efficiency practices in their retail facilities. These two barriers received the lowest ratings (means of 2.4) from the respondents. Hence, according to the calculated means of responses, respondents disagreed that these barriers prevented them from implementing energy efficiency practices. Respondents rated financial constraints (mean of 4.2) and misalignment of historic preservation codes and energy efficiency requirements (mean of 3.4) as the largest barriers of implementing energy efficiency practices in food retail sector. Hence, respondents agreed that financial constraints prevented them from implementing energy efficiency practices. However, misalignment of historic preservation codes and energy efficiency requirements rating revealed that respondents neither agreed nor disagreed that this barrier prevented them from implementing energy efficiency practices in their retail facilities.

Table 12. Realized Barriers to Integrating Energy Efficiency Practices in Food Retail Sector: Distribution of Responses, and Means

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Financial constraints (N=5)	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (10%)	4.2
2	Misalignment of historic preservation codes and energy efficiency requirements (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
3	Unavailability of building automation systems (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (10%)	0 (0%)	3.2
4	Incompatibility of building automation systems with other building systems (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (10%)	0 (0%)	3.2
5	Lack of support for energy efficiency practices from upper management of retail stores (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (10%)	0 (0%)	3.2
6	Time constraints (N=5)	0 (0%)	1 (10%)	2 (40%)	2 (40%)	0 (0%)	3.2
7	Difficulty with maintaining the aesthetic attributes of the building (N=5)	0 (0%)	1 (10%)	3 (60%)	1 (10%)	0 (0%)	3.0
8	Lack of sustainability training for facilities managers (N=5)	0 (0%)	1 (10%)	3 (60%)	1 (10%)	0 (0%)	3.0
9	Unavailability of effective metering systems (N=5)	0 (0%)	1 (10%)	4 (80%)	0 (0%)	0 (0%)	2.8
10	Lack of negotiation skills (N=5)	1 (10%)	0 (0%)	3 (60%)	1 (10%)	0 (0%)	2.8
11	Absence of energy efficiency related regulations (N=5)	0 (0%)	1 (10%)	4 (80%)	0 (0%)	0 (0%)	2.8

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
12	Lack of professional writing skills (e.g., writing proposals) (N=5)	1 (10%)	0 (0%)	4 (80%)	0 (0%)	0 (0%)	2.6
13	Teamwork inefficiencies (N=5)	1 (10%)	1 (10%)	2 (40%)	1 (10%)	0 (0%)	2.6
14	Misalignment of building safety regulations and energy efficiency requirements (N=5)	1 (10%)	0 (0%)	4 (80%)	0 (0%)	0 (0%)	2.6
15	Lack of leadership skills for facilities managers (N=5)	1 (10%)	1 (10%)	3 (60%)	0 (0%)	0 (0%)	2.4
16	Lack of awareness of lifecycle cost of retail facilities (N=5)	1 (10%)	1 (10%)	3 (60%)	0 (0%)	0 (0%)	2.4

In addition to the given barriers, respondents were asked about other barriers that prevented implementation of the energy efficiency practices in their retail facilities. However, respondents did not answer this question.

Calculated means of respondent perceptions about all barriers shown in Table 12 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these barriers. Realized barriers with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 13.

The difference between the means of respondents perception about financial constraints and the remaining 15 barriers was statistically significant. In other words, respondents perceived that financial constraint was a significantly larger barrier than all other barriers presented in Table 12. For instance, the difference between the means of respondents perception about financial constraints and unavailability of building automation systems barriers was statistically significant (p-value = 0.01). In other words, respondents perceived that financial constraint was a significantly larger barrier than unavailability of building automation systems. With p-value of 0.001, the difference between the means of respondents perception about financial constraints barrier versus unavailability of effective metering systems barrier was deemed statistically significant. In other words, respondents perceived that financial constraint was a significantly larger barrier than unavailability of effective metering systems. Similarly, respondents perceived that financial constraint was a significantly larger barrier than lack of sustainability training for facilities managers (p-value = 0.01). Mean comparison of respondent perceptions about other barriers in integrating energy efficiency practices did not show a statistically significant difference.

Table 13. Mean Comparison of Respondent Perceptions about Realized Barriers to Integrating Energy Efficiency Practices in Food Retail Sector

Barriers	Barriers	p-value
Financial Constraints (M=4.2)	Unavailability of building automation systems (M=3.2)	0.01
Financial Constraints (M=4.2)	Incompatibility of building automation systems with other building systems (M=3.2)	0.01
Financial Constraints (M=4.2)	Unavailability of effective metering systems (M=2.8)	0.001
Financial Constraints (M=4.2)	Difficulty with maintaining the aesthetic attributes of the building (M=3.0)	0.01
Financial Constraints (M=4.2)	Lack of professional writing skills (e.g., writing proposals) (M=2.6)	0.01
Financial Constraints (M=4.2)	Teamwork inefficiencies (M=2.6)	0.03
Financial Constraints (M=4.2)	Lack of negotiation skills (M=2.8)	0.04
Financial Constraints (M=4.2)	Lack of leadership skills for facilities managers (M=2.4)	0.004
Financial Constraints (M=4.2)	Lack of awareness of lifecycle cost of retail facilities (M=2.4)	0.004
Financial Constraints (M=4.2)	Lack of sustainability training for facilities managers (M=3.0)	0.01
Financial Constraints (M=4.2)	Lack of support for energy efficiency practices from upper management of retail stores (M=3.2)	0.01
Financial Constraints (M=4.2)	Time constraints (M=3.2)	0.05
Financial Constraints (M=4.2)	Absence of energy efficiency related regulations (M=2.8)	0.001
Financial Constraints (M=4.2)	Misalignment of building safety regulations and energy efficiency requirements (M=2.6)	0.01
Financial Constraints (M=4.2)	Misalignment of historic preservation codes and energy efficiency requirements (M=3.4)	0.04

Our study found that financial constraints prevented facilities managers from implementing energy efficiency practices in their food retail facilities. This finding aligns with those of Elmualim et al. (2010), Halim et al. (2017), Hodges (2005), Shafii et al. (2006), and Shah (2007) that lack of funding for FM related activities prevented facilities managers from implementing energy efficiency practices in their facilities. Furthermore, our study found that barriers such as lack of leadership skills for facilities managers, and lack of awareness of lifecycle cost of retail facilities did not prevent facilities managers from implementing energy efficiency practices in their facilities. This finding is in contrast with previous studies that found lack of professional skills such as leadership and lack of awareness of building whole-life value as main capability challenges faced by FM practitioners in implementing energy efficiency practices (Elmualim et al., 2009; Halim et al., 2017; Hodges, 2005; Shafii et al., 2006); Shah, 2007).

4.9 BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN NON-FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with 16 barriers that prevented the use of energy efficiency practices in their non-retail facilities. Respondents were asked to rate these barriers using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5).

4.9.1 PERCEIVED BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN NON-FOOD RETAIL FACILITIES

Of eight respondents that did not integrate energy efficiency practices into their non-food retail facilities, five answered a question about barriers that prevented the use of energy efficiency practices in their facilities. The distribution of responses and the calculated means of respondent perceptions about 16 barriers are presented in Table 14.

All five respondents either agreed or strongly agreed that financial constraints prevented them from using energy efficiency practices in their retail facilities. Four respondents agreed that time constraints, and misalignment of building safety regulations and energy efficiency requirements prevented them from using energy efficiency practices. The same number of respondents agreed that absence of energy efficiency related regulations hindered their ability to use energy efficiency practices. Three respondents neither agreed nor disagreed that lack of leadership skills for facilities managers prevented them from using energy efficiency practices. Furthermore, the same number of respondents either disagreed or strongly disagreed that teamwork inefficiencies and lack of professional writing skills prevented them from using energy efficiency practices. Respondents rated financial constraints (mean of 4.2), time constraints (mean of 3.8), misalignment of building safety regulations and energy efficiency requirements (mean of 3.8), and lack of support for energy efficiency practices from upper management of retail stores (mean of 3.6) as the largest barriers that prevented the use of energy efficiency practices. Based on the calculated means, respondents agreed that these four barriers prevented them from using energy efficiency practices in their retail stores. On the other hand, respondents rated barriers such as teamwork inefficiencies (mean of 2.4), lack of leadership skills for facilities managers (mean of 2.4), lack of professional writing skills (mean of 2.2), and lack of negotiation skills (mean of 2.2) as smallest barriers that prevented the use of energy efficiency practices. In other words, respondents disagreed that these barriers prevented them from using energy efficiency practices in their non-food retail stores.

In addition to the given barriers, respondents were asked about other barriers that prevented implementation of the energy efficiency practices in their retail facilities. However, respondents did not answer this question.

Table 14. Perceived Barriers to Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Means

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Financial constraints (N=5)	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	4.2
2	Time constraints (N=5)	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	3.8
3	Misalignment of building safety regulations and energy efficiency requirements (N=5)	0 (0%)	0 (0%)	1 (20%)	4 (80%)	0 (0%)	3.8
4	Lack of support for energy efficiency practices from upper management of retail stores (N=5)	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	3.6
5	Incompatibility of building automation systems with other building systems (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
6	Unavailability of effective metering systems (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
7	Absence of energy efficiency related regulations (N=5)	1 (20%)	0 (0%)	0 (0%)	4 (80%)	0 (0%)	3.4
8	Misalignment of historic preservation codes and energy efficiency requirements (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
9	Unavailability of building automation systems (N=5)	1 (20%)	0 (0%)	1 (20%)	3 (60%)	0 (0%)	3.2
10	Difficulty in maintaining the aesthetic attributes of the building (N=5)	1 (20%)	0 (0%)	1 (20%)	3 (60%)	0 (0%)	3.2
11	Lack of sustainability training for facilities managers (N=5)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0 (0%)	3.2
12	Lack of awareness of lifecycle cost of retail facilities (N=5)	1 (20%)	1 (20%)	1 (20%)	2 (40%)	0 (0%)	2.8
13	Teamwork inefficiencies (N=5)	1 (20%)	2 (40%)	1 (20%)	1 (20%)	0 (0%)	2.4
14	Lack of leadership skills for facilities managers (N=5)	2 (40%)	0 (0%)	2 (40%)	1 (20%)	0 (0%)	2.4
15	Lack of professional writing skills (e.g., writing proposals) (N=5)	2 (40%)	1 (20%)	1 (20%)	1 (20%)	0 (0%)	2.2
16	Lack of negotiation skills (N=5)	2 (40%)	0 (0%)	3 (60%)	0 (0%)	0 (0%)	2.2

Calculated means of respondent perceptions about all barriers shown in Table 14 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these barriers. Realized barriers with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 15. There was a statistically significant difference (p-value = 0.03) between the means of responses related to time constraints and teamwork inefficiencies barriers. In other words, respondents perceived that time constraint was a significantly larger barrier to using energy efficiency practices in their retail facilities than teamwork inefficiencies. With p-value of 0.04, the difference between the means of respondents level of agreement with financial constraints versus misalignment of historic preservation codes and energy efficiency requirements was deemed statistically significant. To elaborate more, respondents perceived that financial constraint was a significantly larger barrier than misalignment of historic preservation codes and energy efficiency requirements in using energy efficiency practices in their retail facilities. Mean comparison of respondent perceptions about other barriers to integrating energy efficiency practices did not show a statistically significant difference.

Table 15. Mean Comparison of Respondent Perceptions about Perceived Barriers to Integrating Energy Efficiency Practices in Non-food Retail Facilities

Barriers	Barriers	p-value
Lack of support for energy efficiency practices from upper management of retail stores (M=3.6)	Lack of negotiation skills (M=2.2)	0.03
Financial constraints (M=4.2)	Lack of negotiation skills (M=2.2)	0.01
Time constraints (M=3.8)	Lack of negotiation skills (M=2.2)	0.02
Misalignment of building safety regulations and energy efficiency requirements (M=3.8)	Lack of negotiation skills (M=2.2)	0.02
Financial constraints (M=4.2)	Teamwork inefficiencies (M=2.4)	0.01
Time constraints (M=3.8)	Teamwork inefficiencies (M=2.4)	0.03
Misalignment of building safety regulations and energy efficiency requirements (M=3.8)	Teamwork inefficiencies (M=2.4)	0.03

Barriers	Barriers	p-value
Financial constraints (M=4.2)	Lack of professional writing skills (M=2.2)	0.01
Time constraints (M=3.8)	Lack of professional writing skills (M=2.2)	0.03
Misalignment of building safety regulations and energy efficiency requirements (M=3.8)	Lack of professional writing skills (M=2.2)	0.03
Financial constraints (M=4.2)	Lack of leadership skills for facilities managers (M=2.4)	0.02
Financial constraints (M=4.2)	Misalignment of historic preservation codes and energy efficiency requirements (M=3.4)	0.04

Our study found that respondents neither agreed nor disagreed that unavailability of building automation systems prevented them from using energy efficiency practices. This finding does not align with those of Rock et al. (2019) that technological obstacles such as nonexistence of building monitoring systems in old buildings imposed significant challenges on FM professionals. Rock et al. (2019) also stated opposition of regulatory goals with each other caused confusion among facilities managers. This aligns with the finding of our study as respondents agreed that misalignment of building safety regulations and energy efficiency requirements prevented them from using energy efficiency practices. In our study, respondents agreed that financial constraints prevented them from using energy efficiency practices. Facilities managers might encounter financial constraints due to lack of professional writing skills. In other words, facilities managers that are not able to present business plans that demonstrate good ROI may encounter challenges with any capital investment requests (Aishah Kamarazaly et al., 2013). However, our study found that respondents disagreed that lack of professional writing skills prevented them from using energy efficiency practices. Furthermore, in our study, respondents perceived that financial constraint was a significantly larger barrier to using energy efficiency practices in their non-food retail facilities than the lack of professional writing skills.

4.9.2 REALIZED BARRIERS TO INTEGRATING ENERGY EFFICIENCY PRACTICES IN NON-FOOD RETAIL FACILITIES

Of 54 respondents that integrated energy efficiency practices into their non-food retail facilities, depending on the question, 45 (83%) to 46 (85%) answered a question about barriers that prevented implementing energy efficiency practices in their retail facilities (see Table 16).

Majority of respondents (36, 78%) either agreed or strongly agreed that financial constraints prevented them from implementing energy efficiency practices in their retail stores. More than half of respondents (26, 56%) agreed or strongly agreed that time constraints prevented them from implementing energy efficiency practices in their retail stores. Of 46 respondents, majority (28, 61%, and 24, 52%) either disagreed or strongly disagreed that lack of negotiation skills and lack of professional writing skills prevented them from implementing energy efficiency practices respectively. Almost half of respondents (21, 46%) either agreed or strongly agreed that lack of support for energy efficiency practices from upper management of retail stores prevented the implementation of energy efficiency practices in their retail facilities. About one-third of respondents (15, 33%) neither agreed nor disagreed that barriers such as absence of energy efficiency related regulations and teamwork inefficiencies prevented the implementation of energy efficiency practices. Respondents rated financial constraints (mean of 3.96) and time constraints (mean of 3.52) as the largest barriers that prevented implementing energy efficiency practices. Consecutively, respondents rated incompatibility of building automation systems with other building systems (mean of 3.37) and lack of support for energy efficiency practices from upper management of retail stores (mean of 3.32) as being the third and fourth largest barriers that prevented implementing energy efficiency practices. Based on the calculated means of responses, respondents neither agreed nor disagreed that these two barriers prevented them from implementing energy efficiency practices in their retail stores. Respondents rated lack of leadership skills for facilities managers (mean of 2.49), lack of professional writing skills (mean of 2.43), and lack of negotiation skills (mean of 2.33) as the smallest barriers that prevented the implementation of energy efficiency practices in their retail facilities. In other words, respondents disagreed that lack of professional writing skills and lack of negotiation skills prevented them from implementing energy efficiency practices in their non-food retail facilities.

