Building Energy Benchmarking in Northern Virginia

An Interactive Qualifying Project

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Acronym	Definition
ABGR	Australian Building Greenhouse Rating
ACEEE	American Council for an Energy-Efficient Economy
AIRE	Arlington Initiative to Rethink Energy
AOBA	Apartment and Office Building Association
APD	Alexandria Police Department
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
BEAP	Building Energy Assessment Professional
BEMP	Building Energy Modeling Professional
bEQ	Building Energy Quotient
BOMA	Building Owners and Managers Association
BTU	British Thermal Units
CBECS	Commercial Building Energy Consumption Survey
CEEPC	Climate, Energy and Environment Policy Committee
CEP	Community Energy Plan
CFL	Compact Fluorescent Light bulb
DC	District of Columbia
DCHS	Department of Community and Human Services
DEQ	Department of Environmental Quality
DER	Deep Energy Retrofit
DEUS	Department of Energy Utilities and Sustainability
DGS	Department of General Services
EI	Energy Indicator
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EPL	Energy Performance Label
EPRI	Electric Power Research Institute
EU	European Union
EUI	Energy Use Intensity
GARI	Geographic Analysis and Research Interface
GBIG	Green Building Information Gateway
GBRC	Green Building Resource Center
GDP	Gross Domestic Product
GHG	Greenhouse Gas
HPwES	Home Performance with ENERGY STAR
HPWH	Heat Pump Water Heater
HVAC	Heating, Ventilation, and Air Conditioning
IEA	International Energy Agency
IQP	Interactive Qualified Project
JEM	Joulex Energy Management
kWh	Kilowatt Hour

LBNL	Lawrence Berkeley national Laboratory
LED	Light-Emitting Diode
LEED	Leadership in Energy & Environmental Design
LF	Load Factor
MDER	Massachusetts Department of Energy Resources
MWCOG	Metropolitan Washington Council of Governments
NIAOP	Commercial Real Estate Development Association
NSW	New South Wales
NVRC	Northern Virginia Regional Commission
OEM	Office of Energy Management
OHA	Office of Historic Alexandria
PE	Professional Engineer
PV	Photovoltaic
QR	Quick Response
RA	Registered Architect
RPCA	Recreation, Parks, and Cultural Activities
TES	Transportation and Environmental Services
UAP	Urban Affairs and Planning
USDOE	United States Department of Energy
USEPA	United States Environmental Protection Agency
USGBC	United States Green Building Council
VDH	Virginia Department of Health
VEEP	Virginia Environmental Excellence Program
VEPGA	Virginia Energy Purchasing Government Association
WTE	Waste-to-Energy

Abstract

The goal of our project was to provide recommendations for improving the energy efficiency in both public and private facilities and operations in the Northern Virginia region. Our first objective was to conduct a benchmarking analysis of 41 government buildings within the City of Alexandria. After identifying best benchmarking practices, our group then developed a government building benchmarking and labeling plan designed to help building owners in Northern Virginia jurisdictions benchmark the energy performances of their facilities. We also designed an energy performance label prototype to be utilized by these building owners to communicate their facilities' energy use. Lastly, we drafted a white paper on key policy and programmatic considerations for implementing a voluntary benchmarking and labeling program for Northern Virginia's private commercial building stock.

Executive Summary

The services demanded of buildings – lighting, warmth in the winter, cooling in the summer, water heating, electronic entertainment, computing, refrigeration, and cooking – require significant energy use, about 40 quadrillion BTU (British thermal units) per year in the United States (USDOE, 2008). The nation's 114 million households and more than 4.7 million commercial buildings consume a greater percentage of the available energy supply than either industrial or transportation sectors. In fact, the building sector is considered the single largest user of energy, accounting for roughly 40 percent of the nation's total primary energy consumption. In addition, the burning of coal and natural gas to provide buildings with electricity also makes buildings the largest share of U.S. carbon dioxide emissions.

One method to manage energy consumption is to collect utility data and benchmark buildings' energy use. Benchmarking informs organizations about how they use energy, where they use it, and what drives their energy use (ENERGY STAR, 2013b). It is an integral step in identifying opportunities to increase profitability by lowering energy and operating costs. Ultimately, energy benchmarking identifies high-performing facilities for public recognition and prioritizes poor performing facilities for immediate improvement. Program like ENERGY STAR Portfolio Manager created by the U.S. Department of Energy (USDOE) can help building managers to benchmark their buildings and identify areas for operational improvements.

The goal of this project was to provide the City of Alexandria and Northern Virginia Regional Commission (NVRC) with recommendations to improve the energy efficiency of public and private buildings. The goal was achieved through three objectives: (1) completed energy benchmarking on 41 government buildings in the City of Alexandria and disclosing the results in the *2013 Energy Benchmarking Report*, (2) designed an energy performance label (EPL) prototype, and delivered the *Government Building Energy Benchmarking and Labeling Plan* to NVRC, and (3) outlined key considerations for *Implementing Voluntary Commercial Building, Disclosure, and Labeling Programs in Northern Virginia*.

To benchmark government buildings in Alexandria, we collected building information, such as space type, hours of operation, number of occupants, number of computers, percent heated, and percent cooled, from various sources. The Space Inventory Assessment Plan, provided by Baker and Associates, and the Geographic Analysis and Research Interface (GARI) were used to collect building parameters. We made assumptions based on published documents and other recourses from energy manager of the City for buildings that were not listed in the Plan. These parameters were manually imported in an Excel spreadsheet for organizational purposes and then transferred to the respective accounts in ENERGY STAR Portfolio Manager to generate ratings. The figure below displays the distribution of weather normalized site EUIs for all 41 benchmarked

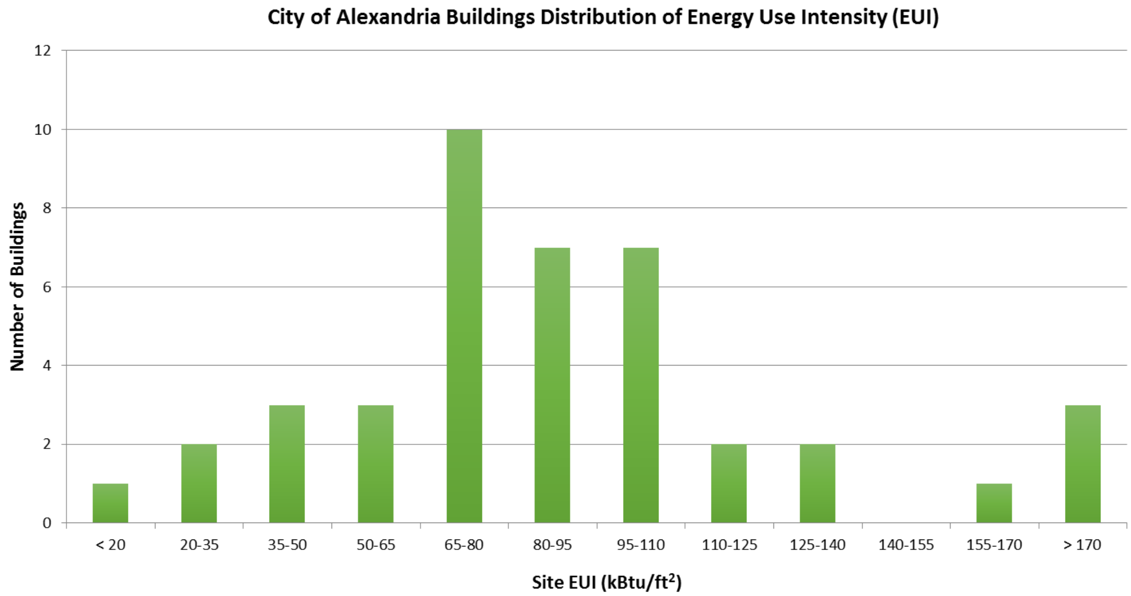

Figure 1: Alexandria Buildings' EUI Distribution

buildings. This plot serves as a coarse screening tool for overall energy efficiency potential, and allows the City of Alexandria to identify which buildings would benefit from operational improvements. The results of this benchmarking analysis were documented in the *2013 Energy Benchmarking Report* for the energy manager of the City.

To design a visually-appealing and practical energy performance label, we studied related graphic design concepts such as page layout, data visualization, saturation of color, and graphical representation from Edward Tufte's books, *The Visual Display of Quantitative Information*, *Envisioning Information*, and *Visual Explanations*. We also conducted an interview with John Morrill, Energy Manager, and Jeannie Altavilla, Energy Program Analyst, from Arlington County's Department of Environmental Services to discuss Arlington's iterative steps in developing their own EPL. Our group wanted to identify which types of information should be included on the label, and which types of data visualization would be most effective at communicating this information. Our group also conducted an interview with the Alexandria City Energy Manager, Bill Eger, to talk about his expectations for a future performance label. Through many trials, we produced several iterations of the EPLs using Microsoft PowerPoint. Shown to the right is the final EPL prototype.

This benchmarking process was documented in the *Government Building Energy Benchmarking and Labeling Plan* for NVRC. We conducted a formal interview with Andrew Burr, the Director of Building Energy Performance Policy from the Institute for Market Transformation (IMT), to review their organization's programs focusing on building performance policy and building energy codes. Based on the interview, the plan clarifies mandatory policy requirements and deadlines for building owners to continually rate and disclose the energy performances of their buildings.

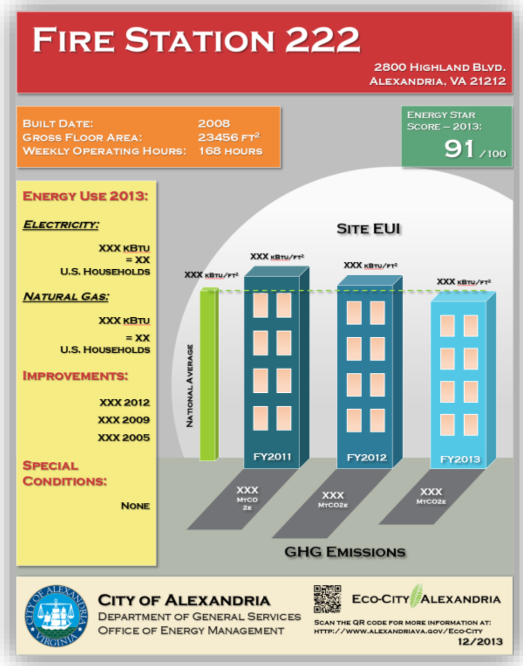

Figure 2: EPL Prototype

As the last objective, we developed a scalable voluntary program targeting private commercial buildings. It was based on the interview with Kelly Zonderwyk, Energy Program Specialist from Arlington Initiative to Rethink Energy (AIRE) at the Arlington County Department of Environmental Service. Our team identified the steps that Arlington County (specifically, AIRE) took to kick start Arlington Green Games: a voluntary program designed to encourage residents and business owners to reduce their operational expenses and greenhouse gas emissions by means of an annual benchmarking competition.

Our accomplishments and documents provided in this report will help promote market transparency in the City of Alexandria as well as Northern Virginia region, and ultimately, improve energy efficiency in both public and commercial buildings.

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1.0 Introduction

Since the industrial revolution, human population has mostly relied on fossil resources as the main fuel for electricity generation, transportation, and industry. Petroleum, coal and natural gas, are used at a rapidly increasing rate as the world's population grows. In fact, earth's fossil resources could be used up before the end of this century (Ecotricity, 2011). People have also been producing energy from non-fossil and renewable resources such as wind, sunlight, tides, and nuclear energy. Yet at this time alternative energy sources produce no more than a quarter of the world's energy supply. In order to respond to the need for energy saving due to the limited fuel options, building energy efficiency has become an important topic. Buildings play a significant role as they account for 40 percent of all energy use in the United States, followed by industrial and transportation (USDOE, 2008). Both residential and commercial building energy use are growing, and they represent an increasing share of U.S. energy consumption.

The City of Alexandria in Northern Virginia is one of the cities in the United States that has been putting an effort into improving energy efficiency in public and private facilities. It has yet to establish a corresponding rating system to reach its goal. On March 14, 2011, the City developed the "Energy and Climate Change Action Plan" targeting reductions in greenhouse gas emissions and to prepare for the impacts of climate change (Energy and Climate Change Action Plan, 2011). This plan is in effect from 2012 until 2020 and it aims to achieve these goals through partnering with agencies at regional and state levels. One of the important partners is the Northern Virginia Regional Commission (NVRC) (2013), a regional council that serves as a government agency in the Northern Virginia suburbs of Washington, DC. NVRC mainly focuses on providing information, performing professional and technical services for its members, and serving as a mechanism for regional coordination. With a rapidly growing energy demand, the city is ready to make further improvements in energy use and the resulting reduction in CO2 emissions across the communities of Alexandria. These improvements will allow the city to reach the energy efficiency targets based on the Energy and Climate Change Action Plan.

Current research on energy efficiency generally focuses on sustainability of residential and commercial buildings, specifically on how to reduce costs and emissions per unit time. The local community is strongly encouraged to replace inefficient appliances with certified efficient ones through a variety of incentives and rebate programs organized by utility companies and government organizations. The concept of being green is an important factor to consider when building a new facility. Current NVRC (2013) programs on improving energy efficiency in the City of Alexandria also focus on energy security, renewable energy integration, and environmental sustainability. While achieving energy efficiency is never a simple task, NVRC follows the Community Energy Planning (CEP), a process addressing energy security and environmental challenges with policies and practices that systematically integrate energy efficiency, heat recovery, use of multiple energy sources including renewable energies, flexible energy distribution, transportation, and land uses to create a sustainable community.

Despite the efforts of the City of Alexandria and the support of NVRC, there is still room for improvement in regards to achieving energy efficiency targets that were stated in the Plan. Energy performance data have been collected from public facilities, but the energy efficiency rating has yet to be conducted. An energy efficient labeling system is also needed in Northern Virginia region to encourage and educate all residents and businesses to increase energy rating transparency.

The goal of this project is to provide NVRC and the City of Alexandria with recommendations to improve the energy efficiency of facilities and operations. In order to achieve this goal, our first objective is to benchmark government buildings in the city. The second objective is to develop energy benchmarking plan that will be used to evaluate energy efficiencies of government facilities in Northern Virginia region. The third objective is to design an energy performance label for print and digital display in public facilities and operations of the region. Then the last objective is to apply best practice for government facilities to private commercial buildings. To accomplish our objectives we plan to conduct interviews with government agencies, non-profit organizations and local stakeholders for best benchmarking practices, policies and label designs. Ultimately, our project aims at making buildings in Alexandria and subsequently the rest of Northern Virginia more energy efficient.

2.0 Background

The services demanded of buildings – lighting, warmth in the winter, cooling in the summer, water heating, electronic entertainment, computing, refrigeration, and cooking – require significant energy use, about 40 quadrillion BTU (British thermal units) per year in the United States (USDOE, 2008). The nation's 114 million households and more than 4.7 million commercial buildings consume a greater percentage of the available energy supply than either industrial or transportation sectors, as shown in the figure below.