In addition to the given barriers, respondents were asked about other barriers that prevented implementation of the energy efficiency practices in their retail facilities. Three respondents answered this question. One respondent stated that interorganizational collaboration between facilities management department and IT department regarding integration of automated systems was a barrier for their retail stores. Another respondent stated that lack of comprehensive design standards and guidelines prevented them from using energy efficiency practices. One response was omitted due to repetition of respondent's entry.

Table 16. Realized Barriers to Integrating Energy Efficiency Practices in Non-food Retail Sector: Distribution of Responses, and Mean

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Financial constraints (N=46)	2 (4%)	3 (7%)	5 (11%)	21 (46%)	15 (33%)	3.96
2	Time constraints (N=46)	1 (2%)	6 (13%)	13 (28%)	20 (43%)	6 (13%)	3.52
3	Incompatibility of building automation systems with other building systems (N=46)	2 (4%)	7 (15%)	12 (26%)	22 (48%)	3 (7%)	3.37
4	Lack of support for energy efficiency practices from upper management of retail stores (N=46)	6 (13%)	10 (22%)	9 (20%)	10 (22%)	11 (24%)	3.22
5	Misalignment of historic preservation codes and energy efficiency requirements (N=46)	4 (9%)	7 (15%)	16 (35%)	14 (30%)	5 (11%)	3.20

#	Barriers (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
6	Unavailability of effective metering systems (N=46)	4 (9%)	9 (20%)	12 (26%)	17 (37%)	4 (9%)	3.17
7	Lack of sustainability training for facilities managers (N=46)	5 (11%)	11 (24%)	11 (24%)	13 (28%)	6 (13%)	3.09
8	Misalignment of building safety regulations and energy efficiency requirements (N=46)	4 (9%)	12 (26%)	13 (28%)	12 (26%)	5 (11%)	3.04
9	Lack of awareness of lifecycle cost of retail facilities (N=45)	7 (16%)	10 (22%)	8 (18%)	15 (33%)	5 (11%)	3.02
10	Absence of energy efficiency related regulations (N=46)	4 (9%)	11 (24%)	15 (33%)	13 (28%)	3 (7%)	3.00
11	Difficulty with maintaining the aesthetic attributes of the building (N=46)	7 (15%)	10 (22%)	11 (24%)	14 (30%)	4 (9%)	2.96
12	Unavailability of building automation systems (N=46)	8 (17%)	13 (28%)	12 (26%)	11 (24%)	2 (4%)	2.70
13	Teamwork inefficiencies (N=46)	9 (20%)	11 (24%)	15 (33%)	10 (22%)	1 (2%)	2.63
14	Lack of leadership skills for facilities managers (N=45)	10 (22%)	15 (33%)	10 (22%)	8 (18%)	2 (4%)	2.49
15	Lack of professional writing skills (e.g., writing proposals) (N=46)	13 (28%)	11 (24%)	12 (26%)	9 (20%)	1 (2%)	2.43
16	Lack of negotiation skills (N=46)	11 (24%)	17 (37%)	11 (24%)	6 (13%)	1 (2%)	2.33

Calculated means of respondent perceptions about all barriers shown in Table 16 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these barriers. Realized barriers with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 17. The difference between the means of respondents level of agreement with unavailability of building automation systems and unavailability of effective metering systems was statistically significant (p-value = 0.05). In other words, respondents perceived that unavailability of effective metering systems was a significantly larger barrier than unavailability of building automation systems to implementing energy efficiency practices in their retail facilities. Additionally, with p-value of 0.003, the difference between the means of respondents level of agreement with incompatibility of building automation systems with other building systems versus unavailability of building automation systems was deemed statistically significant. Hence, respondents perceived that unavailability of building automation systems was a significantly smaller barrier than incompatibility of building automation systems with other building systems. Furthermore, the difference between the means of respondents level of agreement with lack of leadership skills for facilities managers and lack of support for energy efficiency practices from upper management of retail facilities was statistically significant (p-value = 0.01). To elaborate more, respondents perceived that lack of support for energy efficiency practices from upper management of retail facilities was a significantly larger barrier than of lack of leadership skills for facilities managers to implementing energy efficiency practices in their facilities. With p-values of 4.60×10^{-6}, 0.0001, and 1.24×10^{-5}, respondents perceived that time constraint was a significantly larger barrier than lack of professional writing skills, teamwork inefficiencies, and lack of leadership skills for facilities managers. In this study, respondents perceived that financial constraints barrier was significantly larger than other 15 barriers presented in Table 16. For instance, with p-values of 3.87×10^{-7}, 0.001, and 0.01, respondents perceived that financial constraint was a significantly larger barrier than unavailability of building automation systems, unavailability of effective metering systems, and incompatibility of building automation systems with other building systems. Mean comparison of respondent perceptions about other barriers in integrating energy efficiency practices did not show a statistically significant difference. It should be noted that not all significant findings are discussed. Only those findings that are deemed extraordinarily cogent were examined in this study.

Table 17. Mean Comparison of Respondent Perceptions about Realized Barriers to Integrating Energy Efficiency Practices in Non-food Retail Facilities

Barriers	Barriers	p-value
Incompatibility of building automation systems with other building systems (M=3.37)	Unavailability of building automation systems (M=2.70)	0.003
Unavailability of effective metering systems (M=3.17)	Unavailability of building automation systems (M=2.70)	0.05
Financial constraints (M=3.96)	Unavailability of building automation systems (M=2.70)	3.87×10^{-7}
Time constraints (M=3.52)	Unavailability of building automation systems (M=2.70)	0.0003
Incompatibility of building automation systems with other building systems (M=3.37)	Lack of professional writing skills (M=2.43)	0.0001
Incompatibility of building automation systems with other building systems (M=3.37)	Teamwork inefficiencies (M=2.63)	0.001
Incompatibility of building automation systems with other building systems (M=3.37)	Lack of negotiation skills (M=2.33)	3.77×10^{-6}
Incompatibility of building automation systems with other building systems (M=3.37)	Lack of leadership skills for facilities managers (M=2.49)	0.0002
Financial constraints (M=3.96)	Incompatibility of building automation systems with other building systems (M=3.37)	0.01
Unavailability of effective metering systems (M=3.17)	Lack of professional writing skills (M=2.43)	0.003
Unavailability of effective metering systems (M=3.17)	Teamwork inefficiencies (M=2.63)	0.02
Unavailability of effective metering systems (M=3.17)	Lack of negotiation skills (M=2.33)	0.0003
Unavailability of effective metering systems (M=3.17)	Lack of leadership skills for facilities managers (M=2.49)	0.01
Financial constraints (M=3.96)	Unavailability of effective metering systems (M=3.17)	0.001
Difficulty with maintaining the aesthetic attributes of the building (M=2.96)	Lack of professional writing skills (M=2.43)	0.04
Difficulty with maintaining the aesthetic attributes of the building (M=2.96)	Lack of negotiation skills (M=2.33)	0.01
Financial constraints (M=3.96)	Difficulty with maintaining the aesthetic attributes of the building (M=2.96)	0.0001
Time constraints (M=3.52)	Difficulty with maintaining the aesthetic attributes of the building (M=2.96)	0.02
Lack of awareness of lifecycle cost of retail facilities (M=3.02)	Lack of professional writing skills (M=2.43)	0.02
Lack of sustainability training for facilities managers (M=3.09)	Lack of professional writing skills (M=2.43)	0.01

Barriers	Barriers	p-value
Lack of support for energy efficiency practices from upper management of retail stores (M=3.22)	Lack of professional writing skills (M=2.43)	0.004
Financial constraints (M=3.96)	Lack of professional writing skills (M=2.43)	3.25×10^{-9}
Time constraints (M=3.52)	Lack of professional writing skills (M=2.43)	4.60×10^{-6}
Absence of energy efficiency related regulations (M=3.00)	Lack of professional writing skills (M=2.43)	0.02
Misalignment of building safety regulations and energy efficiency requirements (M=3.04)	Lack of professional writing skills (M=2.43)	0.01
Misalignment of historic preservation codes and energy efficiency requirements (M=3.20)	Lack of professional writing skills (M=2.43)	0.002
Lack of support for energy efficiency practices from upper management of retail stores (M=3.22)	Teamwork inefficiencies (M=2.63)	0.03
Financial constraints (M=3.96)	Teamwork inefficiencies (M=2.63)	6.34×10^{-8}
Time constraints (M=3.52)	Teamwork inefficiencies (M=2.63)	0.0001
Misalignment of historic preservation codes and energy efficiency requirements (M=3.20)	Teamwork inefficiencies (M=2.63)	0.02
Lack of awareness of lifecycle cost of retail facilities (M=3.02)	Lack of negotiation skills (M=2.33)	0.01
Lack of sustainability training for facilities managers (M=3.09)	Lack of negotiation skills (M=2.33)	0.002
Lack of support for energy efficiency practices from upper management of retail stores (M=3.22)	Lack of negotiation skills (M=2.33)	0.001
Financial constraints (M=3.96)	Lack of negotiation skills (M=2.33)	6.37×10^{-11}
Time constraints (M=3.52)	Lack of negotiation skills (M=2.33)	1.60×10^{-7}
Absence of energy efficiency related regulations (M=3.00)	Lack of negotiation skills (M=2.33)	0.003
Misalignment of building safety regulations and energy efficiency requirements (M=3.04)	Lack of negotiation skills (M=2.33)	0.002
Misalignment of historic preservation codes and energy efficiency requirements (M=3.20)	Lack of negotiation skills (M=2.33)	2.17×10^{-4}
Lack of awareness of lifecycle cost of retail facilities (M=3.02)	Lack of leadership skills for facilities managers (M=2.49)	0.04
Lack of sustainability training for facilities managers (M=3.09)	Lack of leadership skills for facilities managers (M=2.49)	0.02
Lack of support for energy efficiency practices from upper management of retail stores (M=3.22)	Lack of leadership skills for facilities managers (M=2.49)	0.01
Financial constraints (M=3.96)	Lack of leadership skills for facilities managers (M=2.49)	1.01×10^{-8}
Time constraints (M=3.52)	Lack of leadership skills for facilities managers (M=2.49)	1.24×10^{-5}

Barriers	Barriers	p-value
Absence of energy efficiency related regulations (M=3.00)	Lack of leadership skills for facilities managers (M=2.49)	0.03
Misalignment of building safety regulations and energy efficiency requirements (M=3.04)	Lack of leadership skills for facilities managers (M=2.49)	0.02
Misalignment of historic preservation codes and energy efficiency requirements (M=3.20)	Lack of leadership skills for facilities managers (M=2.49)	0.004
Financial constraints (M=3.96)	Lack of awareness of lifecycle cost of retail facilities (M=3.02)	0.0003
Time constraints (M=3.52)	Lack of awareness of lifecycle cost of retail facilities (M=3.02)	0.04
Financial constraints (M=3.96)	Lack of sustainability training for facilities managers (M=3.09)	0.0004
Financial constraints (M=3.96)	Lack of support for energy efficiency practices from upper management of retail stores (M=3.22)	0.005
Financial constraints (M=3.96)	Time constraints (M=3.52)	0.041
Financial constraints (M=3.96)	Absence of energy efficiency related regulations (M=3.00)	4.15×10^{-5}
Financial constraints (M=3.96)	Misalignment of building safety regulations and energy efficiency requirements (M=3.04)	1.48×10^{-4}
Financial constraints (M=3.96)	Misalignment of historic preservation codes and energy efficiency requirements (M=3.20)	1.09×10^{-3}
Time constraints (M=3.52)	Absence of energy efficiency related regulations (M=3.00)	0.02
Time constraints (M=3.52)	Misalignment of building safety regulations and energy efficiency requirements (M=3.04)	0.03

Our study found that respondents neither agreed nor disagreed that difficulty with maintaining the aesthetic attributes of the building prevented them from implementing energy efficiency practices in their non-food retail facilities. This finding is in contrasts with that of Rock et al. (2019) that designers may refrain from specifying energy efficient practices due to the importance of building aesthetics, which hinders facilities managers' ability to implement sustainability measures into the building. Similarly, our study found that respondents neither agreed nor disagreed that absence of energy efficiency related regulations prevented them from implementing energy efficiency practices in their facilities. This finding is in contrast with those of Ikediashi et al. (2012) that lack of policy and regulation to enforce existing laws on sustainability practices hinders facilities managers' ability to implement sustainability measures into the building. Furthermore, our study found respondents disagreed that professional limitations such as lack of leadership skills for facilities managers, and lack of professional writing skills prevented them from implementing energy efficiency practices in their facilities. This finding does not align with those of Elmualim et al. (2010), Halim et al. (2017), Hodges (2005), Shafii et al. (2006), and Shah (2007) that lack of professional capabilities and skills are the main barriers faced by FM practitioners that prevented implementing energy efficiency practices into their non-food retail facilities.

4.10 SOLUTIONS TO WIDER INTEGRATION OF ENERGY EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with 22 solutions that could increase implementation of the energy efficiency practices in their food retail facilities. Respondents were asked to rate these solutions using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). In this study, the following analysis scale was applied. Solutions with calculated means of responses that fell between 1 and 1.5 were considered as strongly disagree, between 1.5 and 2.5 as disagree, between 2.5 to 3.5 as neither agree nor disagree, 3.5 to 4.5 as agree, and 4.5 to 5 as strongly agree.

4.10.1 SOLUTIONS TO WIDER INTEGRATION OF ENERGY-EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES: RESPONDENTS THAT DID NOT INTEGRATE ENERGY EFFICIENCY PRACTICES

Of two respondents that did not integrate energy efficiency practices into their food retail facilities, none answered a question about solution that could increase implementation of energy efficiency practices in their retail facilities. Additionally, respondents were asked about other sustainable building systems and building structural features that could be used to achieve energy-efficient retail facilities. Furthermore, respondents were asked about other professional development methods and/or sustainable management strategies for facilities management personnel that could help achieve energy-efficient retail facilities. However, respondents did not answer these questions.

4.10.2 SOLUTIONS TO WIDER INTEGRATION OF ENERGY-EFFICIENCY PRACTICES INTO FOOD RETAIL FACILITIES: RESPONDENTS THAT INTEGRATED ENERGY EFFICIENCY PRACTICES

Of 10 respondents that integrated energy efficiency practices into their food retail facilities, depending on the question, four to five answered a question about solution that could increase implementation of energy efficiency practices in their retail facilities (see Table 18). All five respondents either agreed or strongly agreed that incorporation of commissioning into the building's life cycle could increase implementation of the energy efficiency practices. Furthermore, all five respondents agreed that proactive operation and maintenance of sustainable building systems could increase implementation of the energy efficiency practices in their retail facilities. Four respondents agreed that promotion of an integrated collaboration between policy makers, code councils, and facilities managers could increase implementation of the energy efficiency practices. Of five respondents, four neither agreed nor disagreed that use of skylights and use of energy efficient refrigerators cycle could increase implementation of the energy efficiency practices in their retail facilities. Three respondents neither agreed nor disagreed that training on teamwork skills for facilities managers could increase implementation of the energy efficiency practices. Respondents rated incorporation of commissioning into the building's life cycle (mean of 4.2), proactive operation and maintenance of sustainable building systems (mean of 4.0), and use of high-performance windows and HVAC (mean of 3.6) as the top solutions that could increase implementation of the energy efficiency practices in their retail facilities. Based on the calculated means, respondents agreed that these four solutions could increase implementation of the energy efficiency practices. On the other hand, the lowest rated solutions were use of skylights, use of energy efficient refrigerators, and training on teamwork skills for facilities managers (means of 2.6). In other words, respondents neither agreed nor disagreed that these three solutions could increase implementation of the energy efficiency practices.