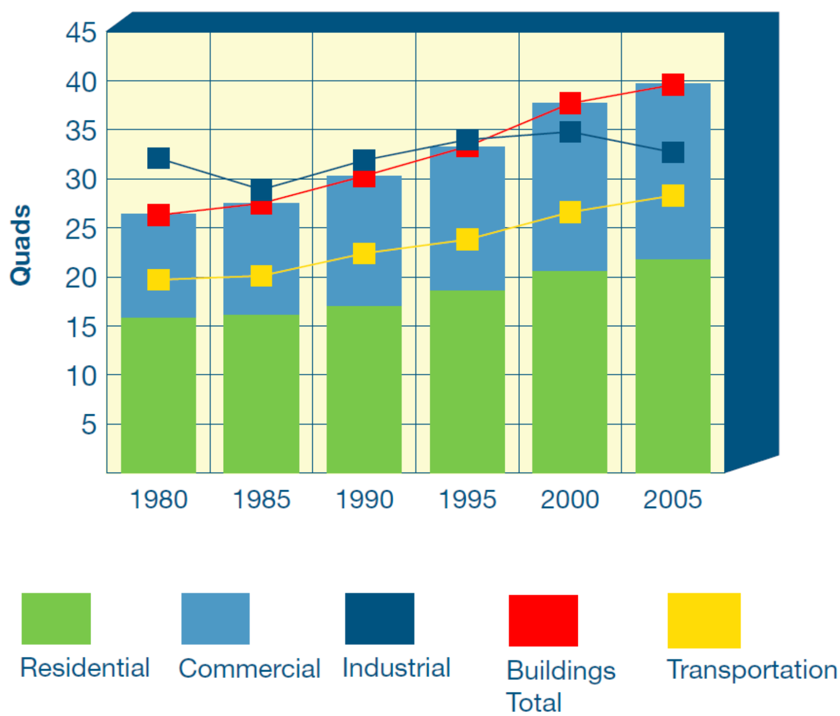

Figure 3: Growth in Buildings Energy Use Relative to Other Sectors (USDOE, 2008)

In fact, the building sector is considered the single largest user of energy, accounting for roughly 40 percent of the nation's total primary energy consumption (USDOE, 2008). The overall growth in the U.S. housing market, despite the recent economic downturn, has driven an increase in electricity consumption across the nation's building stock. The demand for electricity in buildings was the principal force behind the 58 percent growth in net electricity generation from 1985 to 2006. Electricity, the most versatile form of energy, is also the most expensive per equivalent BTU. Specifically, electric utility bills accounted for nearly 65 percent of building energy costs in 2005. In addition, the burning of coal and natural gas to provide buildings with electricity also makes buildings the largest share of U.S. carbon dioxide emissions. From a global perspective, U.S buildings represented about 9 percent of the world's carbon dioxide emissions in 2005. In fact, U.S. buildings would rank just behind the United States itself (5,957) and China (5,322) as the largest source of carbon dioxide emissions. The figure below indicates that carbon dioxide emissions from U.S. buildings exceed the combined emissions of Japan, France, and the United Kingdom.

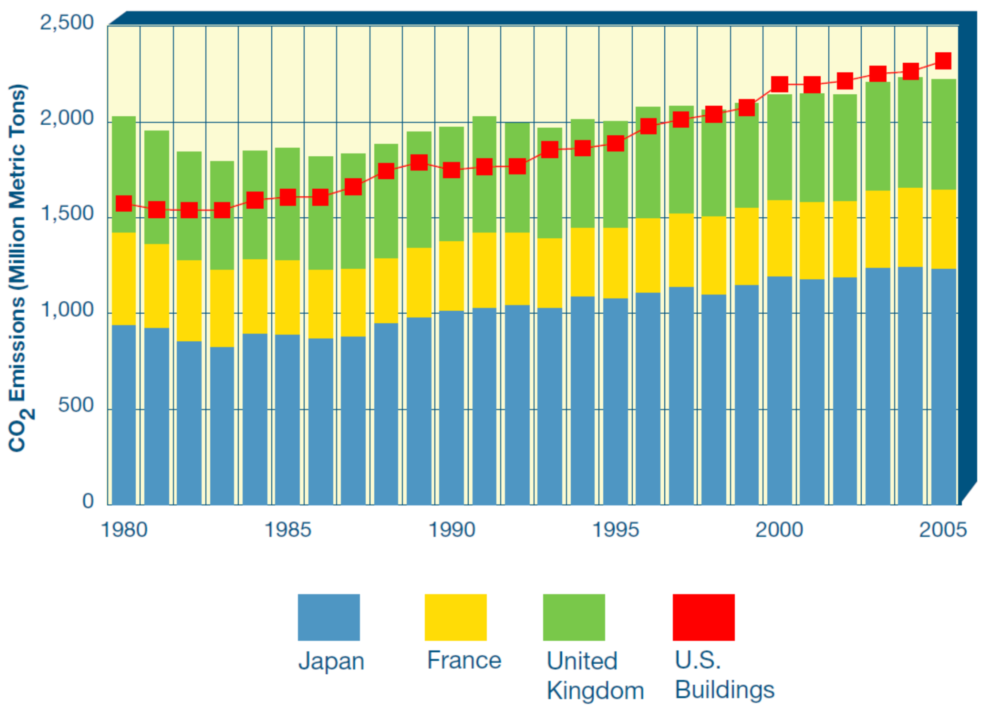

Figure 4: CO2 Emissions of U.S. Buildings Relative to Japan, France, and the United Kingdom (USDOE, 2008)

To satisfy building energy demands and reduce atmospheric emissions in the United States, there must be further consideration for better energy management practices and renewable energy solutions. Improvements in the energy performance of existing facilities can be realized through the implementation of building energy codes and energy efficiency programs. The adoption of regional energy strategies can be shown to assist local governments, as well as private-sector corporations, in coordinating community energy plans that address issues regarding energy consumption and conservation. The International Energy Agency has estimated that since 1973 energy efficiency improvements have helped save over 50 percent of the energy consumed in the

United States (Krarti, 2011). However, the energy systems currently utilized in buildings are still far from achieving the highest levels of thermodynamic efficiency. Even considering present technologies, there is significant potential to improve energy productivity in a cost effective manner in both new and existing buildings. The primary focus of this background chapter is to highlight the current efforts, both domestic and international, that support the development and maintenance of energy efficient buildings, both publicly and privately owned.

2.1 Energy Efficiency

To some extent, there are limits for currently available resources to generate energy. The figure below shows energy reserves prediction throughout the year of 2011 till 2081. As the graph shows, the coal deposits will only be enough to last as far as 2088.

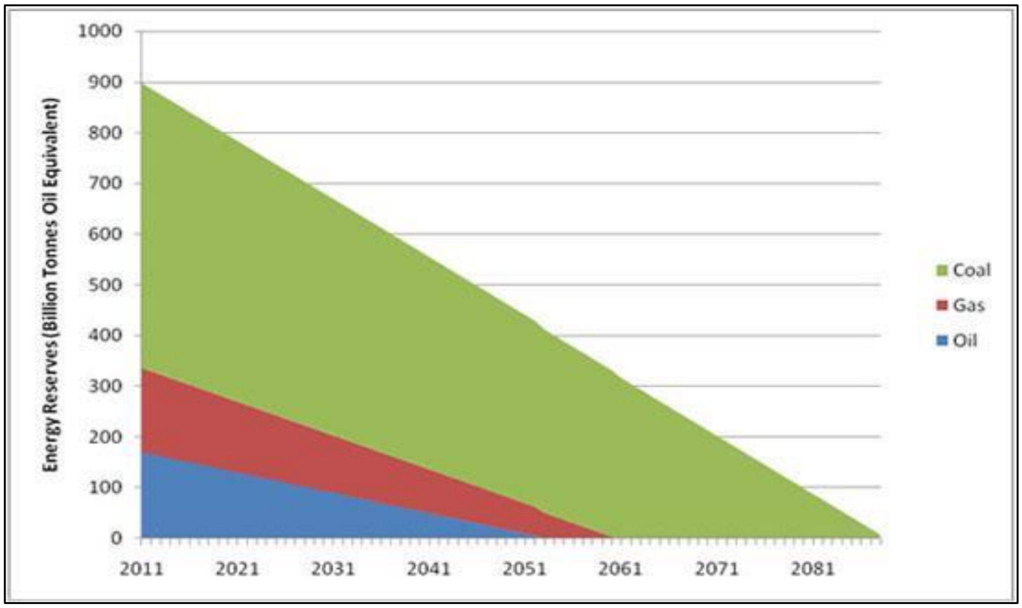

Figure 2.1-1: Fossil fuel reserve (Ecotricity 2011)

Producing, transporting, and using energy recklessly would devastate the natural environment and contribute to carbon dioxide emissions. One solution to these issues is increased energy efficiency. Energy efficiency concept and its application to buildings are covered in this section.

2.1.1 Energy Efficiency and Energy Conservation

There are two ways to save energy; energy conservation and energy efficiency. Energy conservation is reducing energy use, or not using the service at all. For example, turning off a light or raising the air-conditioning temperature would be energy conservation (LBNL, 2013). Energy efficiency, on the other hand, is providing better quality energy services with less energy by using advanced technologies. For example changing the light bulb from incandescent to compact fluorescent is energy efficiency. It does not involve giving up services and being uncomfortable, but it takes an advantage of technological improvements to provide smarter services. Energy efficiency is a valuable resource that creates a win-win solution for multiple fronts (Alliance to Save Energy, 2013). It eliminates energy waste without having to remember to do it in daily life. Development and implementation of energy efficient products, technologies and services save consumers and businesses money, drive innovation and productivity, support a cleaner environment, and reduce dependence on fossil fuels.

2.1.2 Energy Efficiency Practices in Buildings

The buildings sector is the largest consumer of energy in the United States, using approximately 41% of total U.S. energy use (IEA, 2007). Office buildings, universities, laboratories, residential homes and other facilities require a lot of energy to operate daily. There are rooms for improving energy efficiency of those buildings. Buildings need to be checked to identify what technical supports or updates are the most appropriate depending on the purpose of buildings. This can be done by energy auditor, who is a professional to conduct building's energy inspection. When auditing a building, it is important to check for insulation, heating, ventilating, and air condition (HVAC), and lighting.

Insulation

Most homes in the United States have significant air leaks due to insufficient insulation (ENERGY STAR, 2013i). Without a good insulation system, other energy efficient efforts and equipment may not perform as intended. A well-insulated home, particularly one that is insulated with fiber glass, rock wool, or slag wool insulation, is one of the most cost effective ways of saving energy and reducing heating and cooling bills (NAIMA, 2013). Sealing leaks and adding insulation can improve the overall comfort living and help to fix common problems such as mold, mildew or musty odors, dust, ice dams, peeling paint, pest infestation, drafty rooms and cold floors or walls in winter. To determine whether insulation needs to be added or not, the first step required is to find out how much insulation already exists and where it is. A qualified energy auditor will include an insulation check as a routine part of an energy assessment, which will help identify areas that are in need of air sealing.

One of the most common types of insulation is batt and roll insulation, which is also called blanket insulation (USDOE, Energy Saver, 2013). Blanket insulation is the most widely available type of insulation that comes in the form of batts or rolls. It consists of flexible fibers such as fiberglass. Batts and rolls can be made from mineral wool (rock and slag), plastic fibers, and natural fibers like cotton and sheep's wool. Manufacturers often attach a facing, such as kraft paper, foil-kraft paper or vinyl, to act as a vapor and air barrier. Batts with a special flame-resistant facing are available in various widths for basement walls and other places where the insulation will be left exposed. This facing helps facilitate fastening during the installation.

Other type of insulation is using foam board or rigid foam. Foam boards are rigid panels of insulation that can be used to insulate almost any part of a building, from the roof down to the foundation. They provide thermal resistance and reduce heat conduction through structural elements similar to wood and steel studs. The most common types of materials used in making foam board are polystyrene, polyisocyanurate (polyiso), and polyurethane.

Loose-fill and brown-in insulation is another type of insulation that is commonly used. Loose-fill insulation consists of small particles of fiber, foam, or other materials. These small particles can be insulated in any space without damaging the structure or finishes of the space. This is why loose-fill insulation is well suited for retrofits and locations where it would be difficult to install other types of insulation. The most common types of materials used for loose-fill insulation are cellulose, fiberglass, mineral wool (rock and slag). These materials are produced using recycled waste materials. For example, cellulose is primarily made from recycled newsprint and most fiber glasses contain 20% to 30% recycled glass. Mineral wool is usually produced from 75% post-industrial recycled content. The figure on the next page shows cellulose blown into an attic.

Figure 2.1-2: Blown-in insulation of cellulose (USDOE, Energy Saver, 2013)

Heating, Ventilating, and Air Conditioning (HVAC) Systems:

HVAC equipment performs heating and cooling for residential, commercial or industrial buildings (FSEC, 2013). A properly designed and maintained system will provide a comfortable indoor environment year round when properly maintained. As much as half of the energy used in homes goes to heating and cooling (ENERGY STAR, 2013e). Making smarter decisions about HVAC system can have a significant effect on the utility bills and the comfort.

Checking an air filter every month, especially during the heavy use months in winter and summer, and changing it at regular basis will help keep the air flow constant and prevent dust and dirt from building up in the system that could cause expensive maintenance or early failure. A dirty filter will make the system work harder to keep the space warm or cool. Another way to manage the system is to get a programmable thermostat. It is ideal for people who are away from home during set periods of time throughout the week. It is recommended to update HVAC equipment when the unit is either more than 10 years old, or not keeping the space comfortable. Replacing the old heating and cooling equipment with ENERGY STAR qualified equipment can possibly cut the annual energy bill by nearly $200.

Lighting

If every American home replaced one light bulb with an energy efficient light bulb, such as ENERGY STAR labeled bulb, there would be enough energy saved to light 3 million homes for a year saving about $600 million in annual energy costs and preventing 9 billion pounds of greenhouse gas emissions per year, which is equivalent to those from about 800,000 cars (ENERGY STAR, 2013f). There are 2 main lighting options that have revolutionized the energy efficient lighting: Light Emitting Diode (LED) and Compact Fluorescent Lights (CFL) bulbs.

CFLs are 4 times more efficient and last up to 10 times longer compared to incandescent bulbs (Eartheasy, 2013). Their initial costs are expensive, but it would be a great saving in the long run since CFLs only use 1/3 the electricity and last up to 10 times as long as incandescent bulbs. One of the important factors to consider when choosing CFLs over other options is air pollution resulted from the greenhouse gas emissions. Replacing a single incandescent bulb with a CFL will keep a half a ton of CO2 out of the atmosphere over the life of the bulb.

There is a variety of types of CFLs for different needs. Spiral lamps are the standard continuous tube in a spiral shape as it is shown in figure 2.1.3 below. Standard lamps are no different than regular CFL spiral lams except they are placed inside a dome cover and fitted with a standard base that fits common lamp sockets. Figure 2.1.4 shows what the standard lamp looks like. They are designed to give the appearance of the traditional light bulb for consumers who are looking for familiar appearance. Some of the types also have interesting features such as dimmable and 3-way. Dimmable lamps dim to 10% - 40% of their original brightness, and 3-way CFLs use 1/3 as much electricity as incandescent bulbs. These characteristics allow saving energy when possible.

Figure 2.1-3: Spiral Lamp (Eartheasy, 2013)

Figure 2.1-4: Standard Lamp (Eartheasy, 2013)

LEDs are small, very efficient solid bulbs. LED technology is advancing rapidly, with many new bulb styles available. They are more expensive than CFLs initially, but LEDs last up to 10 times as long as compact fluorescents, and far longer than incandescent bulbs. The price of LED bulbs is going down each year as the manufacturing technology continues to improve. LEDs are durable, and they do not get damaged when regular incandescent bulb would be broken because LEDs do not have a filament. They also produce only 3.4 Btu/hour, compared to 85 for incandescent bulbs, indicating that there is no heat build-up. Common incandescent bulbs get hot, but LEDs prevent this heat build-up, helping to reduce air conditioning costs in the home. LED light bulbs use only 2 - 17 watts of electricity, which is equivalent to 1/3 to 1/30 of incandescent bulbs or CFL. Because of the low power requirement for LEDs, using solar panels becomes more practical and less expensive.

There are some different types of LEDs just like CFLs. In diffused bulbs, clusters of LEDs are covered by a dimpled lens which spreads the light out over a wider area, so they are useful for lighting rooms, porches, hallways and low-light applications where lights remain on for extended periods. Dimmable glove LED bulbs are designed for bathroom vanities or anywhere a globe bulb is required. They produce light equivalent to a 40-watt incandescent bulb, while only consuming 10 watts of power, and they are also dimmable from 100% to 10%. LED tube lights are designed to replace fluorescent tube bulbs that are typically in office buildings. These tubes are available in 8 and 16 watts, which will replace traditional 25-watt and 40-watt fluorescent tubes. Figures below show how each types of bulb looks like.

Figure 2.1-5: Dimmable Glove LED bulb (Eartheasy, 2013)

Figure 2.1-6: Diffused Bulb (Eartheasy, 2013)

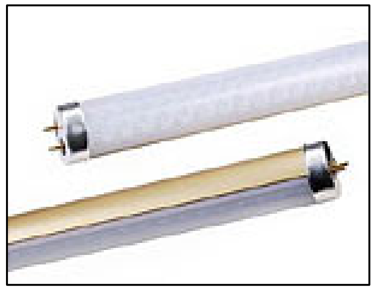

Figure 2.1-7: LED Tube Light (Eartheasy, 2013)

Renewable Energy

Renewable energy is energy that is derived from natural processes, such as sunlight and wind that are replenished at a higher rate than they are consumed (IEA, 2013). Common sources of renewable energy are solar, wind, geothermal, hydro, and biomass. Renewable sources of energy have been the driver of the global growth in clean energy since the year 2000. In recent years there have been major improvements in wind and solar photovoltaic (PV) technologies. One of the reasons for the success of wind and solar PV power is policy support. Policies continue to grow to address energy market developments and cost reductions. Both utility-scale and rooftop solar PV generation has seen a major increase in demand, resulting from market-creating policies that led to a decline in the costs PV modules. Wind power also experienced dramatic growth over the last decade; global installed capacity at the end of 2011 was around 240 GW, up from 18 GW at the end of the year 2000. Despite this good news, worldwide renewable electricity generation since 1990 grew at an average of 2.8% per year, which is less than the 3% growth seen for total electricity generation. While 19.5% of global electricity in 1990 was produced from renewable sources, this share fell to 19.3% in 2009. This decrease is mainly the result of slow growth in the main renewable source, hydroelectric power. Achieving the goal of halving global energy-related CO_2 emissions by 2050 will require a doubling of renewable generation from today's levels by 2020.

2.2 Energy Benchmarking

To maximize expected profits, businesses continue to search for ways to decrease their operational expenses, especially those associated with energy consumption. As a result of increasing prices in the global energy market, there is a growing need for businesses to minimize their energy use in a cost-effective manner. Unfortunately, the high costs of electric utilities alone have been known to jeopardize business financial plans. Utility expenses are typically 10 to 20 percent of a building's total expense, and rates are constantly increasing (Partner Energy, 2013). Businesses are starting to reduce their energy costs by 10, 20, and 30 percent through effective energy management practices that involve assessing building energy performance, setting energy-savings goals, and regularly evaluating progress (ENERGY STAR, 2013b). Several U.S. cities and states have adopted policies that require businesses, particularly their building managers, to perform evaluations of building energy performance. Facility- or building-level energy performance benchmarking is the key to actualizing achievable these reductions in energy costs and consumption, while continuing to maintain quality output performance.

In simplest terms, benchmarking informs organizations about how they use energy, where they use it, and what drives their energy use (ENERGY STAR, 2013b). It is an integral step in identifying opportunities to increase profitability by lowering energy and operating costs. For example, in commercial real estate, decreasing energy costs by 30 percent is equivalent to increasing net operating income by 4 percent. In the supermarket retail industry, a 10 percent reduction in energy costs is equivalent to increasing sales per square foot by 70 dollars. Realizing these types of savings can be catalyzed through energy benchmarking practices. The benchmarking process determines the primary drivers of energy use and provides an important diagnostic tool for improving building performance. Successful energy benchmarking can provide reference points necessary for gauging the effectiveness of energy management and management for continuous improvement. Through benchmarking procedures, the principal metrics for assessing performance are identified, baselines are established to measure progress, and goals are set for future developments. The metrics are adjusted or "normalized" for characteristics known to affect energy consumption such as weather, production levels, and building occupancy. Essentially, this helps building managers compare energy uses on an equal playing field, ensuring a meaningful analysis of the collected data.

Ultimately, energy benchmarking identifies high-performing facilities for public recognition and prioritizes poor performing facilities for immediate improvement. Regional benchmarking plans are implemented by local governments in an attempt to spur market competition for green, energy efficient properties. Within the past five years, two states and five major cities have passed policies that will affect some of the nation's largest metropolitan real estate markets, including New York City, Los Angeles, Washington, DC, and Seattle (Burr, Keicher, & Leipziger, 2011). The figure below represents the number of buildings impacted by benchmarking policies in seven U.S. jurisdictions.

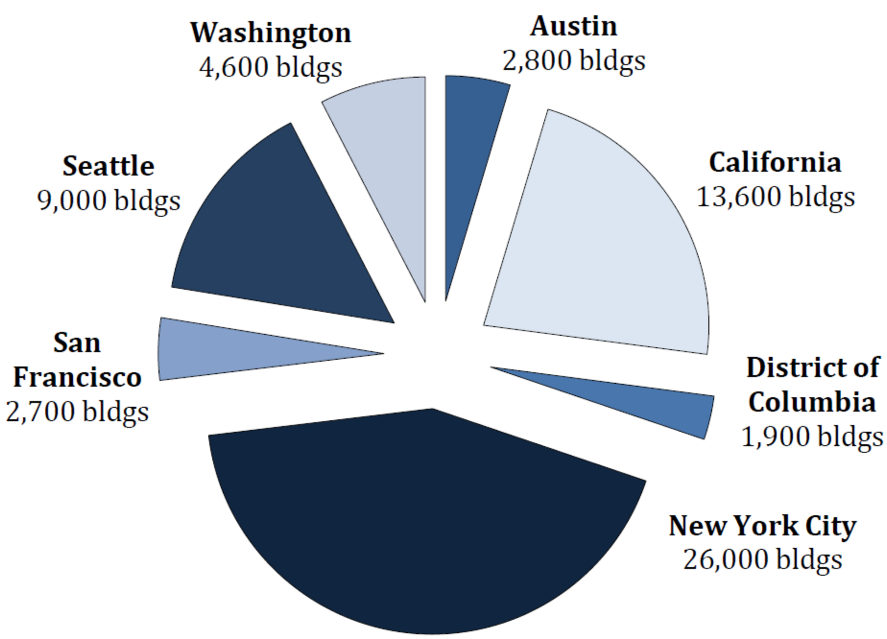

Figure 2.2-1: Policy Impact Projection on Number of Buildings by Jurisdiction (Burr, Keicher, & Leipziger, 2011)

Rating and disclosure policies enable the flow of building energy performance information among real estate stakeholders, allowing property and financial markets to compare the energy performance of buildings during a transaction and appropriately value energy efficiency. Benchmarking can be classified as a statistical examination used to quantify the performance of buildings and plants relative to each other and is able to evaluate an individual organization's position relative to the rest of the market (Chung, Hui, & Lam, 2005). Establishing a strong energy market can ensure that commercial businesses will continue to improve their energy efficiencies over time. Fundamentally, energy benchmarking practices enable building owners to understand the opportunities lost by maintaining average energy performance, and the benefits of achieving superior energy performance. It is crucial for building managers to act on their benchmarking results in order to secure better returns on future energy investments.

2.2.1 Energy Auditing

According to many experts, energy auditing is by far the best approach to managing energy consumption and is used to highlight the dual benefits of dollar savings and environmental protection from energy efficiency and conservation improvements (Reyes, Rosen, & Sarafides, 2006). An energy audit is defined as a systematic procedure used to evaluate the energy consumption of an existing facility – public or private. The energy audit consists primarily of collecting and measuring data that are valuable for the energy assessment of the building. The data collected during the auditing process should highlight the facilities' current energy demands and help managers rationalize their energy use habits. Auditing is a common practice used to initiate an energy benchmark since it permits building managers to set standards for energy use. These standards then serve as a basis for comparing the energy performance of other facilities.

Analyzing the energy use data of a particular building can reveal direct correlations between energy demands and the equipment and type of energy used to heat, cool, ventilate, and light the building (Chung et al., 2005). The figure on the following page is a sample set of annual utility data specifying the distributions of energy use in a particular facility. These distributions can reveal which building systems have the greatest energy use.

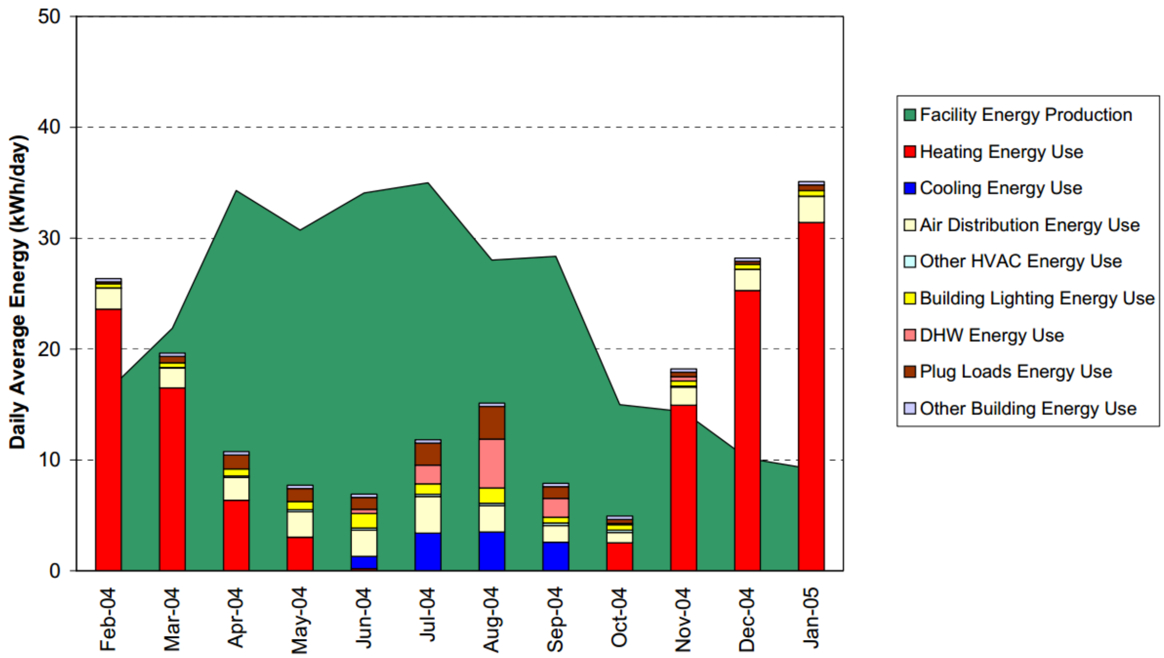

Figure 2.2-2: Average daily end-use energy consumption and PV energy production, by month (Barley, Deru, Pless, & Torcellini, 2005)

Several building conditions including age, occupancy, and square footage also have significant, but luckily, predictable influences on a building's energy consumption. Energy auditing is designed to assist facility managers in identifying potential energy savings by prioritizing their current energy uses based on cost effectiveness. The analysis of energy flows can expose inefficiencies in facility operations and aims to reduce the amount of energy input into the facility without negatively affecting output performance. Information gathered from the energy audit can be used to introduce energy conservation measures or appropriate energy-saving technologies, such as electronic control systems, in the form of retrofits. Energy audits identify economically justified, cost-saving opportunities that result in significantly lowered electrical, natural gas, steam, water and sewer costs. An energy audit, therefore, can be classified as a detailed examination of a facility's energy uses and costs that generates recommendations to reduce those uses and costs by implementing equipment and operational changes.

By going through the auditing process, building managers come to regard energy as a manageable expense, are able to analyze critically the way their facility uses energy, and are more aware of how their day-to-day actions affect building energy consumption (Reyes et al., 2006).

Energy accounting is performed by most building managers to keep track of energy inputs, energy outputs, and non-useful energy versus work data, as well as any transformations within a system. From a business perspective, the accounting process allows building managers to document utility costs and set baselines against which to measure future energy savings. For electricity accounts, usage data normally are tracked and should include metered kilowatt-hour (kWh) consumption, metered peak demand, billed demand, and rate schedules. Similar data are examined for heating fuel and water/sewer accounts. All of this information can be obtained by analyzing typical energy bills. Creating energy accounting records and performing bill audits can be done internally without hiring outside consulting firms. Also, while energy audits as a whole will identify excessive energy use and cost-effective conservation projects, bill auditing will assist in identifying errors in utility company bills and beneficial rate and service options. Bill auditing could provide an excellent opportunity to generate savings without any capital investment. Accurate data from energy accounting/bill auditing are crucial to making informed energy purchasing decisions in a deregulated energy market.

Types of Energy Audits

The term "energy audit" is widely used and may have different meanings depending on the energy service company. Energy auditing of buildings can range from a short walk-through of the facility to a detailed analysis with hourly computer simulation. Generally, there are four types of energy audits commonly applied to buildings which include walk-through audits, utility cost analysis, standard energy audits, and detailed energy audits (Reyes et al., 2006).