In addition to the given solutions, respondents were asked about other sustainable building systems and building structural features as well as other professional development methods and/or sustainable management strategies for facilities management personnel to achieve energy-efficient retail facilities. However, respondents did not answer this question.

Table 18. Solutions to Wider Integration of Energy Efficiency Practices in Food Retail Facilities: Distribution of Responses, and Means

#	Solutions (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Incorporation of commissioning into the building's life cycle (N=5)	0 (0%)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	4.2
2	Proactive operation and maintenance of sustainable building systems (N=5)	0 (0%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	4
3	Use of high-performance windows (N=5)	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	3.6
4	Use of energy efficient HVAC systems (N=5)	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	3.6
5	Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (N=4)	0 (0%)	0 (0%)	2 (50%)	2 (50%)	0 (0%)	3.5
6	Use of renewable energy systems (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
7	Use of energy efficient electrical lighting (N=5)	1 (20%)	0 (0%)	0 (0%)	4 (80%)	0 (0%)	3.4

#	Solutions (N=number of responses)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
8	Retrofitting the building envelope to reduce air leakage (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
9	Efficient space planning (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
10	Development of low-cost building maintenance strategies (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
11	Operating building systems properly (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
12	Sustainability training for upper management of retail stores (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
13	Sustainability training for facilities managers (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
14	Use of Demand Control Ventilation (DCV) systems (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	0 (0%)	3.2
15	Retrofitting the building envelope by implementing more efficient vestibule configurations (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	0 (0%)	3.2
16	Use of anti-sweat heater controls (N=5)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	0 (0%)	3
17	Use of Pollutant Exposure Control Ventilation (PECV) systems (N=5)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	0 (0%)	3
18	Retrofitting the building envelope to reduce thermal bridging (N=5)	0 (0%)	1 (20%)	3 (60%)	1 (20%)	0 (0%)	3
19	Retrofitting the building envelope by implementing better overhead door strategies (N=5)	0 (0%)	1 (20%)	3 (60%)	1 (20%)	0 (0%)	3
20	Training on negotiation skills for facilities managers (N=5)	0 (0%)	1 (20%)	3 (60%)	1 (20%)	0 (0%)	3
21	Training on professional writing skills for facilities managers (N=5)	1 (20%)	0 (0%)	3 (60%)	1 (20%)	0 (0%)	2.8
22	Use of skylights (N=5)	1 (20%)	0 (0%)	4 (80%)	0 (0%)	0 (0%)	2.6
23	Use of energy efficient refrigerators (N=5)	1 (20%)	0 (0%)	4 (80%)	0 (0%)	0 (0%)	2.6
24	Training on teamwork skills for facilities managers (N=5)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	0 (0%)	2.6

Calculated means of respondent perceptions about all 24 solutions shown in Table 18 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these solutions. Solutions with statistically significant different means of responses (p-value less than or equal to 0.05) are shown in Table 19. The difference between the means of respondents level of agreement with the use of high performance windows and use of Pollutant Exposure Control Ventilation (PECV) systems was statistically significant (p-value = 0.04). In other words, respondents perceived that the use of high performance windows was a significantly better solution than the use of Pollutant Exposure Control Ventilation (PECV) systems to increase implementation of the energy efficiency practices in their retail facilities. With p-value of 0.04, the difference between the means of respondents level of agreement with use of energy efficient HVAC systems versus use of Pollutant Exposure Control Ventilation (PECV) systems was deemed statistically significant. To elaborate more, respondents perceived that the use of energy efficient HVAC systems was a significantly better solution than the use of Pollutant Exposure Control Ventilation (PECV) systems to increase implementation of the energy efficiency practices. Furthermore, the difference between the means of respondents level of agreement with proactive operation and maintenance of sustainable building systems and development of low-cost building maintenance strategies was statistically significant (p-value = 0.04). Hence, respondents perceived that proactive operation and maintenance of sustainable building systems was a significantly better solution than development of low-cost building maintenance strategies to increase implementation of the energy efficiency practices in their food retail facilities. Mean comparison of respondent perceptions about other solutions in integrating energy efficiency practices did not show a statistically significant difference.

Table 19. Mean Comparison of Respondent Perceptions about Solutions to Wider Integration of Energy Efficiency Practices in Food Retail Facilities

Solutions	Solutions	p-value
Proactive operation and maintenance of sustainable building systems (M=4.0)	Use of skylights (M=2.6)	0.0081

Solutions	Solutions	p-value
Incorporation of commissioning into the building's life cycle (M=4.2)	Use of skylights (M=2.6)	0.0072
Use of high-performance windows (M=3.6)	Use of anti-sweat heater controls (M=3.0)	0.0400
Use of high-performance windows (M=3.6)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.0)	0.0400
Use of high-performance windows (M=3.6)	Training on teamwork skills for facilities managers (M=2.6)	0.0203
Use of energy efficient HVAC systems (M=3.6)	Use of anti-sweat heater controls (M=3.0)	0.0400
Use of energy efficient HVAC systems (M=3.6)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.0)	0.0400
Use of energy efficient HVAC systems (M=3.6)	Training on teamwork skills for facilities managers (M=2.6)	0.0203
Proactive operation and maintenance of sustainable building systems (M=4.0)	Use of energy efficient refrigerators (M=2.6)	0.0081
Incorporation of commissioning into the building's life cycle (M=4.2)	Use of energy efficient refrigerators (M=2.6)	0.0072
Incorporation of commissioning into the building's life cycle (M=4.2)	Use of anti-sweat heater controls (M=3.0)	0.0003
Proactive operation and maintenance of sustainable building systems (M=4.0)	Use of Demand Control Ventilation (DCV) systems (M=3.2)	0.0039
Incorporation of commissioning into the building's life cycle (M=4.2)	Use of Demand Control Ventilation (DCV) systems (M=3.2)	0.0077
Incorporation of commissioning into the building's life cycle (M=4.2)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.0)	0.0003
Proactive operation and maintenance of sustainable building systems (M=4.0)	Retrofitting the building envelope to reduce air leakage (M=3.4)	0.0400
Incorporation of commissioning into the building's life cycle (M=4.2)	Retrofitting the building envelope to reduce air leakage (M=3.4)	0.0353
Retrofitting the building envelope to reduce air leakage (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497
Proactive operation and maintenance of sustainable building systems (M=4.0)	Retrofitting the building envelope to reduce thermal bridging (M=3.0)	0.0133
Incorporation of commissioning into the building's life cycle (M=4.2)	Retrofitting the building envelope to reduce thermal bridging (M=3.0)	0.0125
Proactive operation and maintenance of sustainable building systems (M=4.0)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.2)	0.0039
Incorporation of commissioning into the building's life cycle (M=4.2)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.2)	0.0077
Proactive operation and maintenance of sustainable building systems (M=4.0)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.0)	0.0133
Incorporation of commissioning into the building's life cycle (M=4.2)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.0)	0.0125
Proactive operation and maintenance of sustainable building systems (M=4.0)	Efficient space planning (M=3.4)	0.0400
Incorporation of commissioning into the building's life cycle (M=4.2)	Efficient space planning (M=3.4)	0.0353
Efficient space planning (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497

Solutions	Solutions	p-value
Proactive operation and maintenance of sustainable building systems (M=4.0)	Development of low-cost building maintenance strategies (M=3.4)	0.0400
Incorporation of commissioning into the building's life cycle (M=4.2)	Development of low-cost building maintenance strategies (M=3.4)	0.0353
Development of low-cost building maintenance strategies (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497
Proactive operation and maintenance of sustainable building systems (M=4.0)	Operating building systems properly (M=3.4)	0.0400
Proactive operation and maintenance of sustainable building systems (M=4.0)	Sustainability training for upper management of retail stores (M=3.4)	0.0400
Proactive operation and maintenance of sustainable building systems (M=4.0)	Sustainability training for facilities managers (M=3.4)	0.0400
Proactive operation and maintenance of sustainable building systems (M=4.0)	Training on teamwork skills for facilities managers (M=2.6)	0.0004
Proactive operation and maintenance of sustainable building systems (M=4.0)	Training on negotiation skills for facilities managers (M=3.0)	0.0133
Proactive operation and maintenance of sustainable building systems (M=4.0)	Training on professional writing skills for facilities managers (M=2.8)	0.0400
Incorporation of commissioning into the building's life cycle (M=4.2)	Operating building systems properly (M=3.4)	0.0353
Incorporation of commissioning into the building's life cycle (M=4.2)	Sustainability training for upper management of retail stores (M=3.4)	0.0353
Incorporation of commissioning into the building's life cycle (M=4.2)	Sustainability training for facilities managers (M=3.4)	0.0353
Incorporation of commissioning into the building's life cycle (M=4.2)	Training on teamwork skills for facilities managers (M=2.6)	0.0010
Incorporation of commissioning into the building's life cycle (M=4.2)	Training on negotiation skills for facilities managers (M=3.0)	0.0125
Incorporation of commissioning into the building's life cycle (M=4.2)	Training on professional writing skills for facilities managers (M=2.8)	0.0294
Operating building systems properly (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497
Sustainability training for upper management of retail stores (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497
Sustainability training for facilities managers (M=3.4)	Training on teamwork skills for facilities managers (M=2.6)	0.0497
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=3.5)	Training on teamwork skills for facilities managers (M=2.6)	0.0479

Our study found that proactive operation and maintenance of sustainable building systems was a significantly better solution than using building systems such as energy efficient refrigerators. This finding is of significant importance as energy efficient refrigerators can significantly reduce energy consumption of food retail facilities (Energy Star, 2008). Hence, it can be implied that proactive operation and maintenance of sustainable building systems may be a significantly better solution than energy efficient refrigerators. Our study found that incorporation of commissioning into the building's life cycle could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with those of California Commissioning Guide (2006) that rather than a one-time event, building commissioning should be viewed as a process that is incorporated into the building's life cycle. According to our study, respondents agreed that promotion of an integrated collaboration between policy makers, code councils, and facilities managers could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with those of Sarpin et al. (2016) that collaboration of facilities managers with other disciplines could increase implementation of the energy efficiency practices in their retail facilities. However, our study also found that respondents neither agreed nor disagreed that training on teamwork skills for facilities managers could increase implementation of the energy efficiency practices in their retail facilities. This finding contradicts those of Barth et al. (2007) that wider implementation of energy efficiency practices requires strong teamwork capabilities. Furthermore, respondents level of agreement with promotion of an integrated collaboration between policy makers, code councils, and facilities managers was significantly higher than training on teamwork skills for facilities managers. Hence, it can be implied that respondents were confident that their ability to work with different disciplines would contribute to increased energy efficiency of their facilities.

4.11 SOLUTIONS TO WIDER INTEGRATION OF ENERGY EFFCIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES

Respondents were asked to rate their level of agreement with 22 solutions that could increase implementation of the energy efficiency practices in their non-food retail facilities.

Respondents were asked to rate these solutions using a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5). In this study, the following analysis scale was applied. Solutions with calculated means of responses that fell between 1 and 1.5 were considered as strongly disagree, between 1.5 and 2.5 as disagree, between 2.5 to 3.5 as neither agree nor disagree, 3.5 to 4.5 as agree, and 4.5 to 5 as strongly agree.

4.11.1 SOLUTIONS TO WIDER INTEGRATION OF ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES: RESPONDENTS THAT DID NOT INTEGRATE ENERGY EFFICIENCY PRACTICES

Of eight respondents that did not integrate energy efficiency practices into their non-food retail facilities, five answered a question about solutions that could increase implementation of energy efficiency practices in their retail facilities (see Table 20). All five respondents agreed that use of energy efficient HVAC systems could increase implementation of energy efficiency practices. Three respondents either agreed or strongly agreed that use of energy efficient electrical lighting and use of skylights could increase implementation of energy efficiency practices in their retail facilities. Similar number of respondents agreed that promotion of an integrated collaboration between policy makers, code councils, and facilities managers could increase implementation of the energy efficiency practices. Four respondents agreed that operating building systems properly could increase implementation of energy efficiency practices. However, three respondents neither agreed nor disagreed that sustainability training for upper management of retail stores could increase implementation of the energy efficiency practices in their non-food retail facilities. Respondents rated use of energy efficient HVAC systems (mean of 4.0), use of energy efficient electrical lighting, and use of skylights (means of 3.8) as the top solutions that could increase implementation of energy efficiency practices. Based on the calculated means of responses, respondents agreed that these three practices could increase implementation of the energy efficiency practices in their retail facilities. On the other hand, the lowest rated solutions were incorporation of commissioning into the building's life cycle, and sustainability training for upper management of retail stores (means of 3.0). However, based on the calculated means of responses, respondents neither agreed nor disagreed that these two solutions could increase implementation of the energy efficiency practices in their retail facilities.

Table 20. Solutions to Wider Integration of Energy Efficiency Practices in Non-food Retail Facilities: Distribution of Responses, and Means

#	Solutions (N=number of respondents)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Use of energy efficient HVAC systems (N=5)	0 (0%)	0 (0%)	0 (0%)	5 (100%)	0 (0%)	4
2	Use of energy efficient electrical lighting (N=5)	0 (0%)	0 (0%)	2 (40%)	2 (40%)	1 (20%)	3.8
3	Use of skylights (N=5)	0 (0%)	0 (0%)	2 (40%)	2 (40%)	1 (20%)	3.8
4	Use of high-performance windows (N=5)	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	3.6
5	Operating building systems properly (N=5)	0 (0%)	1 (20%)	0 (0%)	4 (80%)	0 (0%)	3.6
6	Sustainability training for facilities managers (N=5)	0 (0%)	0 (0%)	2 (40%)	3 (60%)	0 (0%)	3.6
7	Training on negotiation skills for facilities managers (N=5)	0 (0%)	1 (20%)	1 (20%)	2 (40%)	1 (20%)	3.6
8	Training on professional writing skills for facilities managers (N=5)	0 (0%)	1 (20%)	1 (20%)	2 (40%)	1 (20%)	3.6
9	Use of Demand Control Ventilation (DCV) systems (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4
10	Retrofitting the building envelope to reduce air leakage (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
11	Retrofitting the building envelope to reduce thermal bridging (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
12	Retrofitting the building envelope by implementing more efficient vestibule configurations (N=5)	0 (0%)	0 (0%)	3 (60%)	2 (40%)	0 (0%)	3.4

#	Solutions (N=number of respondents)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
13	Development of low-cost building maintenance strategies (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
14	Proactive operation and maintenance of sustainable building systems (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
15	Training on teamwork skills for facilities managers (N=5)	0 (0%)	1 (20%)	1 (20%)	3 (60%)	0 (0%)	3.4
16	Use of renewable energy systems (N=5)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0 (0%)	3.2
17	Use of Pollutant Exposure Control Ventilation (PECV) systems (N=5)	0 (0%)	0 (0%)	4 (80%)	1 (20%)	0 (0%)	3.2
18	Retrofitting the building envelope by implementing better overhead door strategies (N=5)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0 (0%)	3.2
19	Efficient space planning (N=5)	0 (0%)	1 (20%)	2 (40%)	2 (40%)	0 (0%)	3.2
20	Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (N=5)	0 (0%)	2 (40%)	0 (0%)	3 (60%)	0 (0%)	3.2
21	Incorporation of commissioning into the building's life cycle (N=5)	0 (0%)	2 (40%)	1 (20%)	2 (40%)	0 (0%)	3
22	Sustainability training for upper management of retail stores (N=5)	0 (0%)	1 (20%)	3 (60%)	1 (20%)	0 (0%)	3

Additionally, respondents were asked about other sustainable building systems and building structural features to achieve energy-efficient retail facilities. Furthermore, respondents were asked about other professional development methods and/or sustainable management strategies for facilities management personnel to achieve energy-efficient retail facilities. However, respondents did not answer these questions.

Calculated means of respondent perceptions about all 22 solutions shown in Table 20 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these solutions. Solutions with statistically significant different means of responses (p-value less than or equal to

0.05) are shown in Table 21. The difference between the means of respondents level of agreement with use of energy efficient HVAC systems and use of Pollutant Exposure Control Ventilation (PECV) systems was statistically significant (p-value = 0.004). To elaborate more, respondents perceived that the use of energy efficient HVAC systems was a significantly better solution than the use of Pollutant Exposure Control Ventilation (PECV) systems to increase implementation of the energy efficiency practices in their retail facilities. With p-value of 0.04, the difference between the means of respondents level of agreement with use of energy efficient HVAC systems versus retrofitting the building envelope by implementing more efficient vestibule configurations was deemed statistically significant. In other words, respondents perceived that the use of energy efficient HVAC systems was a significantly better solution than retrofitting the building envelope by implementing more efficient vestibule configurations to increase implementation of the energy efficiency practices in their retail facilities. Furthermore, the results indicated that use of energy efficient HVAC systems is a significantly better solution than use of other building systems such as Demand Control Ventilation (DCV) systems, and Pollutant Exposure Control Ventilation (PECV) systems to increase implementation of the energy efficiency practices in non-food retail facilities. Mean comparison of respondent perceptions about other solutions for integrating energy efficiency practices did not show a statistically significant difference.

Table 21. Mean Comparison of Respondent Perceptions about Solutions to Wider Integration of Energy Efficiency Practices in Non-food Retail Facilities

Solutions	Solutions	p-value
Use of energy efficient HVAC systems (M=4.0)	Use of Demand Control Ventilation (DCV) systems (M=3.4)	0.04
Use of energy efficient HVAC systems (M=4.0)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.2)	0.004
Use of energy efficient HVAC systems (M=4.0)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.4)	0.04

Solutions	Solutions	p-value
Use of energy efficient HVAC systems (M=4.0)	Sustainability training for upper management of retail stores (M=3.0)	0.013

Our study found that operating building systems properly could increase implementation of the energy efficiency practices in non-food retail facilities. This finding aligns with those of Cibinskiene et al. (2020) that energy management practices such as proper operation of building system by occupants could increase implementation energy efficiency practices in retail facilities. Furthermore, our study found that the majority of respondents agreed that sustainability training for facilities managers could increase implementation of the energy efficiency practices in retail facilities. This finding aligns with those of Sarpin et al. (2016) that understanding sustainability practices minimizes any capability-related challenges and results in further implementation of the energy efficiency practices in their retail facilities. However, our study found that respondents neither agreed nor disagreed that incorporation of commissioning into the building's life cycle could increase implementation of the energy efficiency practices in their retail facilities. This finding contradicts those of California Commissioning Guide (2006) that rather than a one-time event, building commissioning should be viewed as a process that is incorporated into the building's life cycle. Furthermore, in our study, respondents agreed that training on negotiation skills for facilities managers, and training on professional writing skills for facilities managers could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with those of Aishah Kamarazaly et al. (2013) that facilities managers' ability to write a compelling business plan with proof of optimized asset utilization could increase implementation of the energy efficiency practices.

4.11.2 SOLUTIONS TO WIDER INTEGRATION OF ENERGY EFFICIENCY PRACTICES INTO NON-FOOD RETAIL FACILITIES: RESPONDENTS THAT INTEGRATED ENERGY EFFICIENCY PRACTICES

Of 54 respondents that integrated energy efficiency practices into their non-food retail facilities, depending on the question, 35 (65%) to 40 (74%) answered a question about solutions that could increase implementation of energy efficiency practices in their retail facilities (see Table 22). **A** large majority of respondents (38, 98%) either agreed or strongly agreed that use of energy efficient electrical lighting could increase implementation of the energy efficiency practices. More than half of respondents (20, 51%) agreed that proactive operation and maintenance of sustainable building systems and development of low-cost building maintenance strategies could increase implementation of the energy efficiency practices in their retail facilities. On the other hand, respondents (12, 33%, and 20, 51%) reported that they neither agreed nor disagreed that skylights, and Pollutant Exposure Control Ventilation (PECV) systems could increase implementation of energy efficiency practices. Respondents rated the use of energy efficient electrical lighting (mean of 4.41), operating building systems properly (mean of 4.38), and proactive operation and maintenance of sustainable building systems (mean of 4.33) as the top solutions to wider integration of energy efficiency practices. On the other hand, the lowest rated solutions were retrofitting the building envelope to reduce air leakage (mean of 3.41), use of skylights (mean of 3.23), and use of Pollutant Exposure Control Ventilation (PECV) systems (mean of 3.08). Based on the calculated means, respondents neither agreed nor disagreed that these three solutions could increase implementation of the energy efficiency practices in their retail facilities.

Table 22. Solutions to Wider Integration of Energy Efficiency Practices in Non-food Retail Facilities: Distribution of Responses, and Means

#	Solutions (N=number of participants)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
1	Use of energy efficient electrical lighting (N=39)	1 (3%)	0 (0%)	0 (0%)	19 (49%)	19 (49%)	4.41
2	Operating building systems properly (N=39)	1 (3%)	0 (0%)	1 (3%)	18 (46%)	19 (49%)	4.38
3	Proactive operation and maintenance of sustainable building systems (N=39)	1 (3%)	0 (0%)	1 (3%)	20 (51%)	17 (44%)	4.33
4	Use of energy efficient HVAC systems (N=39)	2 (5%)	0 (0%)	3 (8%)	13 (33%)	21 (54%)	4.31
5	Sustainability training for facilities managers (N=39)	2 (5%)	0 (0%)	3 (8%)	16 (41%)	18 (46%)	4.23
6	Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (N=39)	1 (3%)	0 (0%)	6 (15%)	17 (44%)	15 (38%)	4.15
7	Development of low-cost building maintenance strategies (N=39)	1 (3%)	2 (5%)	4 (10%)	20 (51%)	12 (31%)	4.03
8	Incorporation of commissioning into the building's life cycle (N=39)	1 (3%)	1 (3%)	9 (23%)	15 (38%)	13 (33%)	3.97
9	Use of high-performance windows (N=39)	2 (5%)	1 (3%)	7 (18%)	16 (41%)	13 (33%)	3.95
10	Sustainability training for upper management of retail stores (N=37)	3 (8%)	1 (3%)	4 (11%)	19 (51%)	10 (27%)	3.86
11	Efficient space planning (N=39)	2 (5%)	2 (5%)	8 (21%)	20 (51%)	7 (18%)	3.72
12	Use of Demand Control Ventilation (DCV) systems (N=39)	3 (8%)	3 (8%)	10 (26%)	12 (31%)	11 (28%)	3.64
13	Training on teamwork skills for facilities managers (N=39)	3 (8%)	3 (8%)	9 (23%)	16 (41%)	8 (21%)	3.59
14	Use of renewable energy systems (N=35)	1 (3%)	4 (11%)	11 (31%)	12 (34%)	7 (20%)	3.57
15	Retrofitting the building envelope by implementing more efficient vestibule configurations (N=39)	2 (5%)	3 (8%)	11 (28%)	18 (46%)	5 (13%)	3.54
16	Retrofitting the building envelope to reduce thermal bridging (N=39)	3 (8%)	3 (8%)	11 (28%)	15 (38%)	7 (18%)	3.51
17	Training on negotiation skills for facilities managers (N=38)	3 (8%)	2 (5%)	12 (32%)	15 (39%)	6 (16%)	3.50
18	Training on professional writing skills for facilities managers (N=39)	3 (8%)	3 (8%)	12 (31%)	14 (36%)	7 (18%)	3.49

#	Solutions (N=number of participants)	Strongly Disagree (1)	Disagree (2)	Neither Agree nor Disagree (3)	Agree (4)	Strongly agree (5)	Mean (out of 5)
19	Retrofitting the building envelope by implementing better overhead door strategies (N=39)	2 (5%)	4 (10%)	12 (31%)	16 (41%)	5 (13%)	3.46
20	Retrofitting the building envelope to reduce air leakage (N=39)	3 (8%)	4 (10%)	11 (28%)	16 (41%)	5 (13%)	3.41
21	Use of skylights (N=40)	2 (5%)	7 (18%)	13 (33%)	16 (40%)	2 (5%)	3.23
22	Use of Pollutant Exposure Control Ventilation (PECV) systems (N=39)	3 (8%)	5 (13%)	20 (51%)	8 (21%)	3 (8%)	3.08

In addition to the given solutions, respondents were asked about other sustainable building systems and building structural features to achieve energy-efficient retail facilities. Nine responses were recorded for this question. Incorporation of renewable energy systems such as solar panels, and heat recovery equipment were stated by two distinct respondents. One respondent stated that proper orientation of the building could help achieve energy-efficient retail facilities. Other responses were omitted due to irrelevance or repetition.

Furthermore, respondents were asked about other professional development methods and/or sustainable management strategies for facilities management personnel to achieve energy-efficient retail facilities. Eight responses were recorded for this question. One respondent stated that facility managers should be trained on how to articulate their role in financial performance of facilities management companies and/or departments. Other responses were omitted due to irrelevance and/or repetition.

Calculated means of respondent perceptions about all 22 solutions shown in Table 22 were compared utilizing pooled two-sample t-test or Welch-Satterthwaite t-test to understand if there were significant differences between respondents' level of agreement with these solutions. Solutions with statistically significant different means of responses (p-value less than or equal to

0.05) are shown in Table 23. The difference between the means of respondents level of agreement with use of Demand Control Ventilation (DCV) systems and use of Pollutant Exposure Control Ventilation (PECV) systems was statistically significant (p-value = 0.026). To elaborate more, respondents perceived that use of Demand Control Ventilation (DCV) systems was a significantly better solution than use of Pollutant Exposure Control Ventilation (PECV) systems to increase implementation of the energy efficiency practices in their retail facilities. With p-value of 0.04, respondents perceived that operating building systems properly was a significantly better solution than incorporating commissioning into the building's life cycle to increase implementation of the energy efficiency practices. Similarly, respondents perceived that promotion of an integrated collaboration between policy makers, code councils, and facilities managers was a significantly better solution than training on teamwork skills, negotiation skills, and writing skills for facilities managers. With p-values of 0.00014, and 0.00276, respondents perceived that use of energy efficient electrical lighting and use of energy efficient HVAC systems were significantly better solutions than use of renewable energy systems. Mean comparison of respondent perceptions about other solutions in integrating energy efficiency practices did not show a statistically significant difference. Our study found that use of energy efficient HVAC system, and use of energy efficient electrical lighting were significantly better solutions than practices related to building structural features such as retrofitting the building envelope. Furthermore, in this study, the use of energy efficient HVAC system was a significantly better solution than sustainable building systems such as Demand Control Ventilation (DCV) systems, and Pollutant Exposure Control Ventilation (PECV) systems.

Table 23. Mean Comparison of Respondent Perceptions about Solutions to Wider Integration of Energy Efficiency Practices in Non-food Retail Facilities

Solutions	Solutions	p-value
Use of energy efficient electrical lighting (M=4.41)	Use of renewable energy systems (M=3.57)	0.00014

Solutions	Solutions	p-value
Use of energy efficient HVAC systems (M=4.31)	Use of renewable energy systems (M=3.57)	0.00276
Use of renewable energy systems (M=3.57)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.03884
Proactive operation and maintenance of sustainable building systems (M=4.33)	Use of renewable energy systems (M=3.57)	0.00057
Operating building systems properly (M=4.38)	Use of renewable energy systems (M=3.57)	0.00027
Sustainability training for facilities managers (M=4.23)	Use of renewable energy systems (M=3.57)	0.00650
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Use of renewable energy systems (M=3.57)	0.01073
Use of energy efficient electrical lighting (M=4.41)	Use of skylights (M=3.23)	4.95×10^{-8}
Use of energy efficient electrical lighting (M=4.41)	Use of high-performance windows (M=3.95)	0.02852
Use of energy efficient electrical lighting (M=4.41)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.00112
Use of energy efficient electrical lighting (M=4.41)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	2.85×10^{-8}
Use of energy efficient electrical lighting (M=4.41)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00001
Use of energy efficient electrical lighting (M=4.41)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00008
Use of energy efficient electrical lighting (M=4.41)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00004
Use of energy efficient electrical lighting (M=4.41)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00001
Use of energy efficient electrical lighting (M=4.41)	Efficient space planning (M=3.72)	0.00089
Use of energy efficient electrical lighting (M=4.41)	Development of low-cost building maintenance strategies (M=4.03)	0.04827
Use of energy efficient electrical lighting (M=4.41)	Incorporation of commissioning into the building's life cycle (M=3.97)	0.02841
Use of energy efficient electrical lighting (M=4.41)	Sustainability training for upper management of retail stores (M=3.86)	0.01386
Use of energy efficient electrical lighting (M=4.41)	Training on teamwork skills for facilities managers (M=3.59)	0.00034
Use of energy efficient electrical lighting (M=4.41)	Training on negotiation skills for facilities managers (M=3.50)	0.00005
Use of energy efficient electrical lighting (M=4.41)	Training on professional writing skills for facilities managers (M=3.49)	0.00006
Use of high-performance windows (M=3.95)	Use of skylights (M=3.23)	0.00214
Use of energy efficient HVAC systems (M=4.31)	Use of skylights (M=3.23)	0.00001
Efficient space planning (M=3.72)	Use of skylights (M=3.23)	0.02926
Development of low-cost building maintenance strategies (M=4.03)	Use of skylights (M=3.23)	0.00036
Proactive operation and maintenance of sustainable building systems (M=4.33)	Use of skylights (M=3.23)	0.00000

Solutions	Solutions	p-value
Incorporation of commissioning into the building's life cycle (M=3.97)	Use of skylights (M=3.23)	0.00093
Operating building systems properly (M=4.38)	Use of skylights (M=3.23)	1.24×10^{-7}
Sustainability training for upper management of retail stores (M=3.86)	Use of skylights (M=3.23)	0.00870
Sustainability training for facilities managers (M=4.23)	Use of skylights (M=3.23)	0.00002
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Use of skylights (M=3.23)	0.00003
Use of high-performance windows (M=3.95)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.00031
Use of high-performance windows (M=3.95)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.02953
Use of high-performance windows (M=3.95)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.04125
Operating building systems properly (M=4.38)	Use of high-performance windows (M=3.95)	0.04096
Use of energy efficient HVAC systems (M=4.31)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.00960
Use of energy efficient HVAC systems (M=4.31)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	5.57×10^{-7}
Use of energy efficient HVAC systems (M=4.31)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00032
Use of energy efficient HVAC systems (M=4.31)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00148
Use of energy efficient HVAC systems (M=4.31)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00109
Use of energy efficient HVAC systems (M=4.31)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00042
Use of energy efficient HVAC systems (M=4.31)	Efficient space planning (M=3.72)	0.01117
Use of energy efficient HVAC systems (M=4.31)	Training on teamwork skills for facilities managers (M=3.59)	0.00421
Use of energy efficient HVAC systems (M=4.31)	Training on negotiation skills for facilities managers (M=3.50)	0.00111
Use of energy efficient HVAC systems (M=4.31)	Training on professional writing skills for facilities managers (M=3.49)	0.00106
Use of Demand Control Ventilation (DCV) systems (M=3.64)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.02622
Proactive operation and maintenance of sustainable building systems (M=4.33)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.00339
Operating building systems properly (M=4.38)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.00179
Sustainability training for facilities managers (M=4.23)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.02041
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Use of Demand Control Ventilation (DCV) systems (M=3.64)	0.03446