A walk-through audit is considered the least expensive approach to examining a building's energy consumption (Reyes et al., 2006). It mainly consists of a visual inspection of each associated energy system, particularly those identified as significant energy expenders. Historic energy use data are reviewed to analyze patterns of energy use and compare them with sector and industry averages, or even benchmarks for similar structures. The walk-through audit is designed to provide an initial estimate of potential savings and generates a number of inexpensive savings options, usually involving incremental improvements in both operations and maintenance (O&M). Examples of O&M measures include setting back heating set-point temperatures, replacing broken windows, insulating exposed hot water or steam pipes, and adjusting boiler fuel-air ratio. Information disclosed from walk-through audits can also serve as a basis for determining whether or not a more comprehensive energy audit is necessary.

The purpose of examining utility costs in an energy audit is to carefully analyze the operating costs of the facility (Krarti, 2011). Typically, the utility data over several years is evaluated to identify patterns or repeating cycles of energy use, peak demands, weather effects, and potential for energy savings. In order to perform a successful analysis, it is recommended that the auditor conduct a walk-through survey to get acquainted with the facility and its energy systems. During a cost analysis audit, auditors normally check the utility charges and ensure that no mistakes were made in calculating the monthly bills. Utility rate structures and plans for commercial and industrial facilities can be quite complex with ratchet charges and power factor penalties. Utility cost analysis can help determine the most dominant charges in the monthly utility bills. Peak demand charges are known to comprise a significant portion of the utility bill; however, measures can then be recommended to reduce these demand charges. In addition, this type of audit should be able to identify whether the facility can benefit from using other utility rate structures to purchase cheaper resources and cut operating costs.

A standard audit involves a more comprehensive and highly detailed evaluation of building performance (Krarti, 2011). Technological infrastructure, power equipment, operational systems, and workplace conditions are assessed thoroughly and on-site measurements and testing are conducted to arrive at a meaningful quantification of energy use, including losses. The energy efficiencies of the various systems are determined using accepted engineering computational techniques. Typically, simplified tools are used in the standard energy audit to develop baseline energy models and to calculate the energy savings of energy conservation measures. Among these tools are the degree-day methods and linear regression models. The step-by-step approach of the standard energy audit is very similar to that of the detailed energy audit.

Specifically, the detailed energy audit includes the use of instruments to measure energy use for a whole building, as well as its energy subsystems (Krarti, 2011). Handheld and clamp-on instruments can be used to determine the variation of some building parameters such as the indoor air temperature, luminance level, and electrical energy use. Sensors and smart meters are typically used and connected to a data-acquisition system so that measured data can be stored and accessible remotely. Computer-based simulations are also accepted by many studies as a tool for evaluating building energy. There are many different types of computer-based simulation tools that are available for performing whole-building simulation. The simulation programs can typically provide the energy use distribution by load type (i.e. energy use for lighting, boilers, and chillers). They are often based on dynamic thermal performance of the building energy systems, and for the most part, require a high level of engineering expertise and training. Recommendations initially made by experts through traditional energy audit approaches can be evaluated in the "virtual environment" in order to determine the best solution to achieve the goal of the facility managers (Zhu, 2005).

Energy Indicators

In order to accurately compare the energy use of like-buildings, or track a particular facility's resource consumption from year to year, energy indicators or measurements are typically needed (Conti, Hammarsten, Mahajan, Schieroni, & Zabot, 2012) The knowledge of building energy indicators (EIs) provides quick and useful information about the energy performance of building operations. Building owners, managers, and administrators can utilize this information to enhance the energy efficiencies of their properties and attract new businesses from local markets. The decision to continue with more extensive data collection and analysis should be based on a comparison between calculated energy indicators and a target value. Consideration for target values is simply a function of the situation at hand. When energy indicators are used to measure the general performance of a building, it may be appropriate to give the target values as a function of shape factor, degree-days, age, type of building, and type of heating system used. By comparing the indicators of a specific building with these references or target values, an energy-saving potential can be estimated. It can then be determined whether or not further action to improve building performance is worthwhile. Therefore, energy indicators play key roles in the process of rating buildings during an energy audit.

An energy indicator should be easy to calculate and highly correlated with some important aspects of the energy performance of a building or a set of buildings (Conti et al., 2012). It is not necessary that the indicator be a direct measure of some physical parameter associated with the energy balance of a building. It can derive its meaning through correlations with an intermediate parameter, which in turn, may be dependent on other quantifiable building specifications. The need for energy indicators in benchmarking practices has been recognized by auditors and building managers alike for quite some time. Fairly extensive efforts at the theoretical level have provided a number of acceptable and possibly useful energy indicators.

An appropriate indicator used in the evaluation of a building's energy efficiency is the energy use intensity (EUI) (EIA, 1994). Energy intensity is a term used to express the ratio of energy consumption to a measure of the demand for energy services. A common measure of energy intensity is the ratio of the amount of energy consumed for the building as a whole, or for a particular end use to the square footage of a building's floor space. The EUI, expressed in British thermal units (BTU) per square foot per year, is calculated by converting annual usage of electricity and consumption of all fuels to BTUs, and then dividing by the area of the building (Reyes et al., 2006). Compared to the benchmark for the building type being audited, the EUI is an accurate measure of the relative potential for energy savings. For instance, a relatively low EUI points to less potential for large energy savings. By simply monitoring the EUI based on a rolling twelve-month block of utility bills, the performance of a building can be assessed in terms of decreasing or increasing energy-use trends. However, a more precise measure of energy intensity would most likely consider the building's operating hours and climate. Taking these factors into account allows the energy intensities of buildings to be compared, even though the buildings are of different operating hours. The figure below displays the source EUIs of fire stations within Washington, D.C. in comparison to the national average source EUI (for fire stations).

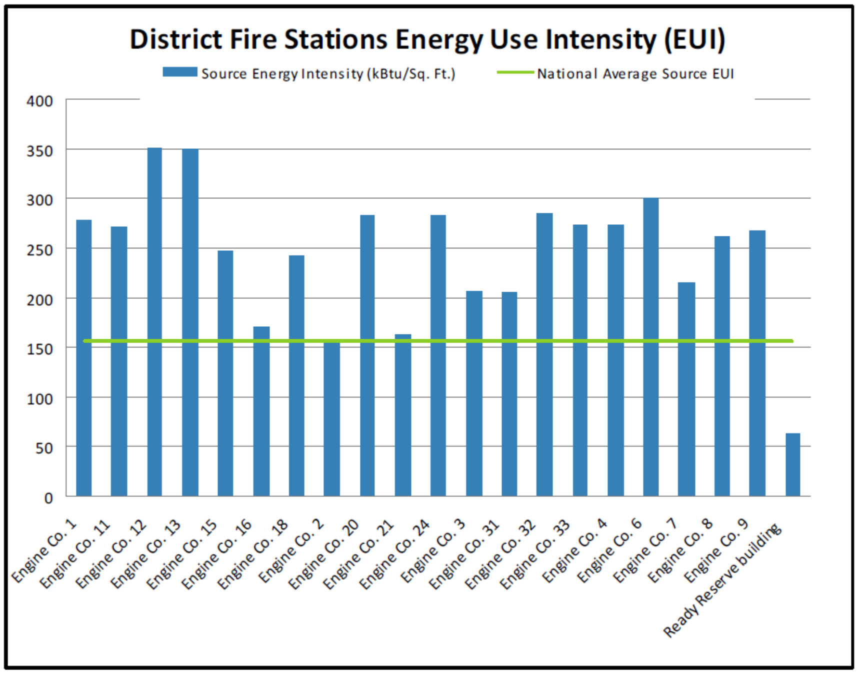

Figure 2.2-3: Comparing the EUIs of District Fire Stations (DDOE, 2010)

Another important indicator to consider during audits is the load factor (LF), which relates electric demand and electric use (Reyes et al., 2006, p. 13). The loading factor is derived by dividing the monthly electric use by the demand, and then by the number of hours in the billing period. This yields a ratio of average to peak energy demand, and therefore indicates the cost-savings potential of shifting some electric loads to off-peak hours. A low LF indicates that a building experiences substantial peak demand at some time in the billing period, relative to the average demand during the billing period. It is critical to monitor LF and determine standards for each facility, watching out for deviations in the normal pattern of electric use and LF. Facility management could restrict operation of non-essential equipment during peak demand periods, shifting their schedule of operation to off-peak hours.

2.2.2 Rating Systems

Rating a building's energy performance has become an increasingly important aspect of building operation (Lamberts, Meier, & Olofsson, 2004). Most energy auditing practices implement rating protocols to evaluate the level of energy efficiency in a particular facility. These ratings provide a quantitative means for benchmarking the energy efficiency of specific buildings against the energy performance of similar facilities. A highly rated building may be eligible for special recognition through a range of voluntary or compulsory programs, which increases its resale value and rental income. Energy rating and certification systems help recognize green buildings in local markets and are used to inform the public about the environmental benefits of a particular property. In addition to establishing transparency in the market, these rating systems also disclose the additional innovation and design efforts that facility managers invest to achieve a high performance building. The process of rating facilities based on their energy security and sustainability can be a powerful means of differentiating the best and poorest energy use practices.

In order for the energy performance rating to serve as a valuable management tool, it must provide an accurate and equitable assessment of a building's energy performance (ENERGY STAR, 2011). To achieve these objectives, most building performance ratings must meet the following criteria: evaluate energy performance of whole building, reflect actual billed energy data, normalize for operation, and provide a peer group comparison. Rather than examining specific pieces of equipment within a building, a whole building metric accounts for the interactions among the various system components. For example, a particular HVAC system may be designed with efficient components, but if it is over-sized relative to the actual heating and cooling loads it will not perform efficiently. A robust analysis, for this reason, will need to account for energy use of the whole building. The rating must also reflect the actual billed energy consumption at a building. It cannot be based on predicted or simulated energy use, as simulations often fail to account for the impact of building operation and maintenance patterns. In addition, the rating cannot introduce bias with respect to the operating constraints at the building. The rating must normalize correctly for operational characteristics that define the building activity. These characteristics may include the required hours of operation or number of occupants. To provide a useful benchmark, the rating must also provide a meaningful comparison to the building's peer group. A given building's peer group is defined by those buildings that have the same primary business function (e.g. retail store), and similar operating characteristics. In order to achieve this goal the rating must be based on an analysis of national data that accurately reflect the distribution of energy use for each building type.

Most rating programs have been rather small, penetrating less than one percent of the building stock (Lamberts, et al., 2004). Recently, however, much larger programs have been launched. The U.S. Environmental Protection Agency (USEPA) has residential and commercial building programs already involving thousands of buildings across the United States. The European Union (EU) proposed measures to promote energy efficiency of buildings, which includes finding methods for estimating the building energy consumption, limits of maximum energy use in new and retrofitted buildings, energy rating and regular inspections of boilers and HVAC-systems. Different approaches for rating the energy use in buildings have been developed over the last twenty years, all of which rely on extrapolations from short term, in-situ measurements.

ENERGY STAR

ENERGY STAR (2013a) is a USEPA voluntary program that helps businesses and individuals save money and protect our climate by integrating a superior energy efficiency label and rating system. The program was established by the USEPA in 1992, under the authority of the Clean Air Act Section 103(g). Section 103(g) of the Clean Air Act directs the Administrator to "conduct a basic engineering research and technology program to develop, evaluate, and demonstrate non–regulatory strategies and technologies for reducing air pollution". The ENERGY STAR program is now jointly operated by both the United States Department of Energy (USDOE) and USEPA. The ENERGY STAR program was established to identify and promote energy efficient products and buildings in order to reduce energy consumption, improve energy security, and reduce harmful emissions (Sanchez, 2008). ENERGY STAR is able to pursue this mission statement by voluntary labeling products and buildings that meet the highest energy efficiency standards. The use of ENERGY STAR labeled products is projected to save a significant percentage of the US energy supply, in hopes that the program retains full governmental support.

The EPA rating system was originally released for Office Buildings in 1999 and since then has expanded to include a variety of other building types including banks, courthouses, data centers, dormitories, hospitals, retail stores, schools, and even supermarkets (ENERGY STAR, 2011). The figure below shows the range of building types covered by the ENERGY STAR rating protocol, as well as the information required to calculate each of their performance ratings.

Information	*Offices*	*Schools*	*Grocery*	*Hospitals*	*Hotels*	*Dorms*	*Warehouses*	*Medical*
ZIP Code	x	x	x	x	x	x	x	x
Gross floor area	x	x	x	x	x	x	x	x
Weekly operating hours	x	x	x				x	x
Number of occupants	x							
Number of students		x						
Number of workers								x
Main shift staffing			x				x	
Number of personal computers/registers	x	x	x					
Number of licensed beds				x				
Number of floors			x	x				
Number of rooms					x	x		
Number of months in operation/year		x						
Percent air-conditioned		x				x	x	x
Percent heated		x				x	x	x
Number of walk-in freezers/coolers			x				x	
Number of refrigerated/freezer cases			x					
Presence of tertiary care				x				
Presence of above ground parking				x				
Presence of on-site cooking		x			x			
Presence of mechanical ventilation		x						
Presence of on-site cooking facilities			x					
Presence of HID or halogen lighting							x	

Figure 2.2-4: ENERGY STAR for Buildings Information Required (Glazer, 2006)

The ENERGY STAR rating system, also known as the National Energy Performance Rating System, is now available for about 60% of the commercial building square footage across the US. EPA continuously reviews the rating system and updates it as new data and techniques become available. The ENERGY STAR rating protocol is based on matching the actual energy use of a building against a statistical distribution of buildings (Glazer, 2006). Building managers can simply access the ENERGY STAR web site and use Portfolio Manager to benchmark their existing building performance without paying a fee. The rating is described on a scale of 1 to 100 and a score of 75 or greater for a facility may make it eligible to receive the ENERGY STAR Label for Buildings. The score is based on where the building fits in the distribution of energy use for similar buildings based on source energy. It indicates the percent of comparable facilities nationwide that are less efficient. For most building types, the data is from DOE/EIA's Commercial Buildings Energy Consumption Survey (CBECS) but data sets from Electric Power

Research Institute (EPRI) and the Hospitality Research Group are used for hospitals and hotels, respectively.

The traditional approach to rating a building's energy performance is known as operational rating (Gromer, 2013). The ENERGY STAR performance rating is the best, well-known example of an operational rating. These types of rating evaluate a building's energy performance based strictly on how it is operating, not on how it is designed. Operational ratings are based purely on a building's actual energy use. An operational rating normalizes that energy use by basic factors such as building size, weather, and building type so that the energy use of different building types can be compared accurately. Because of the normalization, operational ratings make it easy to compare the performance of different buildings throughout a large portfolio of buildings.

LEED

Leadership in Energy & Environmental Design (LEED) is a rating system for the design, construction, operation, and maintenance of green buildings, homes, and neighborhoods (USGBC, 2013a). Developed by the U.S. Green Building Council (USGBC) in the year 2000, LEED is intended to help building owners and operators find and implement ways to be environmentally responsible and resource-efficient. Although it is a relatively new system, it has been adopted by eighteen states and fifty-nine cities, along with some designers, architects and building owners. There are currently four levels of LEED certification: Certified, Silver, Gold, and Platinum (LEED, 2013). Each level represents the degree of sustainability a building can achieve, with Platinum classified as the highest level of recognition.

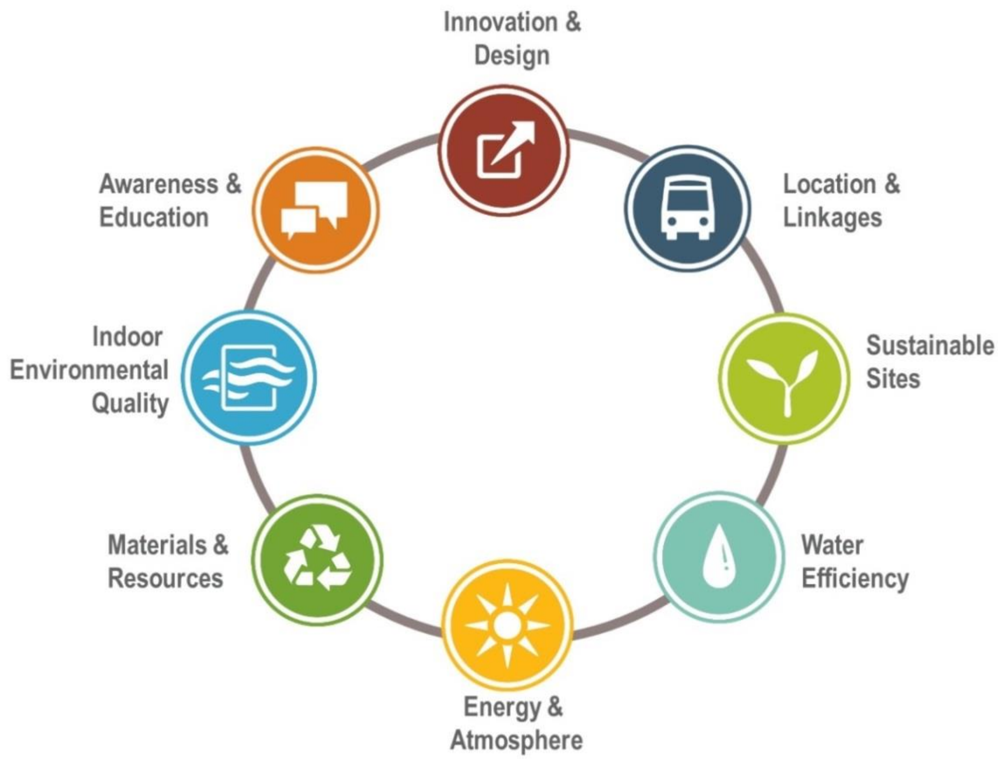

Figure 2.2-5: LEED Rating Elements (USGBC, 2013b)

In the LEED system, as displayed in the above figure, a building is rated on eight key elements: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Material & Resources, Indoor Environmental Quality, Awareness & Education, Location & Linkages, and Innovation & Design Process. Buildings that successfully incorporate these elements are deserving of a higher efficiency rating. Points given to each element are varied from the type of building, such as commercial or residential, and also from the state of building, such as existing renovation or new construction. LEED certified buildings are intended to use resources more efficiently when compared to conventional buildings simply built to code. In addition, LEED certified facilities often provide healthier work and living environments, which contributes to higher productivity and improved employee health and comfort. LEED is not to be considered a performance measurement tool, but rather, a design tool used to address best practices for energy maintenance and upfront environmental planning. The LEED rating system has been developed and continuously modified by workers in the green building industry, especially in the ten largest metro areas in the U.S.

The USGBC LEED rating system, which is commonly used in commercial buildings, is an example of a high-profile asset rating system. A building asset rating evaluates how efficiently a building is designed, not how efficiently it is operating (Gromer, 2013). Rather than focusing on energy use by occupants, as with most operational ratings, an asset rating evaluates the building itself based on physical characteristics. Those characteristics include the building envelope and electrical and mechanical systems. By focusing on these built-in characteristics, an asset rating reveals a building's intrinsic energy performance, separate from how it is operated. It judges how the building should perform, not how it actually performs. In other terms, an asset rating is the building equivalent of the EPA mileage sticker.

ASHRAE

The American Society of Heating, Refrigeration, and Air-Conditioning Engineers (ASHRAE) has developed the Building Energy Quotient (bEQ) (2013a), a rating system that includes information tools to help building owners achieve their energy use goals. It is specifically designed to identify factors causing the gap between a building's design potential and its actual performance in operation. The bEQ's two ratings, *In Operation* and *As Designed*, apply easily understood scales to compare a commercial building's energy use with similar buildings.

New buildings will be eligible to receive an *As Designed* rating – an *In Operation* rating will be available once the building has at least one year of data on the actual energy use of the building (ASHRAE, 2013). Existing buildings would be eligible to receive both an *As Designed* and *In Operation* ratings. The *As Designed* (asset) rating provides an assessment of the building based on the components specified in the design—including mechanical systems, building envelope, orientation, and day lighting. The asset rating will be based on the results of a field inspection and a building energy model. The *In Operation* (operational) rating provides information on the actual energy use of a building and is based on a combination of the structure of the building and how it is operated. Information learned through subsequent years of operational labels can provide building owners and operations and maintenance staff with valuable insight into how the building performs, opportunities for improvement, and where similar buildings fall in comparison. The figure below is the bEQ dashboard for a sample building. The dashboard displays the *As Designed* and *In Operation* ratings, as well as the information needed to generate these ratings. Comparing the *As Designed* and *In Operation* ratings on the same scale is useful in determining whether or not a building is using energy efficiently.

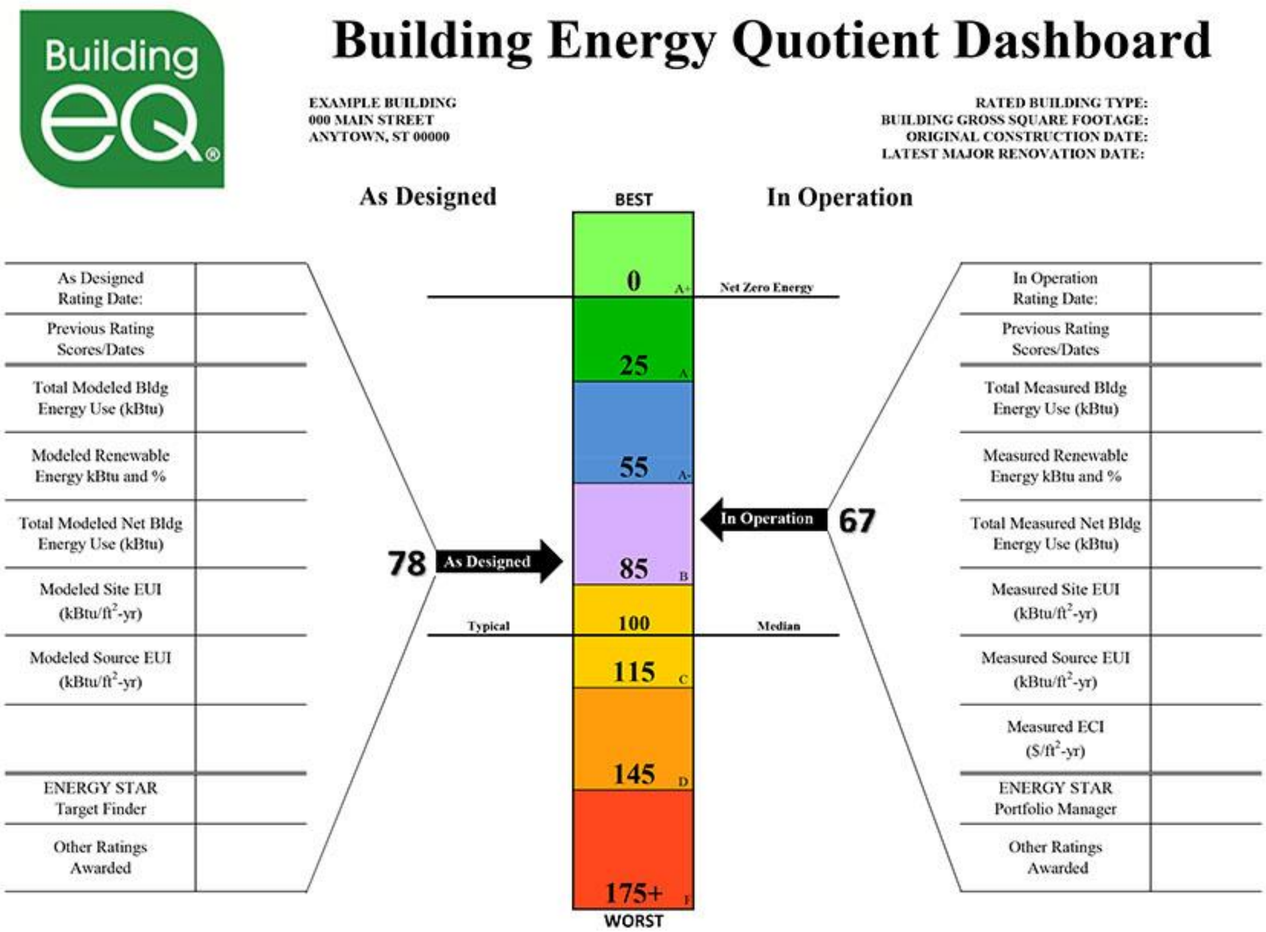

Figure 2.2-6: Building Energy Quotient Dashboard comparing the As Designed and In Operation ratings for a particular facility (bEQ, 2013b)

International Rating Systems

In addition to the programs available in the United States, there are many international organizations interested in implementing similar energy benchmarking practices by rating and publicly disclosing the energy performance of new and existing buildings. For example, the Australian Building Greenhouse Rating (ABGR) (Green Wiki, 2013) is targeted towards developers, owners, and tenants of commercial and office buildings. ABGR rates a building's energy usage performance on a scale between one and five stars, with five stars representing exceptional energy performance (and three stars representing the current market average). It is administered nationally by the NSW Department of Energy Utilities and Sustainability (DEUS) and applies to both new and existing buildings. The scheme is intended to be an Australian national approach to benchmark the “greenhouse” performance of buildings and tenancies to other buildings within the same state. The rating is derived from the actual amount of annual consumption of energy.

Existing buildings can be initially rated using a free, on-line assessment tool, based on one year of energy consumption data and other information such as occupancy rates, leasable area, equipment used and hours of operation (Green Wiki, 2013). For new buildings and refurbishments, the ABGR scheme provides for a commitment agreement, whereby the developer agrees to design, build and commission the proposed building to 4, 4.5 or 5 star rating. This commitment then allows the developer to market the proposed building to prospective tenants who value high environmental performance, such as government departments. Upon completion of the building, the building’s actual energy performance is monitored for one year.

In Montreal, Canada, an energy rating system for existing houses was proposed, combining the information from utility bills with on-site measurements and computer simulations and was tested on a sample of forty-five houses (Lamberts et al., 2004). The method is used to assign an index of performance in terms of the annual heating energy consumption or cost, but also to recommend a goal for a lower, technically feasible, heating bill. The philosophy was to increase the awareness of the owner by a presentation of the actual energy performance compared to that of reference houses, but also of potential savings through renovation or changed habits of users.

Platforms for Managing Energy Data

There are also several data acquisition platforms available online that help building managers track their monthly energy consumption. EnergyCAP, USEPA ENERGY STAR Portfolio Manager, and Arch are just three of several widely recognized data acquisition platforms used to collect and analyze the energy use data of facility HVAC and lighting systems.

With online and installed software for organizations of any size, the EnergyCAP (2013) software delivers powerful utility bill tracking, reporting, analyzing, auditing, and benchmarking. It also provides services including implementation, cost recovery analysis, training, and support services. The EnergyCAP software utilizes a Buildings & Meters Tree View to display an organization's hierarchy consisting of organizations, buildings, and meters. The figure below displays the Buildings and Meters tab in the EnergyCAP software, which provides a total cost summary, energy cost percentage, and daily average costs for a portfolio of sample buildings.

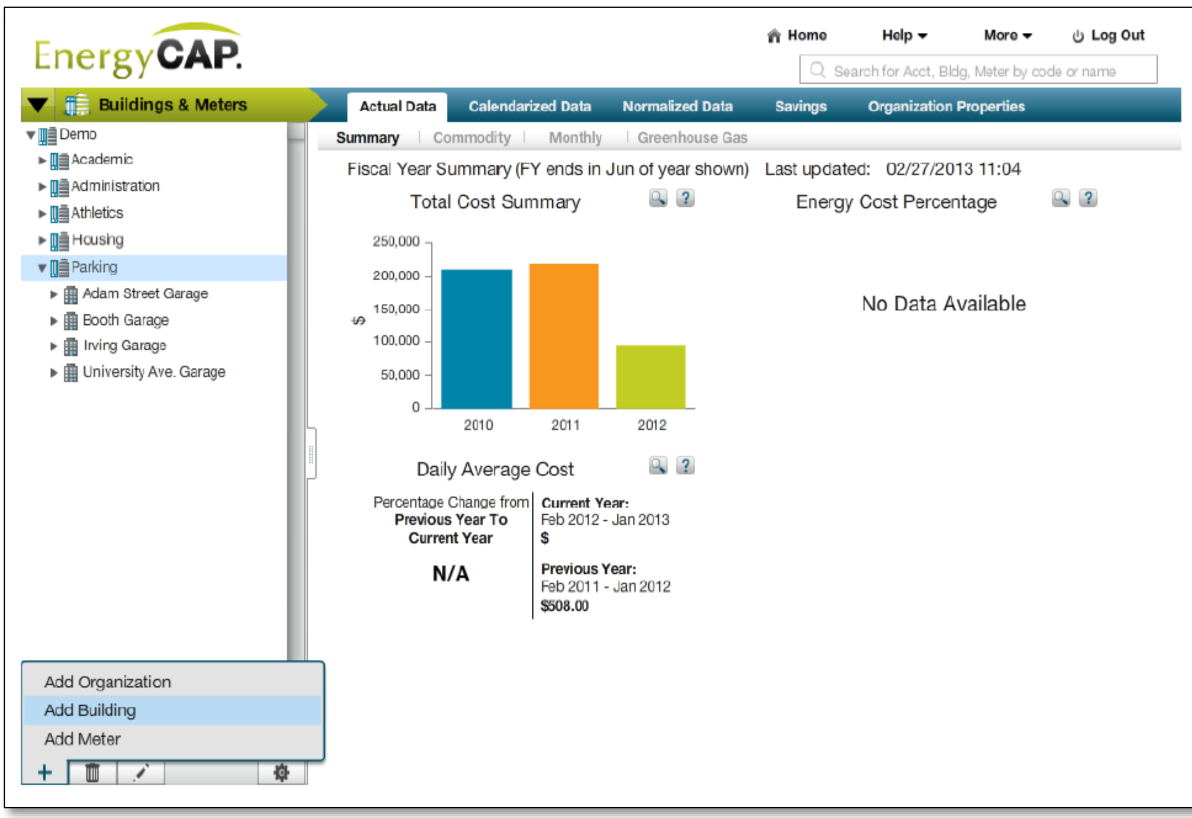

Figure 2.2-7: EnergyCAP's Buildings and Meters Tab (EnergyCAP, 2013)

Creating a hierarchy allows energy data to be easily reported on, specifically showing Power Views and other data that is aggregated at each node level. This kind of organization makes it easy for organizations that have regional divisions, for instance, to quickly see the energy use and expense for each region. Individual billing data can always be viewed at the meter level, while aggregated energy usage and cost data can be displayed at each Building or Organization node, including the entire organization by using the highest node. Within the Buildings & Meters section there are numerous views of data that all relate to Organizations, Buildings or Meters. The Actual Data tab lists various sub-tabs that display actual bill data into yearly totals, monthly breakdowns, GHG emissions and other trend-type charts. The Calendarization tab displays similar data to that of the Actual Data views, but adjusted in a way that statistically breaks the data into calendar months based on weather. The Normalization tab displays similar data to that of the Calendarized Data views, further adjusted to show what energy usage trends would look like if outside weather was not a factor. Fortunately, the EnergyCAP software also interfaces with the EPA ENERGY STAR Portfolio Manager, allowing building managers to utilize energy use data from EnergyCAP to generate performance ratings for their buildings.