Solutions	Solutions	p-value
Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.04292
Efficient space planning (M=3.72)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.00553
Development of low-cost building maintenance strategies (M=4.03)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.00004
Proactive operation and maintenance of sustainable building systems (M=4.33)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	1.98×10^{-8}
Incorporation of commissioning into the building's life cycle (M=3.97)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.00011
Operating building systems properly (M=4.38)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	7.59×10^{-9}
Sustainability training for upper management of retail stores (M=3.86)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.00159
Sustainability training for facilities managers (M=4.23)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	1.81×10^{-6}
Training on teamwork skills for facilities managers (M=3.59)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	0.03673
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Use of Pollutant Exposure Control Ventilation (PECV) systems (M=3.08)	2.34×10^{-6}
Development of low-cost building maintenance strategies (M=4.03)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00914
Proactive operation and maintenance of sustainable building systems (M=4.33)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00005
Incorporation of commissioning into the building's life cycle (M=3.97)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.01783
Operating building systems properly (M=4.38)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00002
Sustainability training for facilities managers (M=4.23)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00083
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Retrofitting the building envelope to reduce air leakage (M=3.41)	0.00140
Development of low-cost building maintenance strategies (M=4.03)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.03104
Proactive operation and maintenance of sustainable building systems (M=4.33)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00033
Operating building systems properly (M=4.38)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00015
Sustainability training for facilities managers (M=4.23)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00361
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Retrofitting the building envelope to reduce thermal bridging (M=3.51)	0.00620
Development of low-cost building maintenance strategies (M=4.03)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.02863
Proactive operation and maintenance of sustainable building systems (M=4.33)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00018

Solutions	Solutions	p-value
Operating building systems properly (M=4.38)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00008
Sustainability training for facilities managers (M=4.23)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00284
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Retrofitting the building envelope by implementing more efficient vestibule configurations (M=3.54)	0.00489
Development of low-cost building maintenance strategies (M=4.03)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.01287
Proactive operation and maintenance of sustainable building systems (M=4.33)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00006
Incorporation of commissioning into the building's life cycle (M=3.97)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.02512
Operating building systems properly (M=4.38)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00003
Sustainability training for facilities managers (M=4.23)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00114
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Retrofitting the building envelope by implementing better overhead door strategies (M=3.46)	0.00192
Proactive operation and maintenance of sustainable building systems (M=4.33)	Efficient space planning (M=3.72)	0.00320
Operating building systems properly (M=4.38)	Efficient space planning (M=3.72)	0.00156
Sustainability training for facilities managers (M=4.23)	Efficient space planning (M=3.72)	0.02527
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Efficient space planning (M=3.72)	0.04377
Development of low-cost building maintenance strategies (M=4.03)	Training on negotiation skills for facilities managers (M=3.50)	0.02522
Development of low-cost building maintenance strategies (M=4.03)	Training on professional writing skills for facilities managers (M=3.49)	0.02377
Proactive operation and maintenance of sustainable building systems (4.33)	Sustainability training for upper management of retail stores (M=3.86)	0.03520
Proactive operation and maintenance of sustainable building systems (4.33)	Training on teamwork skills for facilities managers (M=3.59)	0.00118
Proactive operation and maintenance of sustainable building systems (4.33)	Training on negotiation skills for facilities managers (M=3.50)	0.00021
Proactive operation and maintenance of sustainable building systems (4.33)	Training on professional writing skills for facilities managers (M=3.49)	0.00022
Operating building systems properly (M=4.38)	Incorporation of commissioning into the building's life cycle (M=3.97)	0.04184
Incorporation of commissioning into the building's life cycle (M=3.97)	Training on negotiation skills for facilities managers (M=3.50)	0.04544
Incorporation of commissioning into the building's life cycle (M=3.97)	Training on professional writing skills for facilities managers (M=3.49)	0.04261

Solutions	Solutions	p-value
Operating building systems properly (M=4.38)	Sustainability training for upper management of retail stores (M=3.86)	0.02038
Operating building systems properly (M=4.38)	Training on teamwork skills for facilities managers (M=3.59)	0.00058
Operating building systems properly (M=4.38)	Training on negotiation skills for facilities managers (M=3.50)	0.00010
Operating building systems properly (M=4.38)	Training on professional writing skills for facilities managers (M=3.49)	0.00010
Sustainability training for facilities managers (M=4.23)	Training on teamwork skills for facilities managers (M=3.59)	0.00964
Sustainability training for facilities managers (M=4.23)	Training on negotiation skills for facilities managers (M=3.50)	0.00276
Sustainability training for facilities managers (M=4.23)	Training on professional writing skills for facilities managers (M=3.49)	0.00263
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Training on teamwork skills for facilities managers (M=3.59)	0.01655
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Training on negotiation skills for facilities managers (M=3.50)	0.00467
Promotion of an integrated collaboration between policy makers, code councils, and facilities managers (M=4.15)	Training on professional writing skills for facilities managers (M=3.49)	0.00450

Additionally, our study found that sustainability training for facilities managers could increase implementation of the energy efficiency practices in retail facilities. This finding aligns with those of Sarpin et al. (2016) that understanding sustainability practices minimizes any capability-related challenges and results in further implementation of the energy efficiency practices in their retail facilities. Furthermore, in our study, respondents agreed that incorporation of commissioning into the building's life cycle could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with that of California Commissioning Guide (2006) that rather than a one-time event, building commissioning should be viewed as a process that is incorporated into the building's life cycle. Our study also found that respondents agreed that proactive operation and maintenance of sustainable building systems, and development of low-cost building maintenance strategies could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with previous studies that proactive operation and maintenance, and low-cost maintenance strategies can result in continuous improvements of building energy performance (Aune et al., 2009; Hignite 2009; Lewis et al., 2010; Hodges, 2012; Finch and Zhang, 2013). According to our study, respondents agreed that promotion of an integrated collaboration between policy makers, code councils, and facilities managers could increase implementation of the energy efficiency practices in their retail facilities. This finding aligns with that of Sarpin et al. (2016) that collaboration of facilities managers with other disciplines could increase implementation of the energy efficiency practices in their retail facilities.

CHAPTER 5: CONCLUSIONS, LIMITATIONS, AND FUTURE RESEARCH

5.1. CONCLUSIONS

Facilities management is a rapidly growing industry with huge economic, social, and environmental impacts. Due to global warming, there has been a growing interest in implementing environmental sustainability practices into the industry. However, environmental sustainability practices are business sector specific and are not the same for all organizations. Hence, this research aimed to understand the status of implementing energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of U.S. retail sector utilizing a survey of facilities managers with prior experience in retail sector. To accomplish the research purpose, four main research questions were examined. These questions were: 1) To what extent do facilities managers in the U.S. integrate sustainable practices to achieve energy-efficient retail facilities? 2) What are the realized and perceived benefits of implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.? 3) What are the realized and perceived barriers to implementing sustainable practices by facilities managers to achieve energy-efficient retail facilities in the U.S.? and 4) What do facilities managers propose as viable solutions that could help wider implementation of energy-efficient practices in the U.S. retail sector? A summary of research findings, categorized per type of retail facilities, is presented in the next sections.

5.1.1 FOOD RETAIL FACILITIES

According to the findings of this study, a majority of facilities managers that participated in the survey integrated energy efficiency practices into their food retail facilities. Integration of practices such as cool roof and energy efficient HVAC systems could be effective for increasing energy efficiency of retail facilities that did not integrate them. However, it should be noted that the efficiency of these practices is dependent on other building systems. For instance, inefficient building envelope may negatively impact the efficiency of cool roofs (Konopacki and Akbari, 2001). Despite this relationship, aligned with findings of previous studies, this study found that facilities managers that did not integrate energy efficiency practices deemed most building envelope enhancement practices not at all effective in enhancing the energy efficiency of their facilities. In facilities in which energy efficiency practices were integrated, building envelope enhancement to reduce air leakage, energy efficient electrical lighting, and energy efficient HVAC systems have been effective for increasing their energy efficiency. According to Energy Star (2008) refrigerators are considered the largest energy consumer of food retail facilities. Hence, the use energy efficient refrigerators can significantly reduce the energy consumption of these facilities (Energy Star, 2008). However, according to the findings of this study, energy efficient refrigerators are only moderately effective in enhancing energy efficiency of food retail facilities.

According to the findings, facilities managers that never integrated energy efficiency practices did not perceive these practices to be beneficial. On the other hand, facilities with integrated energy efficiency practices benefited from reduced energy consumption and lower energy bills. However, this study did not conclude that facilities managers perceived reduction of CO_2 emissions as a benefit. This finding contradicts those of Energy Star (n.d.) that integration of one energy efficiency practice, energy efficient electrical lighting, in stores and parking lots of a grocery store reduced CO_2 emissions by 78 million pounds per year. This might be due to the fact that tracking levels of CO_2 emission requires specific tools and skills that may not be available to all facilities managers.

In this study, respondents perceived that unavailability of building automation systems, teamwork inefficiencies, and lack of negotiation skills have been preventing the use of energy efficiency practices in these facilities. In addition, facilities managers that integrated energy efficiency practices perceived that financial constraints have been preventing implementation of these practices. It can be interpreted that facilities managers may encounter financial constraints due to lack of professional writing skills. In other words, facilities managers that are not able to present business plans that demonstrate good ROI may encounter challenges with any capital investment requests (Aishah Kamarazaly et al., 2013). However, according to the findings of this study, facilities managers neither agreed nor disagreed that lack of professional writing skills prevented implementation of energy efficiency practices in their retail facilities. Furthermore, they perceived that financial constraint was a significantly larger barrier than lack of professional writing skills.

Facilities with integrated energy efficiency practices could see an increase in implementation of these practices by incorporating commissioning into the building's life cycle, proactive operation and maintenance of sustainable building systems, and use of high-performance windows and HVAC systems in their retail facilities. According to the findings, proactive operation and maintenance of sustainable building systems is a significantly better solution than the use of building systems such as energy efficient refrigerators, Demand Control Ventilation (DCV) systems, and skylights.

5.1.2 NON-FOOD RETAIL FACILITIES

According to the findings of this study, a majority of facilities managers integrated energy efficiency practices into their non-food retail facilities. Integration of practices such as energy efficient electrical lighting, cool roof, and energy-efficient HVAC systems could be effective for increasing energy efficiency of retail facilities that did not integrate them. In facilities in which energy efficiency practices were integrated, energy efficient lighting, energy-efficient HVAC systems, and demand Control Ventilation (DCV) systems have been effective for increasing their energy efficiency. While facilities managers perceived that skylights were significantly less effective than energy efficient electrical lighting, it should be noted that combination of skylights and energy efficient electrical lighting could result in further energy savings according to Galvez-Martos et al. (2013).

According to our findings, facilities managers that never integrated energy efficiency practices perceived that integration of such practices could result in reduced energy consumption and lower energy bills. Similarly, facilities with integrated energy efficiency practices have been benefitting from reduced energy consumption and lower energy bills. However, these facilities managers neither agreed nor disagreed that integration of energy efficiency practices into their retail facilities could lower levels of CO_2 emission. Furthermore, they perceived that reduced energy consumption and lower energy bills were significantly larger benefits than lower levels of CO_2 emission. This finding contradicts that of Ríos-Fernández (2020) that integration of one energy efficiency practice, energy efficient HVAC systems, could reduce levels of CO_2 emission of retail stores by 50%. Factors such as lack of appropriate tools and required skills to track levels of CO_2 emission may justify respondents low level of agreement with this benefit.

Our study found that financial constraints, time constraints, lack of support for energy efficiency practices from upper management, and misalignment of building safety regulations and energy efficiency requirements have been preventing implementation of energy efficiency practices. In facilities in which energy efficiency practices were integrated, financial constraints and time constraints have been preventing implementation of these practices. According to Barth et al. (2007) and Sarpin et al. (2016), negotiation with upper management teams and regulators could potentially address the barriers faced for implementing energy efficiency practices in non-food retail facilities. However, in this study, facilities managers perceived that financial constraint was a significantly larger barrier than their lack of negotiation skills.

Use of energy efficiency practices such as energy efficient HVAC systems, energy efficient electrical lighting, and skylights could increase implementation of energy efficiency practices in food retail facilities that did not integrate them. However, this study found that the use of energy efficient HVAC systems was a significantly better solution than use of other building systems such as Demand Control Ventilation (DCV) systems, and Pollutant Exposure Control Ventilation (PECV) systems. Furthermore, according to the findings, facilities managers neither agreed nor disagreed that incorporation of commissioning into the building's life cycle could increase implementation of the energy efficiency practices in their retail facilities. This finding contradicts that of California Commissioning Guide (2006) that rather than a one-time event, building commissioning should be viewed as a process that is incorporated into the building's life cycle. Facilities with integrated energy efficiency practices could see an increase in implementation of these practices by using energy efficient electrical lighting, operating building systems properly, and proactive operation and maintenance of sustainable building systems in their retail facilities. In general, facilities managers preferred less complex and less expensive strategies that could increase implementation of energy efficiency practices in their retail facilities.

5.2 RESEARCH CONTRIBUTIONS

Implementation of environmental sustainability agenda, particularly energy-efficient practices, are business sector specific. Hence, this study contributes to the existing body of knowledge by focusing on U.S. retail sector. The study findings are significant as among U.S. commercial buildings, the retail sector accounts for the most energy consumption per year. The major contribution is that study findings could help researchers and facilities management professionals identify the most effective energy efficiency practices and their associated benefits for food and non-food retail facilities. Another contribution is that study findings could help researchers, managers of retail facilities, and regulators understand the main barriers that prevented their wider implementation, and utilize the proposed solutions to enhance implementation of energy efficiency practices in retail facilities.

5.3 RESEARCH LIMITATIONS & DELIMITATIONS

Lack of access to online email directories of leading facilities management organizations was a limitation for this research. The study population was limited to the members of International Facilities Management Association (IFMA) and researcher's LinkedIn network. Furthermore, sample size for facilities managers that never integrated energy efficiency practices into their food and non-food retail facilities was small. Due to the small size of the samples, our findings for these groups cannot be generalized. In addition, the number of responses from facilities management professionals with prior domestic and international experience was limited. This may have had negative implications on the diversity of our findings.

Sustainable Facilities Management is driven by the need to reduce the negative impacts of the built environment by advancing economic, environmental, and social sustainability agenda (Elmualim et al., 2010). Hence, a delimitation of this study is that it only focused on energy efficiency aspect of environmental sustainability agenda.

5.4 RECOMMENDATIONS FOR FUTURE RESEARCH

Future research should utilize a large sample of facilities managers that never integrated energy efficiency practices in food and non-food retail facilities. Additionally, future research should utilize a larger sample of facilities management professionals managing food retail facilities. Generalized findings from a large sample will help researchers and industry professionals to understand the implementation status of energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of these retail facilities. Future research should specifically attempt to identify solutions that could increase implementation of energy efficiency practices in food retail facilities that did not integrate these practices.

Future research should compare the status of implementing energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of retail sector in other countries besides the US.

Future research should compare the level of effectiveness of energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of retail industry between food and non-food sectors. Given a larger sample size, future research could compare facilities managers perception of energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of retail industry among respondents that integrated these practices and those that did not integrate.

Future research should compare the level of effectiveness of energy efficiency practices, their benefits, barriers that prevented wider implementation, and potential solutions for increasing energy efficiency of retail industry based on the size of retail facilities, type of facilities management organization, and the annual revenue of facilities management company.

REFERENCES

Aaltonen, A., Määttänen, E., Kyrö, R., & Sarasoja, A. L. (2013). Facilities management driving green building certification: a case from Finland. *Facilities*, *31*(7/8), 328–342. https://doi.org/10.1108/02632771311317475

Accenture. (2012). Sustainable Energy for All: *Opportunities for the retail industry*.

Ahn, K.-U., & Park, C.-S. (2016). Correlation between occupants and energy consumption. *Energy and Buildings*, *116*, 420- 433

Aishah Kamarazaly, M., Mbachu, J., & Phipps, R. (2013). Challenges faced by facilities managers in the Australasian universities. *Journal of Facilities Management*, *11*(2), 136–151. https://doi.org/10.1108/14725961311319755

Ali, Q., Thaheem, M. J., Ullah, F., & Sepasgozar, S. M. E. (2020). The Performance Gap in Energy-Efficient Office Buildings: How the Occupants Can Help? *Energies*, *13*(6), 1480. https://doi.org/10.3390/en13061480

Akenji, L., Bengtsson, M., Briggs, E., Chiu, A., Daconto, G., Fadeeva, Z., Fotiou, S., Gandhi, R., Mathews, C., Metternicht, G., Mohanty, B., Salem, J., Sang-Arun, J., Srisakulchairak, T., Schandl, H., & Tabucanon, M. (2015). Sustainable consumption and production: A handbook for policymakers. (Global, Ed.). United Nations Environment Programme.

ASHRAE (2011). The American Institute of Architects, Illuminating Engineering Society of North America, U.S. Green Building Council, & U.S. Department of Energy. Advanced energy design guide for medium to big box retail buildings achieving 50% energy savings toward and net zero energy building. Atlanta, GA: ASHRAE.

Atkin, B., & Brooks, A. (2009). Total facility management (Third edition.). John Wiley & Sons Inc.

Aune, M., Berker, T., Bye, R. (2009). The missing link which was already there. Facilities 27 (1/2), 44–55. http://dx.doi.org/10.1108/02632770910923081.

Barth, M., Godemann, J., Rieckmann, M., & Stoltenberg, U. (2007). Developing Key Competencies for Sustainable Development in Higher Education. International Journal of Sustainability in Higher Education, 8(4), 416–430.

Benne, K, Griffith, B, Long, N, Torcellini, P, Crawley, D, & Logee, T. (2009) *Assessment of the Energy Impacts of Outside Air in the Commercial Sector*. United States. doi:10.2172/951796.

Boubekri, M., Cheung, I. N., Reid, K. J., Wang, C.-H., & Zee, P. C. (2014). Impact of Windows and Daylight Exposure on Overall Health and Sleep Quality of Office Workers: A Case-Control Pilot Study. *Journal of Clinical Sleep Medicine*, *10*(06), 603–611. https://doi.org/10.5664/jcsm.3780

Brundtland, G.H. (1987). Our Common Future: Report of the World Commission on Environment and Development. Geneva, UN-Document A/42/427. http://www.un-documents.net/ocf-ov.htm

Caldwell, L. K. (1998). The Concept of Sustainability: A Critical Approach. *Environmental Science and Technology Library Ecological Sustainability and Integrity: Concepts and Approaches*, 1–15. https://doi.org/10.1007/978-94-017-1337-5_1

Carbon Trust. (2012). Closing the Gap: Lessons Learned on Realising the Potential of Low Carbon Building Design. The Carbon Trust, London.

California Commissioning Collaborative. (2006). California Commissioning Guide: Existing Buildings. California Commissioning Collaborative, http://www.cacx.org/resources/documents/CA_Commissioning_Guide_Existing.pdf

CIBSE Guide F. (2012). Energy Efficiency in Buildings. CIBSE Guide F, third ed. The Chartered Institution of Building Services Engineers, London.

Cibinskiene, A., Dumciuviene, D., & Andrijauskiene, M. (2020). Energy Consumption in Public Buildings: The Determinants of Occupants' Behavior. *Energies*, *13*(14), 3586. https://doi.org/10.3390/en13143586

CIOB. (2004). Sustainability and Construction, Ascot, Chartered Institute of Building.

Chotipanich, S. (2004). Positioning facility management. *Facilities*, *22*(13/14), 364–372. https://doi.org/10.1108/02632770410563086

Dannenberg, A. L., Frumkin, H., & Jackson, R. J. (2011). *Making Healthy Places: Designing and Building for Health, Well-being, and Sustainability*. Island Pr.

Darakdjian, Q., Bille, S., & Inard, C. (2018). Data mining of building performance simulations comprising occupant behaviour modelling. *Advances in Building Energy Research,* 1-17.

Delai, I., & Takahashi, S. (2013). Corporate sustainability in emerging markets: insights from the practices reported by the Brazilian retailers. *Journal of Cleaner Production, 47*, 211-221.

Department of Energy's National Nuclear Security Administration. (2019). *Energy Flow Charts*. Lawrence Livermore National Laboratory. https://flowcharts.llnl.gov/

Ding, D., & Gebel, K. (2012). Built environment, physical activity, and obesity: What have we learned from reviewing the literature? *Health & Place*, *18*(1), 100–105. https://doi.org/10.1016/j.healthplace.2011.08.021

Durand, C. P., Andalib, M., Dunton, G. F., Wolch, J., & Pentz, M. A. (2011). A systematic review of built environment factors related to physical activity and obesity risk: implications for smart growth urban planning. *Obesity Reviews*, *12*(5). https://doi.org/10.1111/j.1467-789x.2010.00826.x

Dixon-O'Mara, C., & Ryan, L. (2018). Energy efficiency in the food retail sector: barriers, drivers and acceptable policies. *Energy Efficiency*, *11*(2), 445–464. https://doi.org/10.1007/s12053-017-9577-5

EERE - Energy Efficiency & Renewable Energy (2014). Windows and Building Envelope Research and Development: Roadmap for Emerging Technologies. Washington, DC: U.S. Department of Energy.

Eley Associates. (2004). Hawaii commercial building guidelines for energy efficiency Honolulu: Energy, resources & technology division, dept. of business, economic development and tourism, state of Hawaii, 2004. No. TJ164.5.B84.E7.2004. Hawaii

Elmualim, A., Czwakiel, A., Valle, R. C., Ludlow, G., & Shah, S. (2008). Barriers for implementing sustainable facilities management. Proceedings of the Conference on Sustainable Building SB08 Melbourne. In *ICONDA CIB Library*. CSIRO-Commonwealth Scientific and Industrial Research Organisation. https://www.irbnet.de/daten/iconda/CIB15780.pdf.

Elmualim, A., Czwakiel, A., Valle, R., Ludlow, G. and Shah, S. (2009). The practice of sustainable facilities management: design sentiments and the knowledge chasm. *Architectural Engineering and Design Management*, *5*, 91-102.

Elmualim, A., Shockley, D., Valle, R., Ludlow, G., & Shah, S. (2010). Barriers and commitment of facilities management profession to the sustainability agenda. *Building and Environment*, *45*(1), 58–64. https://doi.org/10.1016/j.buildenv.2009.05.002

Elmualim, A., Valle, R. and Kwawu, W. (2012). Discerning policy and drivers for sustainable facilities management practice. *International Journal of Sustainable Built Environment. 1*(1), 16-25. https://doi.org/10.1016/j.ijsbe.2012.03.001

Energy Star. (2008). Energy Star Building Manual.

Environmental Protection Agency. (2020). *Green Power Partnership Top 30 Retail*. EPA. https://www.epa.gov/greenpower/green-power-partnership-top-30-retail.

Environmental Protection Agency. (2019). *Using Green Roofs to Reduce Heat Islands*. EPA. https://www.epa.gov/heatislands/using-green-roofs-reduce-heat-islands.

Fedrizzi, Rick & Rogers, Jim. (2002). Energy Efficiency Opportunities: Big Box Retail and Supermarkets.

Finch, E., Zhang, X. (2013). Facilities management. In: Design and Management of Sustainable Built Environments. Springer, London, pp. 305–326.

Frank, L. D., Andresen, M. A., & Schmid, T. L. (2004). Obesity relationships with community design, physical activity, and time spent in cars. *American Journal of Preventive Medicine*, *27*(2), 87–96. https://doi.org/10.1016/j.amepre.2004.04.011

Galvez-Martos, J.-L., Styles, D., & Schoenberger, H. (2013). Identified best environmental management practices to improve the energy performance of the retail trade sector in Europe. *Energy Policy*, *63*, 982–994. https://doi.org/10.1016/j.enpol.2013.08.061

Global Alliance for Buildings and Construction, International Energy Agency and the United Nations Environment Programme (2019): 2019 global status report for buildings and construction: Towards a zero-emission, efficient and resilient buildings and construction sector.

Haldi, F., & Robinson, D. (2011). The impact of occupants' behaviour on building energy demand. *Journal of Building Performance Simulation*, *4*(4), 323–338. https://doi.org/10.1080/19401493.2011.558213

Halim, A. I. A., Sarpin, N., Kasim, N. B., & Zainal, R. B. (2017). Capability challenges of facility management (FM) personnel toward sustainability agenda. https://doi.org/10.1063/1.5005357

Haves, P., Coffey, B., & Williams, S. (2008). Benchmarking and equipment and controls assessment for a 'big box' retail chain. 2008 ACEEE Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.

Heerwagen, J., & Zagreus, L. (2005). The human factors of sustainable building design: post occupancy evaluation of the Philip Merrill Environmental Center. *UC Berkeley: Center for the Built Environment*. Retrieved from https://escholarship.org/uc/item/67j1418w

Hignite, K. (2009). The Educational Facilities Professional's Practical Guide to Reducing the Campus Carbon Footprint. APPA: Association of Higher Education Facilities Officers (NJ1).

Hodges, C. (2012). High-performance buildings need high-performance FM. In: World Workplace Asia, July 2012.

Hodges, P. (2005), "A facility manager's approach to sustainability", Journal of Facilities Management, Vol. 3 No. 4, pp. 312-324.

Humpel, N. (2002). Environmental factors associated with adults' participation in physical activity A review. *American Journal of Preventive Medicine*, *22*(3), 188–199. https://doi.org/10.1016/s0749-3797(01)00426-3

IBM. (2020). *What is facilities management?* IBM. https://www.ibm.com/topics/facilities-management.

IEA. (2019a). World Energy Statistics and Balances (database). www.iea.org/statistics

IEA. (2019b). Energy Technology Perspectives, buildings model. www.iea.org/buildings

IPCC, Lucon, O., UÅN rge-Vorsatz, D., Ahmed, A.Z., Akbari, H., Bertoldi, P., Cabeza, L.F., et al. (2014). Buildings. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. <http://www.ipcc.ch/pdf/assessment-report/ar5/ wg3/ipcc_wg3_ar5_chapter9.pdf>

Ikediashi, D. I., Ogunlana, S. O., Oladokun, M. G., & Adewuyi, T. (2012). Assessing the level of commitment and barriers to sustainable facilities management practice: A case of

Nigeria. *International Journal of Sustainable Built Environment*, *1*(2), 167–176. https://doi.org/10.1016/j.ijsbe.2013.06.002

Jensen, P. A. (2009). Design Integration of Facilities Management: A Challenge of Knowledge Transfer. *Architectural Engineering and Design Management*, *5*(3), 124–135. https://doi.org/10.3763/aedm.2009.0101

Junghans, A. (2011). State of the art in sustainable Facility Management. https://brage.bibsys.no/xmlui/bitstream/handle/11250/2391048/Anhang-632-Junghans-2011b.pdf?sequence=3

Junnila, S. (2004), "The environmental significance of facilities in service sector companies", Facilities, Vol. 22 Nos 7/8, pp. 190-198, doi: 10.1108/02632770410547552.

Kats, G., Alevantis, L., Berman, A., Mills, E. and Perlman, J. (2003) The Costs and Financial Benefits of Green Buildings. A Report to California's Sustainable Building Task Force.

Kawachi, I., & Berkman, L. F. (2001). Social ties and mental health. *Journal of Urban health*, *78*(3), 458-467.

Kim, J., & Kaplan, R. (2004). Physical and Psychological Factors in Sense of Community. *Environment and Behavior*, *36*(3), 313–340. https://doi.org/10.1177/0013916503260236

Konopacki, S. J., & Akbari, H. (2001). Measured energy savings and demand reduction from a reflective roof membrane on a large retail store in Austin. https://doi.org/10.2172/787107

Koukiasa, M. (2011). Sustainable facilities management within event venues. Worldwide Hospitality and Tourism Themes, 3(3), 217-228.

Krepchin, I.R.A. & Scruton, C. & Braun, J. (2006). Commercial buildings breathe right with DCV. 23. 38-46.

Kuronuma, T., Watanabe, H., Ishihara, T., Kou, D., Toushima, K., Ando, M., & Shindo, S. (2018). CO_2 Payoff of Extensive Green Roofs with Different Vegetation Species. *Sustainability*, *10*(7), 2256. https://doi.org/10.3390/su10072256

Lawrence, T. (2004). Demand-Controlled Ventilation and Sustainability. ASHRAE Journal. 46. 117. 120-121.

Lai, J.H.K. and Yik, F.W.H. (2006). "Knowledge and perception of operation and maintenance practitioners in Hong Kong about sustainable buildings", Facilities, Vol. 24 Nos 3/4, pp. 90-105.

Lewis, A., Riley, D., & Elmualim, A. (2010). Defining High Performance Buildings for Operations and Maintenance.

Leyden, K. M. (2003). Social Capital and the Built Environment: The Importance of Walkable Neighborhoods. *American Journal of Public Health*, *93*(9), 1546–1551. https://doi.org/10.2105/ajph.93.9.1546

Lund, H. (2002). Pedestrian Environments and Sense of Community. *Journal of Planning Education and Research*, *21*(3), 301–312. https://doi.org/10.1177/0739456x0202100307

McGraw Hill Construction (2010). *Green Outlook 2011: Green Trends Driving Growth*.

Macnaughton, P., Satish, U., Laurent, J. G. C., Flanigan, S., Vallarino, J., Coull, B., Allen, J. G. (2017). The impact of working in a green certified building on cognitive function and

health. *Building and Environment*, *114*, 178–186.
https://doi.org/10.1016/j.buildenv.2016.11.041

Manjula, N., Dissanayake, D., & Rajini, P. (2016). ICSECM 2015 - Facilities Management Approaches for Sustainability.

Martek, I., Hosseini, M.R., Shrestha, A., Edwards, D.J., Durdyev, S. (2019). Barriers inhibiting the transition to sustainability within the Australian construction industry: An investigation of technical and social interactions. Journal of Cleaner Production 211, 281-292.

Miller, N. G., Pogue, D., Saville, J., & Tu, C. (2010). The Operations and Management of Green Buildings in the United States. *Journal of Sustainable Real Estate*, *2*(1), 51–66.

Mills, E. (2011). Building commissioning: a golden opportunity for reducing energy costs and greenhouse gas emissions in the United States. Energy Efficiency. 4 (2), 145–173.

Moseley, D., Miller, C., Bell, C., Weeks, K., Bass, B., & Berghage, R. (2013). *Green Roof Performance: A cost-benefit analysis based on Walmart's Chicago store*.

Mylona, Z., Kolokotroni, M., & Tassou, S. A. (2017). Frozen food retail: Measuring and modelling energy use and space environmental systems in an operational supermarket. *Energy and Buildings, 144*, 129-143. doi:10.1016/j.enbuild.2017.03.049

Naspi, F., Arnesano, M., Stazi, F., D'Orazio, M., & Revel, G. M. (2018). Measuring Occupants' Behaviour for Buildings' Dynamic Cosimulation. *Journal of Sensors*, *2018*, 1–17. https://doi.org/10.1155/2018/2756542

Natural Resources Canada. (2012). Building Commissioning and Recommissioning Fact Sheet. Natural Resources Canada, <http://www.nrcan.gc.ca/sites/www.nrcan.gc.ca/files/oee/files/pdf/publications/commercial/CxRCx_eng.pdf>

Nazeer, F. S., Gunatilake, S., & Ramachandra, T. (2019). Significant Sustainable Facilities Management (SFM) Practices in the Health Care (HC) Sector. *IOP Conference Series: Earth and Environmental Science*, *290*, 012055. https://doi.org/10.1088/1755-1315/290/1/012055

Nielsen, S. B., Jensen, J. O., & Jensen, P. A. (2009). International Conference on Sustainability Measurement and Modelling. In *Delivering Sustainable Facilities Management in Danish Housing Estates* (pp. 1–18). Barcelona; CIMNE.