The Portfolio Manager is considered the most sophisticated among the web-based rating methods. It is the tool of choice among cities such as New York, Seattle, and Boston that have passed mandatory benchmarking laws (ENERGY STAR, 2013h). Not only that, but Portfolio Manager is used by the Canadian Government as the platform for their national energy benchmarking program for existing commercial and institutional buildings. Within the Portfolio Manager database, individual building spaces are defined, each with parameters that depend on the type of space (Glazer, 2006). Utility energy consumption can be entered on a monthly basis in units of kWh. Users are encouraged to input a long-term history of energy use data to help them monitor changes in building performance on a yearly basis. Multiple facilities' energy use data can be entered and managed within the web site simultaneously, which can be advantageous for managers overseeing a large number of buildings. The figure on the following page is the facility summary page within the Portfolio Manager, which displays the current rating for the building and lists the space names and meter names. If the building were just being rated for the first time, the user would need to add spaces and meters.

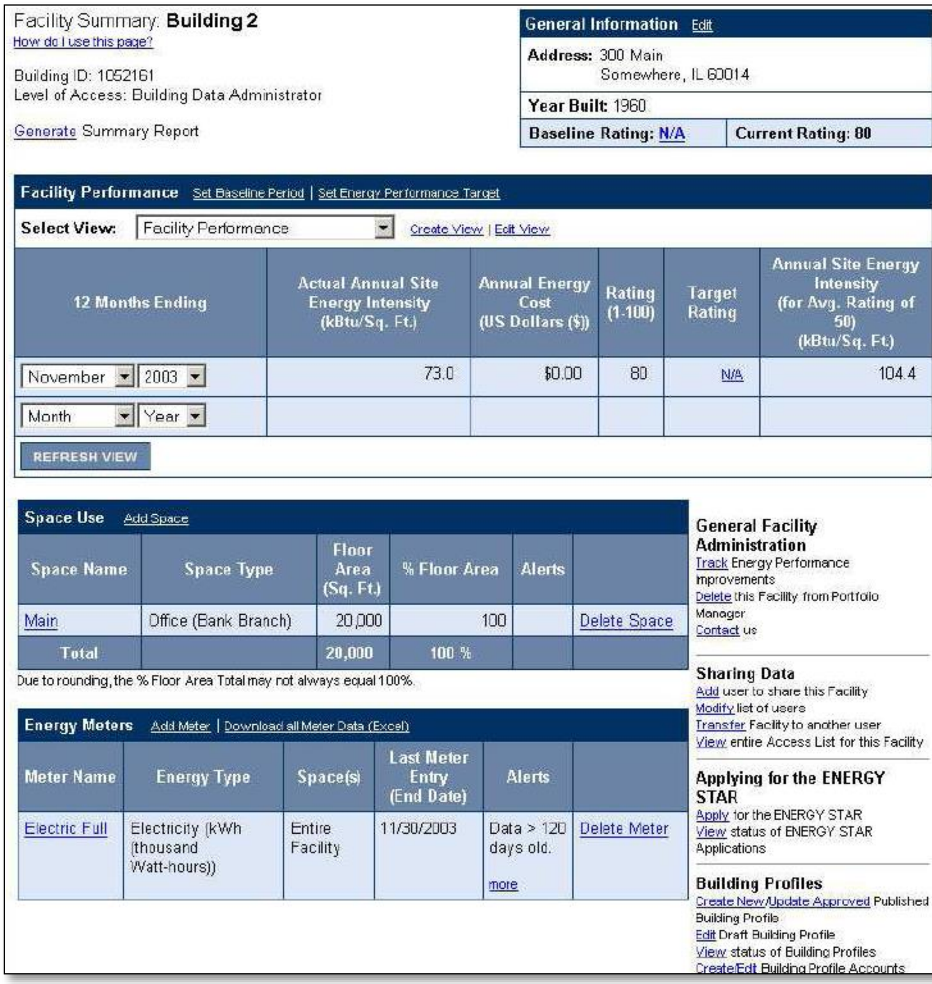

Figure 2.2-8: ENERGY STAR Portfolio Manager Facility Summary Page (Glazer, 2006)

In Arch, the buildings actual total energy use is divided by the gross floor area of the building, becoming the end-use intensity. The EUI of the building is displayed on a histogram graph that shows the frequency of EUI's for buildings in the respective databases for that type of building (Glazer, 2006). The graph also shows the cumulative fraction of buildings with an EUI below a given value so that a percentile value can be determined. This approach of showing the building EUI against uncorrected and unadjusted data from a database provides a very direct understanding to the user of the protocol. Arch is available on the Lawrence Berkeley National Laboratory (LBNL) web site for use by anyone at no charge. No registration is required to use the service and results are delivered in a few seconds. Unfortunately, completely understanding of the output requires some experience with graphs, statistics, and building energy analysis.

2.3 Energy Labeling

To bring the idea of energy efficiency to the convenience of mankind for energy saving, energy labeling has been a great way to help people measure and set the standards for energy efficiency in buildings, home appliances, public facilities, and industrial equipment. Appliance energy labeling and building energy labeling are two main categories of energy performance labeling systems on the market. Programs like ENERGY STAR set standards with their rating systems to give its certification label on a well-defined scale to help public understand more about energy efficiency. Energy labeling is a great way to deliver people with energy performance information and is getting increasingly useful for promoting energy savings. This section introduces different appliance energy labeling programs and building energy labeling programs on the current world market, with a concentration in US.

2.3.1 Appliance Energy Labeling

Energy labeling programs are used to provide people and organizations with useful energy performance and energy efficiency information of different facilities and appliances. ENERGY STAR (2013a) Label and EU (European Union) Energy Label are two of the most widely recognized energy programs in the world with their own rating and labeling systems. As section 2.2.2 mentioned, ENERGY STAR is a USEPA voluntary program that helps businesses and individuals save money and protect our climate through superior energy efficiency. The EU Energy Label provides abundant rating systems for appliances. EnergyGuide Label is one of the subprograms of ENERGY STAR which provides more specific information of rating and labeling on various categorized appliances. LED Lighting Facts of USDOE is a rating and labeling platform for LED and lighting manufacturing companies and their products. These appliance energy labeling programs all contribute to make energy efficiency feasible for a variety of companies and customers.

EU Energy Label

The EU Energy Label is an energy labeling program which helps consumers choosing products which save energy and thus money (European Commission, 2013). The program also provides incentives for the industry to develop and invest in energy efficient product design. In EU Energy Label system, the energy efficiency of the appliances are rated in terms of a set of energy efficiency classes from A to G on the labels, A being the most energy efficient, G the least efficient. The labels also provide other useful information such as technology specifications regarding energy use to the customer as they choose between various models. As technology develops, appliances are being increasingly energy efficient, for example the EU Energy Label adjusted its rating system with A+, A++, and A+++ added for those energy efficiency leading products. The EU Energy Label, widely implemented in European market, is an effective labeling program with many well-defined energy efficiency rating scales for various appliances, yet is still taking its actions and adjustments to improve as technology develops.

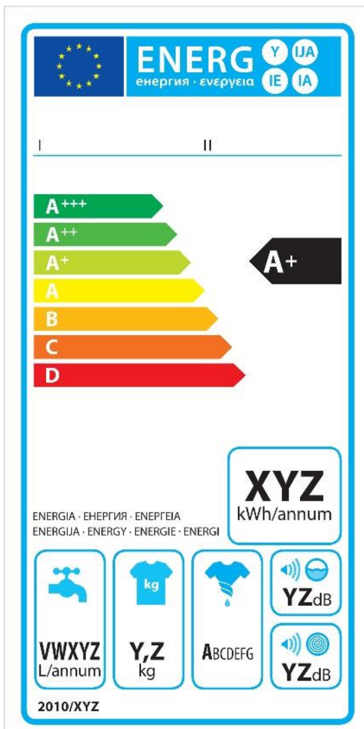

Figure 2.3-1: The new EU Energy Label Layout (European Union, 2013)

ENERGY STAR Label for Certified Appliances

ENERGY STAR originated as a US national energy efficiency rating program run by the EPA and the DOE, now is an international program for energy efficient consumer products. Based on ENERGY STAR's rating systems, devices carrying the ENERFY STAR service mark, such as computer products and peripherals, kitchen appliances, buildings and other products, generally use 20–30% less energy than required by federal standards. The ENERGY STAR label is being implemented throughout the world as a certificate of qualified energy efficient products.

Figure 2.3-2: ENERGY STAR Certified Product (shopExact, 2012)

EnergyGuide Label

Energy Guide Label, as one of the many products of ENERGY STAR (2013c), is commonly seen on different home appliances and cars in the US. All major home appliances must meet the Appliance Standards Program set by the USDOE. Manufacturers must use standard test procedures developed by USDOE to prove the energy use and efficiency of their products. Test results are printed on yellow EnergyGuide label, which manufacturers are required to display on many appliances. This label estimates how much energy the appliance uses, compares energy use of similar products, and lists approximate annual operating costs. An ENERGY STAR qualified appliance must carry the EnergyGuide label.

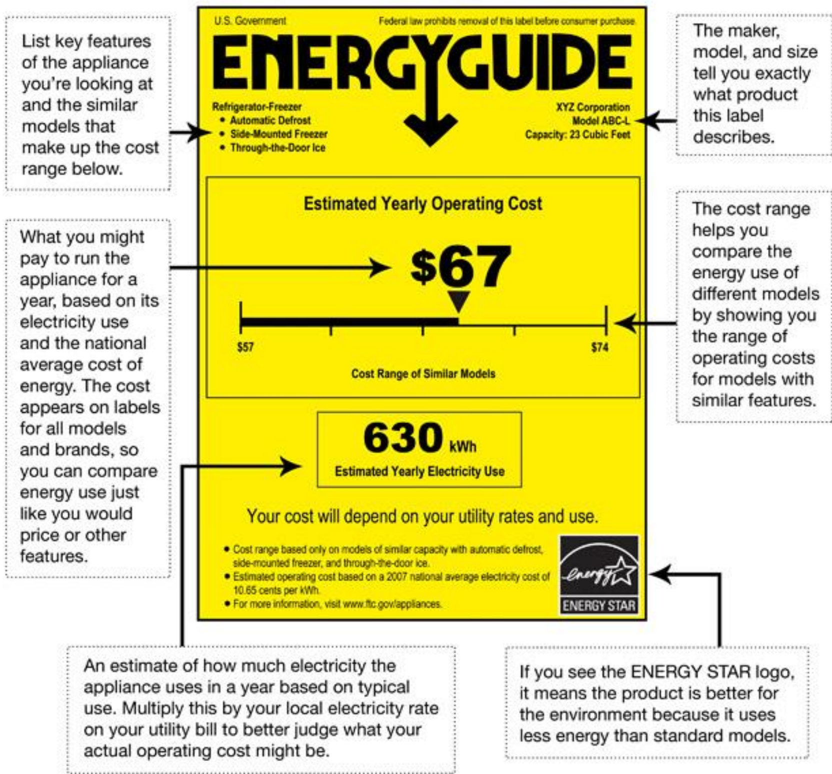

Figure 2.3-3: EnergyGuide Label Example (SCE, 2013)

Lighting Facts Label

The LED Lighting Facts (2013a) is a program of the USDOE that showcases LED products for general illumination from manufacturers who commit to testing products and reporting performance results according to industry standards. LED lighting products that have received a Lighting Facts label with verified performance information are rapidly increasing. The Lighting Facts label provides a good example of how specific and professional a labeling program is and what would make the label brief and essential for customers to easily understand what the label indicates.

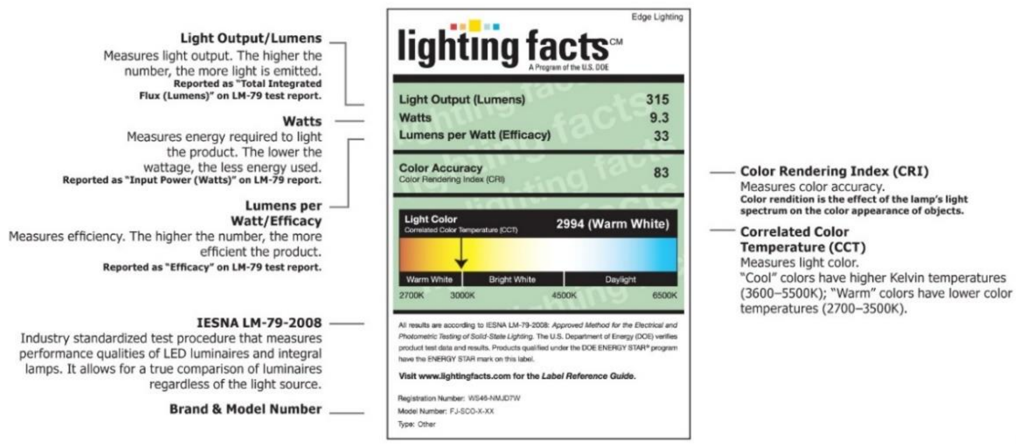

Figure 2.3-4: Lighting Facts Label (Lightology, 2011)

2.3.2 Building Energy Labeling

In order to raise people's awareness for building energy efficiency and promote building managers to take action for improving building energy performance, after building energy benchmark, building energy labels are always used as an expression for the benchmark. From an international perspective, the ASHRAE building Energy Quotient and ENERGY STAR rating and labeling are widely implemented in Europe and North America. From a local perspective in US, other than ENERGY STAR and LEED, the EPL (Energy Performance Label) for buildings developed by AIRE (Arlington Initiative to Rethink Energy) has been implemented in Arlington, VA.