Nielsen, S. B., Sarasoja, A.-L., & Galamba, K. R. (2016). Sustainability in facilities management: an overview of current research. *Facilities*, *34*(9/10), 535–563. https://doi.org/10.1108/f-07-2014-0060

OECD/IEA. (2013). Transition to Sustainable Buildings – Strategies and Opportunities to 2050. OECD/IEA.

Opoku, D.-G. J., Ayarkwa, J., & Agyekum, K. (2019). Barriers to environmental sustainability of construction projects. *Smart and Sustainable Built Environment*, *8*(4), 292–306. https://doi.org/10.1108/sasbe-08-2018-0040

Perera, B. A. K. S., Ahamed, M. H. S., Rameezdeen, R., Chileshe, N., & Hosseini, M. R. (2016). Provision of facilities management services in Sri Lankan commercial organisations. *Facilities*, *34*(7/8), 394–412. https://doi.org/10.1108/f-12-2014-0102

Prasad, D. and Hall, M. (2004). Construction Challenge: Sustainability in Developing Countries, London, RICS Leading Edge Series.

Price, S., Pitt, M., & Tucker, M. (2011). Implications of a sustainability policy for facilities management organisations. *Facilities*, *29*(9/10), 391–410. https://doi.org/10.1108/02632771111146314

Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon and Schuster.

Ramesh, T., Prakash, R., & Shukla, K. (2010). Life cycle energy analysis of buildings: An overview. *Energy and Buildings*, *42*(10), 1592–1600. https://doi.org/10.1016/j.enbuild.2010.05.007

Richman, R. & Simpson, R. (2016). Towards quantifying energy saving strategies in big-box retail stores: A case study in Ontario (Canada). Sustainable Cities and Society. 20. 61-70. 10.1016/j.scs.2015.09.007.

Ríos Fernández J. C. (2020). Economic and environmental improvements using high energy efficiency HVAC in supermarkets. Clean Technologies and Environmental Policy. 10.1007/s10098-020-01881-4.

Rock, S., Hosseini, M. R., Nikmehr, B., Martek, I., Abrishami, S., & Durdyev, S. (2019). Barriers to “green operation” of commercial office buildings. *Facilities*, *37*(13/14), 1048–1065. https://doi.org/10.1108/f-08-2018-0101

Ryan, L., & Campbell, N. (2012). Spreading the net: the multiple benefits of energy efficiency improvements. Paris:OECD/IEA

Saelens, B. E., & Handy, S. L. (2008). Built environment correlates of walking: a review. *Medicine and science in sports and exercise*, *40*(7 Suppl), S550–S566. https://doi.org/10.1249/MSS.0b013e31817c67a4

Saleh, A., Kamarulzaman, N., Hashim, H., & Hashim, S. (2011). An Approach to Facilities Management (FM) Practices in Higher Learning Institutions to Attain a Sustainable Campus (Case Study: University Technology Mara - UiTM). *Procedia Engineering*, *20*, 269–278. https://doi.org/10.1016/j.proeng.2011.11.165

Sarpin, N., Yang, J., & Xia, B. (2016). Developing a people capability framework to promote sustainability in facility management practices. *Facilities*, *34*(7/8), 450–467. https://doi.org/10.1108/f-05-2014-0044

Sekula, M. and Hodges, C. (2014), Managing the Building Life Cycle with sustainable Facilities Management, IFMA

Shafii, F., Ali, Z.A. and Othman, M.Z. (2006). Achieving sustainable construction in the developing countries of Southeast Asia.

Shah, S. (2007). *Sustainable practice for the facilities manager*. Blackwell.

Singh, A., Syal, M., Grady, S. C., & Korkmaz, S. (2010). Effects of green buildings on employee health and productivity. *American journal of public health*, *100*(9), 1665–1668. https://doi.org/10.2105/AJPH.2009.180687

Srinivasan, S.; O'Fallon, L. R.; Dearry, A. (2003). Creating healthy communities, healthy homes, healthy people: initiating a research agenda on the built environment and public health, American Journal of Public Health 93(9): 1446–1450. http://dx.doi.org/10.2105/AJPH.93.9.1446

Straube, J. (2014). Low-Energy Commercial and Institutional Buildings: Top Ten Smart Things to Do for Cold Climates. Building Science Corporation.

Støre-Valen, M., & Buser, M. (2019). Implementing sustainable facility management. *Facilities*, *37*(9/10), 550–570. https://doi.org/10.1108/f-01-2018-0013

Supermarkets: An Overview of Energy Use and Energy Efficiency Opportunities. (n.d.). Retrieved October 9, 2020, from https://www.energystar.gov/sites/default/files/buildings/tools/SPP%20Sales%20Flyer%20for%20Supermarkets%20and%20Grocery%20Stores.pdf

TEFMA. (2004). Draft A Guide to Incorporating Sustainability into Facilities Management, Tertiary Education Facilities Management Association, Australia, pp. 1-52, available at: www.tefma.com/uploads/assets/conference_papers/SustGuideDraft.pdf

UK-GBC. (2008). Zero Carbon Task Group Report: Definition of Zero Carbon. The UK Green Building Council.

United Nation Environment Programme. (2007). Buildings and climate change: Status, Challenges and Opportunities.

United Nations Second Committee Meeting. (2018). 'Emma Aberg: International Renewable Energy Agency.' In *Minutes of U.N. general assembly second coverage 16 October 2018.*

U.S. Census Bureau. (2020). Quarterly Retail E-Commerce Sales. U.S. Department of Commerce.

U.S. Department of Energy on Commercial Building Energy Efficiency. (2015). Walmart – *Saving energy, saving money through comprehensive retrofits* https://www.nrel.gov/docs/fy15osti/63782.pdf

U.S. Department of Energy. (2015). Quadrennial Technology Review: An Assessment of Energy Technologies and Research Opportunities pp. 1-505

U.S. Department of Energy (DOE), Energy Information Administration (EIA), Commercial Building Energy Consumption Survey (CBECS), “End-Use Consumption by Principal Building Activity” (1999 data; published 2003), www.eia.doe.gov/emeu/cbecs/enduse_consumption/ pba.html.

U.S. Department of Energy. (2003). Introduction to Sustainability. Retrieved from https://www1.eere.energy.gov/femp/pdfs/buscase_section1.pdf

U.S. Department of Energy. (2003). The Social Benefits of Sustainable Design. Retrieved from https://www1.eere.energy.gov/femp/pdfs/buscase_section3.pdf

U.S. Energy Information Administration [EIA]. (2003). Commercial Buildings Energy Consumption Survey (CBECS).

U.S. Energy Information Administration [EIA]. (2012). Commercial Buildings Energy Consumption Survey (CBECS)

U.S. Energy Information Administration [EIA]. (2012). Independent Statistics and Analysis. Retrieved October 15, 2020, from https://www.eia.gov/consumption/commercial/reports/2012/lighting/

U.S. Energy Information Administration [EIA]. (2020). Monthly Energy Review. Retrieved January 1, 2021, from https://www.eia.gov/environment/emissions/carbon/

U.S. Energy Information Administration [EIA]. (2020). Monthly Energy Review. Retrieved January 1, 2021, from https://www.eia.gov/environment/emissions/carbon/

U.S. Environmental Protection Agency [EPA]. *Retail: An Overview of Energy Use and Energy Efficiency Opportunities.* Energy Star. https://www.energystar.gov/sites/default/files/buildings/tools/SPP%20Sales%20Flyer%20for%20Retail_1.pdf.

U.S. Environmental Protection Agency. (2001). The Greening Curve: Lessons Learned in the Design of the New EPA Campus in North Carolina. Research Triangle Park, North Carolina.

Walmart. (2019). Environmental, Social & Governance Report 2019. Retrieved from https://corporate.walmart.com/media-library/document/2019-environmental-social-governance-report/_proxyDocument?id=0000016c-20b5-d46a-afff-f5bdafd30000

Weissman, G., Sargent, R., Fanshaw, B., & Burr, J. (2016). *How the Roofs of Big Box Stores Can Help America Shift to Clean Energy*. Environment America. https://environmentamerica.org/reports/ame/solar-superstores.

Wood, L. (2019). *United States $465 Bn Facility Management Market Report 2019: Competition, Forecast & Opportunities, 2014-2024 - ResearchAndMarkets.com*. Research And Markets. https://www.businesswire.com/news/home/20190213005278/en/United-States-465-Bn-Facility-Management-Market.

Wyatt, D.P., Sobotko, A. & Rogalska, M. (2000). Towards a sustainable practice. Facilities, Vol. 18 No. 1, pp. 76-82.

Yang, J., Kumar, D. L. M., Pyrgou, A., Chong, A., Santamouris, M., Kolokotsa, D., & Lee, S. E. (2018). Green and cool roofs' urban heat island mitigation potential in tropical climate. *Solar Energy*, *173*, 597–609. https://doi.org/10.1016/j.solener.2018.08.006

Zaatari, M., Novoselac, A., & Siegel, J. (2016). Impact of ventilation and filtration strategies on energy consumption and exposures in retail stores. Building and Environment, 100, 186–196. https://doi.org/10.1016/j.buildenv.2016.01.026

APPENDIX 1: SURVEY INSTRUMENT

Consent for Participation in Research

Dear Participant,

My name is Armin Saadatian and I am a graduate student in the Department of Construction Management at Colorado State University (CSU). We are currently in the process of collecting data for the research project that aims to assess the status and level of integration of environmental sustainability practices into the retail sector. Dr. Svetlana Olbina, an Associate Professor in our department is the Principal Investigator (PI), and I am the Co-Principal Investigator (Co-PI) for this project.

We would like you to take an anonymous online survey. You have been selected to participate in this survey because of your experience with managing retail facilities. We got your contact information from International Facilities Management Association (IFMA), ConnexFM, and/or LinkedIn. If you feel you are not the correct person to complete this survey or know of others that would be interested, please forward along this email invitation.

Participation will take approximately 10-15 minutes. Your participation in this research is voluntary. If you decide to participate in the study, you may withdraw your consent and stop participation at any time without penalty.

Your responses, as well as your identity associated with the answers, will be in a strict confidence, and will not be shared with anyone outside of the research team. However, we may be asked to share the research files with the CSU Institutional Review Board ethics committee for auditing purposes. This survey does not ask for any personal identifying information and there is no mean by which to connect you personally with your responses. When we report and share the data to others, we will combine the data from all participants. Your answers to the survey questions will contribute to our understanding of how widely facilities managers use energy efficiency practices in the retail sector, their benefits, barriers that prevent wider implementation, and the potential solutions for increasing energy efficiency. The results will contribute to this research and appropriate publications.

While it is impossible to identify all potential risks in research procedures, the researchers have taken reasonable precautions to minimize any known and potential (but unknown) risks.

If you have any questions about this research project, please contact Armin Saadatian at Armin.Saadatian_Farivar@colostate.edu or Dr. Svetlana Olbina at Svetlana.Olbina@colostate.edu. If you have questions about your rights or welfare as a participant, please contact the CSU Institutional Review Board, at (970) 491-1553 or by email at RICRO_IRB@mail.colostate.edu.

Do you consent to participate in this survey?

○ Yes

○ No

Eligibility for Participation

Have you worked as a facility manager in the retail sector?

○ Yes

○ No

If the response is no, the survey will end.

SECTION I: PARTICIPANT DEMOGRAPHIC QUESTIONS (all participants)

Q1. Which of the following options best describes your role in your facilities management company?

◯ Vice President of Facilities

◯ Chief Facilities Officer

◯ Facilities Director

◯ Facilities Manager

◯ Assistant Facilities Manager

◯ Facilities Coordinator

◯ Facilities Engineer

◯ Facility Maintenance Technician

◯ Safety and Occupational Health Specialist

◯ Workplace Wellness Coordinator

◯ Other (please specify) ________________

Q2. What level of education do you have?

◯ High school graduate, diploma or equivalent

◯ Associate degree

◯ Bachelor's degree

◯ Master's degree

◯ Doctorate degree

◯ Other (please specify) ________________

Q3. Which of the following professional development courses did you complete? (select all that apply)

◯ Sustainability Facility Professional (SFP)

◯ Facility Management Professional (FMP)

◯ Certified Facility Manager (CFM)

◯ None

◯ Other (please specify) ________________

Q4. Which environmental sustainability-related training did you complete? (select all that apply)

◯ LEED Green Associate

◯ LEED Accredited Professional Operation + Maintenance (LEED AP O+M)

◯ LEED Accredited Professional (other than LEED AP O+M)

◯ Living Future Accreditation (LFA)

◯ WELL Accredited Professional (WELL AP)

◯ None

○ Other (please specify) ________________

SECTION II: FM ORGANIZATION DEMOGRAPHIC QUESTIONS (all participants)

Q5. In which country do you manage retail facilities? (If your facilities are located in multiple countries, choose the country in which you manage the largest number of facilities):

List of Countries

If the response is United States, the participant will be directed to Q6. If not, the participant will be directed to Q7.

Q6. If you manage retail facilities in the USA, please select the state. (If your facilities are located in multiple sates, choose the state in which you manage the largest number of facilities):

List of U.S. States

Q7. What is the type of your facilities management organization?

○ End-user (e.g., In-house facilities management department)

○ Facilities Management Company (e.g., outsourced providers of full facilities management services to clients)

If the response is end-user, the participant will be directed to Q8. If not, the participant will be directed to Q9.

Q8. What is your company's annual revenue?

○ Less than $1M

○ Between $1M and $5M

○ Between $5M and $10M

○ More than $10M

○ Unknown

Q9. What is the average size of the facilities you manage?

○ Up to 50,000 SF

○ 50,001 SF to 100,000 SF

○ 100,001 SF to 250,000 SF

○ 250,001 SF to 500,000 SF

○ 500,001 SF to 1,000,000 SF

○ More than 1,000,000 SF

Q10. What is the average age of the facilities you manage?

○ Less than 5 years

○ 5-10 Years

○ 11-15 Years

○ 16-20 Years

○ 21-30 Years

○ 31-50 Years

○ 51-100 Years

○ More than 100 Years

FOOD V.S. NON-FOOD DIVISION

Q11. What type of retail facilities do you manage?

- ◯ Food retail stores
- ◯ Non-food retail stores

If the response is non-food retail stores, the participant will have to answer an additional question (Q12). Based on the response to question (11), participants will be directed to their corresponding section of questions (food and non-food).

Q12. Please select the type of your non-food retail store:

- ◯ Specialty Stores (e.g., florists, locksmiths, etc.)
- ◯ Category Specialist Stores (e.g., home goods, office supply, etc.)
- ◯ Department Stores (i.e., stores selling apparel and bedding)
- ◯ Discount Stores (i.e., stores selling name brand items at a lower price)
- ◯ Variety Stores (i.e., small stores selling inexpensive general merchandise)
- ◯ Extreme Value Retailers (i.e., selling limited merchandise assortment at very low prices)
- ◯ Off-Price Stores (i.e., stores selling high quality products at lower prices)
- ◯ Other (please specify) ________________

ALL RETAIL STORES

Q1. Do you implement energy efficiency measures in the facilities you manage?

○ Yes

○ No

Participants who do not integrate energy efficiency measures will be directed to Section IV. Participants who do integrate energy efficiency measures will be directed to Section III.

Q2. Does your company offer incentives to the facilities management department to integrate energy efficiency practices into your retail facilities?

This question is only shown to respondents working at end-user facilities management organizations. If yes, respondents will be directed to Q3.

○ Yes

○ No

○ I don't know

Q3. What kind of incentives are offered to the facilities management department to integrate energy-efficiency practices into your retail facilities?

____

____

____

Q4. Does your facility management company offer incentives to the facilities managers who integrate energy-efficiency practices into retail facilities?

○ Yes

○ No

○ I don't know

This question is only shown to respondents working at facilities management companies. If yes, respondents will be directed to Q5.

Q5. What kind of incentives are offered to the facilities managers who integrate energy-efficiency practices into retail facilities?

____

____

____

SECTION III: NON-FOOD RETAIL STORES: INTEGRATE ENERGY-EFFICIENT MEASURES

Q1. Based on your experience with integrating energy efficiency practices in your retail facilities, please indicate how effective the following practices have been for increasing energy efficiency:

The following options will be available in the form of Likert Scale (1 = Not at all effective, 2 = Slightly effective, 3 = Moderately effective, 4 = Very effective, 5 = Extremely Effective).

If participants do not use the given options, they can select "We do not integrate this practice" for each choice.

○ Green Roof

○ Cool Roof

○ Renewable Energy Sources (please specify the type)

○ Energy Efficient Lighting Systems

○ Skylights

◯ High-performance windows

◯ Energy Efficient HVAC Systems

◯ Demand Control Ventilation (DCV) Systems

◯ Pollutant Exposure Control Ventilation (PECV) Systems

◯ Building envelope enhancement to reduce air leakage

◯ Building envelope enhancement to reduce thermal bridging

◯ Building envelope enhancement by implementing better vestibule configurations

◯ Building envelope enhancement by implementing better overhead door strategies

Q2. If there are other energy-efficient practices that you use in your retail facilities that you would like to add to the list above, please add them below:

____

____

____

Q3. Based on your experience with integrating energy efficiency practices in your retail facilities, please rate your level of agreement with the following realized-benefits they have brought:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

◯ Lower levels of CO_2 emission

◯ Reduced energy consumption

○ Lower energy bills

Q4. If there are other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q5. Please indicate your level of agreement with the following realized-barriers that have been preventing implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

○ Lack of support for energy efficiency practices from upper management of retail stores

○ Lack of awareness of lifecycle cost of retail facilities

○ Financial constraints

○ Time constraints

○ Lack of professional writing skills (e.g., writing proposals)

○ Teamwork inefficiencies

○ Lack of negotiation skills

○ Lack of sustainability training for facilities managers

○ Lack of leadership skills for facilities managers

○ Unavailability of building automation systems

- ◯ Incompatibility of building automation systems with other building systems
- ◯ Unavailability of effective metering systems
- ◯ Absence of energy efficiency related regulations
- ◯ Misalignment of building safety regulations and energy efficiency requirements
- ◯ Misalignment of historic preservation codes and energy efficiency requirements
- ◯ Difficulty with maintaining the aesthetic attributes of the building

Q6. If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q7. Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ◯ Efficient space planning
- ◯ Development of low-cost building maintenance strategies
- ◯ Proactive operation and maintenance of sustainable building systems
- ◯ Incorporation of commissioning into the building's life cycle

○ Operating building systems properly

○ Sustainability training for upper management of retail stores

○ Sustainability training for facilities managers

○ Training on teamwork skills for facilities managers

○ Training on negotiation skills for facilities managers

○ Training on professional writing skills for facilities managers

○ Promotion of an integrated collaboration between policy makers and facilities managers

○ Use of renewable energy sources (please specify the type)

○ Use of energy efficient lighting

○ Use of skylights

○ Use of high-performance windows

○ Use of energy efficient HVAC systems

○ Use of Demand Control Ventilation (DCV) systems

○ Use of Pollutant Exposure Control Ventilation (PECV) systems

○ Retrofitting the building envelope to reduce air leakage

○ Retrofitting the building envelope to reduce thermal bridging

○ Retrofitting the building by implementing more efficient vestibule configurations

◯ Retrofitting the building envelope by implementing better overhead door strategies

Q8. What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?

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Q9. What other professional development methods for FM personnel would you suggest to achieve energy-efficient retail facilities?

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SECTION IV: NON-FOOD RETAIL STORES:

DO NOT INTEGRATE ENERGY-EFFICIENT MEASURES

Q1. How effective the integration of the following energy efficiency practices could be for increasing energy efficiency in your retail facilities?

The following options will be available in the form of Likert Scale (1 = Not at all effective, 2 = Slightly effective, 3 = moderately effective, 4 = Very effective, 5 = Extremely Effective).

If participants do not use the given options, they can select "We do not integrate this practice" for each choice.

◯ Green Roof

◯ Cool Roof

◯ Renewable Energy Sources (please specify the type)

○ Energy Efficient Lighting Systems

○ Skylights

○ High-performance windows

○ Energy Efficient HVAC Systems

○ Demand Control Ventilation (DCV) Systems

○ Pollutant Exposure Control Ventilation (PECV) Systems

○ Building envelope enhancement to reduce air leakage

○ Building envelope enhancement to reduce thermal bridging

○ Building envelope enhancement by implementing better vestibule configurations

○ Building envelope enhancement by implementing better overhead door strategies

Q2. If there are other energy-efficient practices that you would use in your retail facilities that you would like to add to the list above, please add them below:

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Q3. Please rate your level of agreement with the following benefits that the integration of the energy efficiency practices in your retail facilities could bring:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

○ Lower levels of CO_2 emission

- ◯ Reduced energy consumption
- ◯ Lower energy bills

Q4. If there would be other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q5. Please select your level of agreement with the following barriers that have been preventing the use of energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ◯ Lack of support for energy efficiency practices from upper management of retail stores
- ◯ Lack of awareness of lifecycle cost of retail facilities
- ◯ Financial constraints
- ◯ Time constraints
- ◯ Lack of professional writing skills (e.g., writing proposals)
- ◯ Teamwork inefficiencies
- ◯ Lack of negotiation skills
- ◯ Lack of sustainability training for facilities managers
- ◯ Lack of leadership skills for facilities managers

○ Unavailability of building automation systems

○ Incompatibility of building automation systems with other building systems

○ Unavailability of effective metering systems

○ Absence of energy efficiency related regulations

○ Misalignment of building safety regulations and energy efficiency requirements

○ Misalignment of historic preservation codes and energy efficiency requirements

○ Difficulty with maintaining the aesthetic attributes of the building

Q6. If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q7. Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

○ Efficient space planning

○ Development of low-cost building maintenance strategies

○ Proactive operation and maintenance of sustainable building systems

○ Incorporation of commissioning into the building's life cycle

○ Operating building systems properly

○ Sustainability training for upper management of retail stores

○ Sustainability training for facilities managers

○ Training on teamwork skills for facilities managers

○ Training on negotiation skills for facilities managers

○ Training on professional writing skills for facilities managers

○ Promotion of an integrated collaboration between policy makers and facilities managers

○ Use of renewable energy sources (please specify the type)

○ Use of energy efficient lighting

○ Use of skylights

○ Use of high-performance windows

○ Use of energy efficient HVAC systems

○ Use of Demand Control Ventilation (DCV) systems

○ Use of Pollutant Exposure Control Ventilation (PECV) systems

○ Retrofitting the building envelope to reduce air leakage

◯ Retrofitting the building envelope to reduce thermal bridging

◯ Retrofitting the building by implementing more efficient vestibule configurations

Q8. What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?

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Q9. What other professional development methods for FM personnel would you suggest to achieve energy-efficient retail facilities?

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FOOD RETAIL STORES

Participants who do not integrate energy efficiency measures will be directed to Section VI. Participants who do integrate energy efficiency measures will be directed to Section V.

SECTION V: FOOD RETAIL STORES:

INTEGRATE ENERGY-EFFICIENT MEASURES

Q1. Based on your experience with integrating energy efficiency practices in your retail facilities, please indicate how effective the following practices have been for increasing energy efficiency:

The following options will be available in the form of Likert Scale (1 = Not at all effective, 2 = Slightly effective, 3 = moderately effective, 4 = Very effective, 5 = Extremely Effective).

If participants do not use the given options, they can select "We do not integrate this practice" for each choice.

- ◯ Energy efficient refrigerators
- ◯ Anti-sweat heater controls
- ◯ Green Roof
- ◯ Cool Roof
- ◯ Renewable Energy Sources (please specify the type)
- ◯ Energy Efficient Lighting
- ◯ Skylights
- ◯ High-performance windows
- ◯ Energy Efficient HVAC Systems
- ◯ Demand Control Ventilation (DCV) Systems
- ◯ Pollutant Exposure Control Ventilation (PECV) Systems
- ◯ Building envelope enhancement to reduce air leakage
- ◯ Building envelope enhancement to reduce thermal bridging
- ◯ Building envelope enhancement by implementing better vestibule configurations
- ◯ Building envelope enhancement by implementing better overhead door strategies

Q2. If there are other energy-efficient practices that you use in your retail facilities that you would like to add to the list above, please add them below:

Q3. Based on your experience with integrating energy efficiency practices in your retail facilities, please rate your level of agreement with the following realized-benefits they have brought:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ○ Lower levels of CO_2 emission
- ○ Reduced energy consumption
- ○ Lower energy bills

Q4. If there are other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

Q5. Please indicate your level of agreement with the following realized-barriers that have been preventing implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ○ Lack of support for sustainability practices from upper management of retail stores
- ○ Lack of awareness of lifecycle cost of retail facilities

○ Financial constraints

○ Time constraints

○ Lack of professional writing skills (e.g., writing proposals)

○ Teamwork inefficiencies

○ Lack of negotiation skills

○ Lack of sustainability training for facilities managers

○ Lack of leadership skills for facilities managers

○ Unavailability of building automation systems

○ Incompatibility of building automation systems with other building systems

○ Unavailability of effective metering systems

○ Absence of energy efficiency related regulations

○ Misalignment of building safety regulations and energy efficiency requirements

○ Misalignment of historic preservation codes and energy efficiency requirements

○ Difficulty in maintaining the aesthetic attributes of the building

Q6. If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q7. Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ◯ Efficient space planning
- ◯ Development of low-cost building maintenance strategies
- ◯ Proactive operation and maintenance of sustainable building systems
- ◯ Incorporation of commissioning into the building's life cycle
- ◯ Operating building systems properly
- ◯ Sustainability training for upper management of retail stores
- ◯ Sustainability training for facilities managers
- ◯ Training on teamwork skills for facilities managers
- ◯ Training on negotiation skills for facilities managers
- ◯ Training on professional writing skills for facilities managers
- ◯ Promotion of an integrated collaboration between policy makers and facilities managers
- ◯ Use of renewable energy sources (please specify the type)
- ◯ Use of energy efficient lighting

○ Use of skylights

○ Use of high-performance windows

○ Use of energy efficient HVAC systems

○ Use of energy efficient refrigerators

○ Use of anti-sweat heater controls

○ Use of Demand Control Ventilation (DCV) systems

○ Use of Pollutant Exposure Control Ventilation (PECV) systems

○ Retrofitting the building envelope to reduce air leakage

○ Retrofitting the building envelope to reduce thermal bridging

○ Retrofitting the building envelope by implementing more efficient vestibule configurations

○ Retrofitting the building envelope by implementing better overhead door strategies

Q8. What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?

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Q9. What other professional development methods for FM personnel would you suggest to achieve energy-efficient retail facilities?

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SECTION VI: FOOD RETAIL STORES:

DO NOT INTEGRATE ENERGY-EFFICIENT MEASURES

Q1. How effective the integration of the following energy efficiency practices could be for increasing energy efficiency in your retail facilities?

The following options will be available in the form of Likert Scale (1 = Not at all effective, 2 = Slightly effective, 3 = moderately effective, 4 = Very effective, 5 = Extremely Effective).

If participants do not use the given options, they can select "We do not integrate this practice" for each choice.

- ○ Energy efficient refrigerators
- ○ Anti-sweat heater controls
- ○ Green Roof
- ○ Cool Roof
- ○ Renewable Energy Sources (please specify the type)
- ○ Energy Efficient Lighting
- ○ Skylights
- ○ High-performance windows
- ○ Energy Efficient HVAC Systems
- ○ Demand Control Ventilation (DCV) Systems
- ○ Pollutant Exposure Control Ventilation (PECV) Systems
- ○ Building envelope enhancement to reduce air leakage

○ Building envelope enhancement to reduce thermal bridging

○ Building envelope enhancement by implementing better vestibule configurations

○ Building envelope enhancement by implementing better overhead door strategies

Q2. If there are other energy-efficient practices that you would use in your retail facilities that you would like to add to the list above, please add them below:

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Q3. Please rate your level of agreement with the following benefits that the integration of the energy efficiency practices in your retail facilities could bring:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

○ Lower levels of CO_2 emission

○ Reduced energy consumption

○ Lower energy bills

Q4. If there would be other benefits of integrating energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q5. Please select your level of agreement with the following barriers that have been preventing the use of energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

- ◯ Lack of support for sustainability practices from upper management of retail stores
- ◯ Lack of awareness of lifecycle cost of retail facilities
- ◯ Financial constraints
- ◯ Time constraints
- ◯ Lack of professional writing skills (e.g., writing proposals)
- ◯ Teamwork inefficiencies
- ◯ Lack of negotiation skills
- ◯ Lack of sustainability training for facilities managers
- ◯ Lack of leadership skills for facilities managers
- ◯ Unavailability of building automation systems
- ◯ Incompatibility of building automation systems with other building systems
- ◯ Unavailability of effective metering systems
- ◯ Absence of energy efficiency related regulations
- ◯ Misalignment of building safety regulations and energy efficiency requirements

◯ Misalignment of historic preservation codes and energy efficiency requirements

◯ Difficulty in maintaining the aesthetic attributes of the building

Q6. If there are other barriers that have been preventing implementation of the energy efficiency practices in your retail facilities that you would like to add to the list above, please add them below:

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Q7. Please select your level of agreement with the following solutions that could increase implementation of the energy efficiency practices in your retail facilities:

Participants will assign a rating to the following choices on a 5-point Likert Scale. (1 = Strongly disagree, 2 = disagree, 3 = Neither agree nor disagree, 4 = agree, 5 = Strongly agree)

◯ Efficient space planning

◯ Development of low-cost building maintenance strategies

◯ Proactive operation and maintenance of sustainable building systems

◯ Incorporation of commissioning into the building's life cycle

◯ Operating building systems properly

◯ Sustainability training for upper management of retail stores

◯ Sustainability training for facilities managers

○ Training on teamwork skills for facilities managers

○ Training on negotiation skills for facilities managers

○ Training on professional writing skills for facilities managers

○ Promotion of an integrated collaboration between policy makers and facilities managers

○ Use of renewable energy sources (please specify the type)

○ Use of energy efficient lighting

○ Use of skylights

○ Use of high-performance windows

○ Use of energy efficient HVAC systems

○ Use of energy efficient refrigerators

○ Use of anti-sweat heater controls

○ Use of Demand Control Ventilation (DCV) systems

○ Use of Pollutant Exposure Control Ventilation (PECV) systems

○ Retrofitting the building envelope to reduce air leakage

○ Retrofitting the building envelope to reduce thermal bridging

○ Retrofitting the building envelope by implementing more efficient vestibule configurations

○ Retrofitting the building envelope by implementing better overhead door strategies

Q8. What other sustainable building systems and building structural features would you suggest to achieve energy-efficient retail facilities?

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Q9. What other professional development methods for FM personnel would you suggest to achieve energy-efficient retail facilities?

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