ENERGY STAR Label for Certified Buildings

ENERGY STAR (2013d), as it certifies energy efficient home appliances, also certifies energy efficient buildings including commercial, industrial, and residential buildings. On a scale of 1 to 100 provided by ENERGY STAR from least energy efficient to most energy efficient in terms of the buildings' energy performance rating, only buildings with a score of 75 or higher are eligible to apply for ENERGY STAR certification. However, before the Certification is awarded, a Professional Engineer (PE) must perform a site visit, verify data, and complete an application for the certification. ENERGY STAR certified facilities now represent nearly $1.5 billion annually in savings and prevent 25 billion pounds a year of greenhouse gas emissions when compared to typical facilities. The certification is given on an annual basis, so a building must maintain its high performance to be certified year to year. And the information submitted in the certification application must be verified by a licensed Professional Engineer (PE) or Registered Architect (RA) to be eligible for approval.

Figure 2.3-5: ENERGY STAR Certified Building (ENERGY STAR, 2013g)

LEED Building Certification Label

LEED certification (Sarah, 2013) provides independent, third-party verification that a building, home or community was designed and built using strategies aimed at achieving high performance in key areas of human and environmental health. The LEED rating system has four levels of certification: Certified, Silver, Gold, and Platinum. Over 7,000 buildings in the United States and many other countries have achieved LEED certification since it became available in 1993.

Figure 2.3-6: LEED Certification Label (Sarah, 2013)

ASHRAE bEQ Label

As introduced in 2.2.2, the ASHRAE bEQ (Building Energy Quotient) rates buildings by using both *As Designed* and *In Operation* methods. As a result of the rating, the example ASHRAE bEQ Label shown below displays both *As Designed* and *In Operation* ratings of the building.

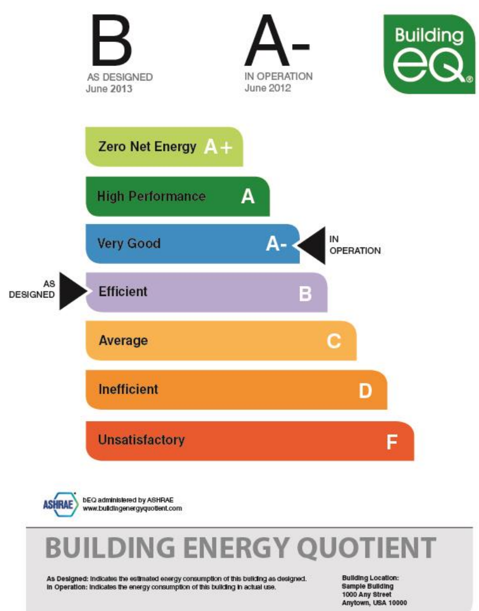

Figure 2.3-7: bEQ Label (Arnold, 2013)

To receive an *As Designed* rating, building owners must engage the services of professionals who have earned the ASHRAE-Certified Building Energy Modeling Professional (BEMP) designation. For instance, the building on this label has an *As Designed* rating of B, which refers as “Efficient” by June 2013. To receive an *In Operation* rating, building owners must engage the services of professionals who have earned the ASHRAE-Certified Building Energy Assessment Professional (BEAP) designation. For example, the building on this label has an *In Operation* rating of A-, which refers as “Very Good” by June 2012.

Arlington County Energy Performance Label

To help consumers understand the energy efficiency of buildings that they use, Arlington had decided to post Energy Performance Label (EPL) which act much like a mile per gallon label for buildings (Altavilla, 2012). EPLs were posted in 2011 in offices and libraries, and by July 1st, 2012 Arlington County had labeled 38 offices, libraries, community centers, and fire stations. Arlington hopes that these labels will advance conversations with the public about energy use.

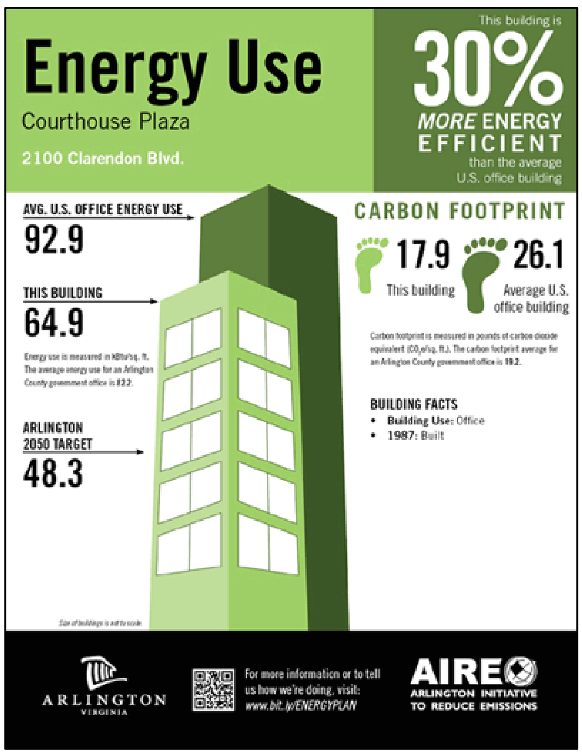

Figure 2.3-8: Arlington EPL (ARLnow, 2011)

The County developed its own label as part its ongoing Arlington Initiative to Rethink Energy (AIRE) program and to implement one of the first steps of its adopted draft Community Energy Plan, but Arlington looks forward to a standardized regional or national label to help consumers understand utility use across all building types. Energy performance labels are not a new idea, but Arlington is one of the first to implement them in the US. It sounds simple, but EPLs are a foundational step to get everyone to think about building energy use below the surface.

2.4 Adoption of Energy Efficiency Programs in the City of Alexandria

The City of Alexandria (2013a) has a long tradition of leadership in community environmental and energy action. In 2009, the Alexandria City Council adopted the Eco-City Alexandria Charter establishing guiding principles for environmental sustainability for the Alexandria community. In 2011 and 2012, the Alexandria City Council adopted the City's Environmental Action Plan 2030 and Energy and Climate Action Plan, respectively. As a result, the Office of Energy management was formed to manage the City's energy use and implement energy efficiency, energy conservation, and clean energy solutions in City operations, and to reduce the City's greenhouse gas emissions.

2.4.1 Energy Efficiency Programs in Alexandria

The City of Alexandria (2013b) Office of Energy Management has been working on projects related to Alexandria Climate Change Initiatives, Energy Reduction, and Green Energy, etc. For instance, the Green Building Resource Center (GBRC) is one of the City's latest Eco-City Alexandria initiatives, offering citizens and business owners' information on how to reduce energy and water consumption and operating costs by offering practical solutions to designing, building and maintaining their spaces in an eco-friendly manner.

Community Energy Planning

Community Energy Planning (CEP) is a process to address energy security and environmental challenges with policies and practices that systematically integrate energy efficiency, heat recovery, use of multiple energy sources including renewable energies, flexible energy distribution, transportation, and land uses to create a sustainable community (NVRC, 2013). One of the implementations of CEP is the Virginia Local Energy Alliance Program (LEAP) (2013). It offers Home Performance with ENERGY STAR program, which helps homeowners to achieve at least 20% energy savings, which they see in lower energy bills and living in a healthier, more comfortable home.

Beatley Library Solar Energy Project – A Building Energy Efficiency Practice

On July 31, 2012 the City of Alexandria (2012) and the Alexandria Library began installation of solar panels at the Beatley Central Library at 5005 Duke Street. Made possible by an American Recovery and Reinvestment Act Grant from the US Department of Energy, the solar panel project is the first on a City building and supports the vision of the City's Eco-City Charter and Environmental Action Plan goals.

Figure 2.4-1: Beatley Library Solar Energy Project (McLoone, 2012)

Converting sunlight to energy, the 42.3 kilowatt system features 180 solar panels that spread across each of Beatley's five signature roof peaks. Due to its large, south-facing roof sections, the Beatley Central Library is an ideal building, as it easily collects sunlight. The solar panels will help offset a portion of its electricity consumption, reduce the City's greenhouse gas emissions and reduce the building's "peak demand" energy usage--the highest demand of energy consumption during a period. Standard Solar was chosen as the contractor.

2.4.2 Energy Efficiency Gaps in the City of Alexandria

The City of Alexandria has been improving its energy performance by a variety of programs as mentioned in 2.4.1. However, the building energy management system in the City of Alexandria is still under development. The city had been collecting its buildings' energy performance data especially utility bills, since 2005, but there hasn't been any building energy benchmark done based on these data yet. Therefore, with the well-developed database, the City of Alexandria decided to develop an energy rating system, an energy label, and an energy benchmarking standardized procedure to improve its buildings' energy efficiency performance in the future.

First of all, the City of Alexandria Office of Energy Management wishes to implement innovative practices, policies, and programs to rate and disclose the energy performance of both public and private facilities/operations within the Alexandria community. Such rating and disclosure would provide valuable information to constituents and consumers and spur market development for energy efficient facilities/operations. Since such rating systems haven't been established yet, it is necessary for the City of Alexandria Office of Energy Management to develop this rating system for future energy efficiency to become more wide spread. Secondly, the City of Alexandria now doesn't have an energy performance label which displays and practices energy efficiency within its public facilities and operations. The City of Alexandria Office of Energy Management together with NVRC are trying to develop an energy performance label in the Northern Virginia Region including the City of Alexandria. The label should serve mainly two purposes. First, it should provide valuable energy efficiency ratings of buildings. Second, it should help raise people's awareness of being energy efficient in the buildings' operation. Third, it shall increase the energy operation transparency of government buildings in the region. Eventually, the City of Alexandria hasn't done any energy benchmark on its government buildings yet, so there is no standardized procedure for how to do energy benchmarking for buildings in Alexandria. With the energy performance database, the rating system, and the labeling program, it is necessary for the city to take the advantage of recording this benchmarking process. And the record of our benchmarking and labeling process could result in a big development of designing the standardized procedure for doing energy benchmarking in the City of Alexandria thus the whole Northern Virginia Region for future needs.

2.5 Summary

This chapter provides background information needed for understanding this report and implementing the products of our project. This information includes energy efficiency, energy benchmarking, energy labeling, and the adoption of energy efficiency programs in the City of Alexandria. The chapter also has identified specifically the key steps and benefits of carrying out an energy benchmarking plan and how the implementation of benchmarking practices can help building managers improve their understanding of energy consumption patterns. The process of benchmarking energy use in buildings enables managers to determine best practices that can be replicated and establishes reference points for measuring and rewarding exceptional performance. All the information included in this chapter serves as relatively current facts in order to support our project and help readers better understand this report.

3.0 Methodology

The primary goal of our project was to provide the NVRC with recommendations for improving the energy efficiency of both public and private facilities within the Northern Virginia region. With access to utility data collected by the Office of Energy Management, our group first focused on benchmarking the energy performances of government buildings and operations, specifically within the City of Alexandria, according to generally established processes and procedures. Following the completion of our data analysis, we composed a benchmarking report discussing the results, as well as the strengths and weaknesses of the City's approach to benchmarking building energy use. Based on best practices, we then proposed a benchmarking strategy designed to assist Northern Virginia jurisdictions in rating and disclosing the energy performance of their government facilities. Our group conducted interviews with local stakeholders focused on promoting energy efficiency in buildings to identify successful benchmarking practices and considerations. Ultimately, our proposed benchmarking strategy would be used to pinpoint government buildings with poor energy productivity and encourage those buildings to improve their operational habits. The implementation of our energy benchmarking plan would set new energy standards for the region's public spaces and potentially serve as a model for other local government agencies in addition to NVRC. We also prototyped a regional government building energy performance label for print and digital display in Northern Virginia's public facilities. The performance label was designed to disclose building energy use and inform public audiences about current levels of energy efficiency. Given our experience with government buildings, we then developed a plan for a voluntary, region-wide energy benchmarking and labeling program for privately-owned commercial buildings. In this chapter, we will introduce the methodologies that we used to achieve our goal in developing a successful energy benchmarking protocol for Northern Virginia communities.

3.1 Government Building Benchmarking in Alexandria

The first objective of our project was to conduct a building energy benchmark for the government facilities in the City of Alexandria. The benchmark was used to identify the range of energy efficiencies (from least to most efficient) among these government facilities. It was critical for our group to cover a variety of governmental building types in the benchmark to ensure that this range of efficiencies was representative of the overall public building performance in the city. Our group was able to utilize online data acquisition software to compare energy use and greenhouse gas emissions between the benchmarked facilities. Once our analysis was complete, we disclosed our results to the Office of Energy Management in the form of a benchmarking report to raise awareness about current levels of energy efficiency in Alexandria government buildings and determine the best practices for future rating and disclosure policies.

3.1.1 Collection and Analysis of Utility Data

The Office utilizes EnergyCAP software to track monthly energy consumption across their entire portfolio of government buildings. The buildings and meters managed within this portfolio include the Alexandria fire stations, public schools, parks and recreational centers, libraries, police department, and courthouse. Specifically, our group was responsible for benchmarking 41 of these government-operated facilities. To clarify, the benchmark did not cover every building and meter within the EnergyCAP portfolio – only the government facilities specified by the Alexandria Energy Manager, Bill Eger. Some building types were excluded from the benchmark due to a variety of complications in quantifying specific building parameters. In addition, buildings in the portfolio without at least 12 months of utility data were also excluded from the benchmark.

Once the selection process was complete, our group created accounts in ENERGY STAR Portfolio Manager for each of the 41 government buildings. As implied, we were required to collect a variety of building parameters for all of the facilities covered in the benchmark. The building parameters considered included space type, hours of operation, number of occupants, number of computers, percent heated, and percent cooled. These parameters were manually imputed in an Excel spreadsheet for organizational purposes and then transferred to the respective accounts in ENERGY STAR Portfolio Manager. Our group utilized several data sources to compile the parameters for each building. The Space Inventory Assessment Plan, provided by Baker and Associates, and the Geographic Analysis and Research Interface (GARI) were two of the primary data sources used to collect building parameters. Unfortunately, the data sources provided by the Office did not contain all of the parameters necessary to complete our benchmark. As a result, our group needed to make several assumptions to obtain these missing parameters.

Performances ratings were then given to most of the 41 government buildings using the Portfolio Manager tool. To do so, we simply imported the utility data and building parameters into the appropriate accounts in Portfolio Manager. The Portfolio Manager was able to generate performance ratings based purely on this imported data sets. The computed ENERGY STAR ratings were expressed on a scale of 1-to-100 where a score of 50 indicated average energy performance. Buildings receiving performance ratings of 75 or higher were considered top performers in terms of energy efficiency. Those buildings that did not receive ENERGY STAR scores were still benchmarked by other metrics including site and source energy use intensities.

3.1.2 Development of Benchmarking Report

After the performance ratings and building metrics were computed, our group compiled the results in a comprehensive benchmarking report, which was then reviewed by the Office of Energy Management. Prior to its submission, our group examined several benchmarking reports published by other U.S. cities to determine the best means of communicating our results. The report served as an indicator for the levels of energy efficiency in Alexandria government buildings during the current fiscal year. The performance ratings, as well as the EUIs, were able to identify which of the 41 benchmarked buildings needed to implement better energy management practices. The Office would be able to notify the building owners of poor performing facilities and encourage them to make operational improvements to boost their overall energy efficiency. In the case of ENERGY STAR scores, those buildings receiving performance ratings of 50 or lower would receive higher priority than those identified as exceptional energy performers.

The report also highlighted the strengths and weaknesses of Alexandria's approach to benchmarking these facilities. The specifics of the selection process, data collection, and generation of building metrics were all discussed within the body of the report. It also examined the accounting and managing capabilities of the Portfolio Manager tool, as well as the limitations it placed on the benchmark. The inputs required to generate ENERGY STAR performance ratings were also addressed. The purpose of the report was to help the City determine some of the best practices when rating and disclosing the energy use of its buildings.

3.2 Government Building Benchmarking Plan for Northern Virginia

Following the completion of Alexandria's government building benchmark, we then extended the scope of our project work to the remaining jurisdictions in Northern Virginia. We were not expected to conduct an energy benchmark for the government facilities in the entire region; however, we wanted to develop a benchmarking plan based on best rating and disclosure practices that could be potentially adopted by all Northern Virginia communities. The plan, which was submitted to NVRC upon completion, specifically outlined the data requirements, tools, and analytical methods that would be used to benchmark government buildings. It was primarily developed to allow government building owners to track and compare building energy use with that of similar buildings both on a region-wide and nation-wide level. However, to determine best benchmarking practices, in addition to reflecting on Alexandria's benchmarking approach, we needed to conduct interviews with other energy planning representatives in the metropolitan area. Our proposed plan would need to promote continual benchmarking of government facility operations in Northern Virginia, and ultimately reduce building energy consumption and resulting greenhouse gas emissions within the region. Luckily, the building stock in the City of Alexandria was fairly representative of the entire Northern Virginia region. Given this consideration, we were able to develop a regional benchmarking plan that was similar to that implemented for Alexandria government facilities.

3.2.1 Interviews for Best Benchmarking Practices

We conducted a formal interview with Andrew Burr, the Director of Building Energy Performance Policy from the Institute for Market Transformation (IMT), to review their organization's programs focusing on building performance policy and building energy codes. Our regional benchmarking plan needed to clarify mandatory policy requirements and deadlines for building owners to continually rate and disclose the energy performances of their buildings. The interview with Andrew Burr uncovered some of the common benchmarking policies implemented in a number of U.S. cities that have been successful at adopting building performance regulations including Seattle, Chicago, Austin, San Francisco, and New York City. Instead of developing an entirely new benchmarking strategy, our group felt that it would be more effective to build off existing models that have already been proven to serve well in other U.S. jurisdictions.

3.2.2 Government Building Tours

Building visits assisted our group in identifying the real-world correlations between energy use habits and efficiency. Our team coordinated tours of government facilities including the Alexandria Police Department and Beatley Central Library, both of which are recognized by their energy efficient operation. The building tours allowed our group to observe the day-to-day operation of these facilities and identify building features that could introduce complications in an energy benchmark. It is critical for our group to address such complications in our regional benchmarking plan in case owners of other buildings encounter similar situations.

3.3 Government Building Energy Performance Label for Northern Virginia

After finalizing our benchmarking plan for Northern Virginia, we then developed a regional government building energy performance label for the use of communicating the energy efficiency of existing government facilities. Due to the project time constraint, we were only able to develop a performance label prototype, as opposed to creating a feasible product suited for region-wide implementation. Essentially, our performance label prototype was designed to inform public audiences (in Northern Virginia) about the energy use of government facilities and attract attention to those buildings needing operational improvements. The resulting transparency would help establish demand for energy efficient properties. The label was also designed to encourage building owners to take further action in managing the energy use of their facilities and to continually disclose key performance metrics on an annual basis.

3.3.1 Interviews for Label Design

Our group decided to interview John Morrill, Energy Manager, and Jeannie Altavilla, Energy Program Analyst, from Arlington County's Department of Environmental Services to discuss Arlington's iterative steps in developing their own, unique energy performance label (EPL). Arlington County has already posted their performance label on 38 government buildings including offices, libraries, community centers, and fire stations. Our group wanted to identify which types of information should be included on the label, and which types of data visualization would be most effective at communicating this information. In addition to uncovering some of Arlington's best practices in regards to their energy performance label, we also set out to address the shortcomings of their label design. The goal of this interview was to simply gain plenty of valuable insights on how to design a professional, informative, and sustainable EPL for the broader Northern Virginia region. Our group also conducted an interview with the Alexandria City Energy Manager, Bill Eger, to talk about his expectations for a future performance label.

3.3.2 Study of Label Design

To properly design a visually-appealing and practical energy performance label, we thought that it would be in our best interest us to research related graphic design concepts such as page layout, data visualization, saturation of color, and graphical representation. Our group referenced Edward Tufte's books, *The Visual Display of Quantitative Information*, *Envisioning Information*, and *Visual Explanations*, to help us brainstorm possible ideas for the regional performance label. We used Tufte's recommendations to avoid using useless, non-informative, or information-obscuring elements in quantitative information displays such as our EPL.

3.4 Application to Private Commercial Buildings

In addition to developing a benchmarking and labeling plan for Northern Virginia government facilities, the last objective of our project was to create a scalable voluntary program targeting private commercial buildings. Commercial building benchmarking creates a market-based incentive to improve energy efficiency because it allows efficiency to become a market differentiator for private companies and organizations. Not only does it drive interest in energy efficiency on the customer side, but it also encourages building owners to maximize the efficiency of their buildings in order to attract and retain tenants. Our voluntary commercial benchmarking program would need to outline a marketing plan that would persuade building owners to invest time and effort into making their properties more energy efficient. Interviewing with local energy stakeholders was extremely useful in helping our group identify some of the ways to initiate such an effort.

3.4.1 Interviews for Effective Voluntary Commercial Benchmarking

We conducted an interview with Kelly Zonderwyk, Energy Program Specialist for AIRE at the Arlington County Department of Environmental Services to talk with her specifically about Arlington Green Games, a voluntary program designed to encourage residents and business owners to reduce their operational expenses and greenhouse gas emissions by means of an annual benchmarking competition. We wanted to identify the steps that Arlington County (specifically, AIRE) took to kick start such a competition. In addition, we also wanted to learn about some of the initiatives typically used to increase the number of building owners willing to participate in a voluntary benchmarking program.

3.5 Summary

The methods described above have provided our group with the information needed for not only achieving our project objectives, but for improving building energy efficiency in both the City of Alexandria and the entire Northern Virginia region.

4.0 Results and Analysis

The following chapter is subdivided into three independent deliverables, all of which have been separately submitted to our sponsoring agencies for future publication. Provided below is the list of deliverables in order as they appear in this report, along with a brief descriptor as to how each of them fit within the context of our building energy benchmarking and labeling project.

1. **2013 Energy Benchmarking Report for the City of Alexandria**

   This first annual benchmarking report for the City of Alexandria, located in Northern Virginia, details the energy performance of 41 government buildings, specifically for the fiscal year of 2013. The report provides comparisons in key energy performance metrics between each of the benchmarked facilities, as well as building energy use trends over 24 consecutive months. In addition, the benchmarking analysis highlights energy performance successes and focuses attention and resources on buildings that could benefit from energy improvements. This report provides the necessary information to building owners, policy makers, and general public audiences to communicate government building performance.

2. **Northern Virginia Government Building Energy Benchmarking and Labeling Plan**

   The Government Building Energy Benchmarking and Labeling Plan is designed to be a step-by-step guidebook for government building owners in the Northern Virginia region to help them benchmark the energy performance of their facilities and operations. Specifically, it outlines the procedures for building selection, data collection and verification, benchmarking building performance using available tools and software, and lastly, reporting energy use to the appropriate audiences. The plan also introduces an energy performance label prototype, which would be used to communicate the level of energy efficiency in these government facilities and encourage building owners to continually improve their buildings' operation.

3. Commercial Building Energy Benchmarking and Labeling Voluntary Program for Northern Virginia

The following sets out an implementation plan for a benchmarking program for the private commercial buildings in Northern Virginia. While Washington DC has implemented mandatory benchmarking requirements on any buildings over 50,000 SF, this plan recommends that Northern Virginia to start with voluntary competition style program. This is due to the policy considerations, such as privacy of utility data and limitations to local government authority in the Commonwealth. Implementation of this plan will allow for a more informed market to compare energy efficiency and future operating costs between similar properties and guide purchasing, leasing, and financing decisions.

Each of these three deliverables will help position both the City of Alexandria and Northern Virginia localities as leaders in promoting energy efficiency. Together they promote a comprehensive strategy to reduce overall energy use and greenhouse gas emissions in Alexandria, Northern Virginia, and the nearby metropolitan area of Washington, D.C.

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City of Alexandria

2013 Energy Benchmarking Report

Government Buildings

December 2013

ECO-CITY ALEXANDRIA
environment economy community

Cover Photos:

Alexandria Police Department
Fire Station 209
Beatley Central Library

Acknowledgments

Collecting the data and information necessary for this benchmarking report relied on the time and expertise of staff from several city departments and partnership with other public agencies and non-profit organizations. This report marks the first time that the City of Alexandria has publicly disclosed the energy use of its government buildings. Continued care went into ensuring that the data was complete and accurate as possible.

Special thanks to the following for assistance and guidance in this report's development.

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Photo (top right): Alexandria City Hall

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Table of Contents

Executive Summary

Background

The data in this report provides a snapshot of energy performance in 41 of Alexandria's government buildings during the fiscal year of 2013. These facilities account for approximately 1.5 million square feet of the City's occupied building area, and approximately 59 % of the City's total energy consumption.

While tracking building energy use is not new to Alexandria, as part of this benchmarking effort, the City utilized the U.S. EPA's ENERGY STAR Portfolio Manager to develop a baseline of energy performance across its buildings, with a focus on larger buildings and community facilities.

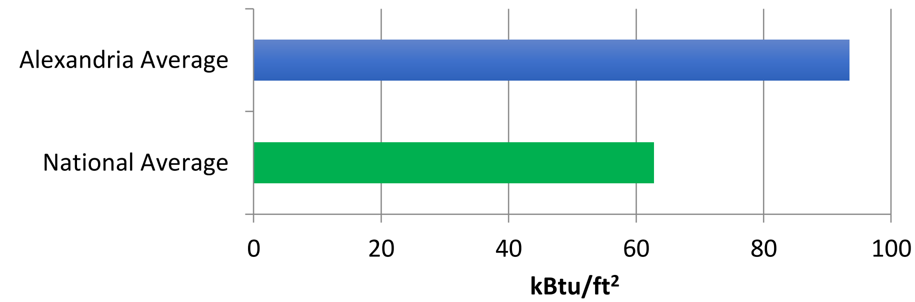
The following report is primarily intended to help inform building owners and other decision makers about where to target public resources, and also provides information to energy efficiency researchers and the general public. However, energy benchmarking must be seen as part of a wider array of energy efficiency strategies that can reduce the City's energy use and improve the operation of its facilities.

By distributing this report, the Office of Energy Management (OEM) hopes to provide a fresh perspective on the City's government facilities, highlighting energy performance successes and focusing attention and resources on buildings that may benefit from energy improvements. It is highly encouraged for readers to suggest improvements to the format of this benchmarking report for future years. As one part of comprehensive strategy to reduce the City's overall energy use and greenhouse gas (GHG) emissions, the OEM offers this report to help better inform the conversation.

Key Findings

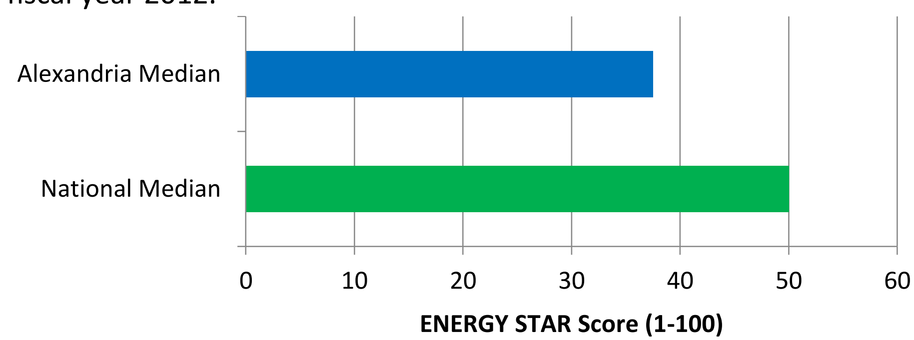
Average Site EUI

The average site EUI for the 41 benchmarked facilities in fiscal year 2013 was 93.4 kBtu/ft^2, which is almost 2 % lower than the average site EUI from the previous fiscal year. However, this current value is nearly 30 % higher than the national average for site EUI provided by the CBECS of 62.8 kBtu/ft^2. There were only 8 government facilities with lower site EUIs than this national average.



Median ENERGY STAR Score

24 of the 41 benchmarked facilities were eligible to receive ENERGY STAR scores. The median score for the 24 rated facilities was a 37.5, indicating that these facilities perform better than 37.5 % of their peers. The Del Ray Center was the facility with the highest ENERGY STAR score, whereas Chinquapin Park Recreation center received the lowest score. The median score for this fiscal year is 7 points higher than that for fiscal year 2012.



Introduction

The City of Alexandria is strongly committed to reducing its impact on the environment and its contributions to climate change. Beginning in spring 2007, the City of Alexandria partnered with Virginia Tech's School of Urban Affairs and Planning (UAP) to design and facilitate a new, strategic collaborative planning process, called Eco-City Alexandria. This collaborative process ultimately created an Eco-City Charter adopted by the City Council in June 2008 and an Environmental Action Plan adopted by City Council in June 2009. These documents will guide both the City of Alexandria and residents towards environmental sustainability over the next twenty years and beyond.

One of the actions the City is taking in promoting environmental sustainability is to reduce the energy consumption of public buildings. Energy benchmarking is the most effective strategy in minimizing building energy use and resulting greenhouse gas emissions over time. It allows building owners to track energy performance on a continual basis and gives them a better sense of how their buildings are using energy. Essentially, benchmarking establishes a baseline of energy performance for each building that can be used to guide energy efficiency investments.

Public disclosure of annual reports of building energy performance will help the City monitor progress towards citywide energy efficiency goals, identify market sectors with the greatest needs and opportunities, and stimulate the development of future policies and incentive programs. Energy performance disclosure allows an informed market to compare energy efficiency and future operating costs between similar properties and guide purchasing, leasing and financing decisions.

The City of Alexandria's Office of Energy Management (OEM), located within the Department of General Services (DGS), has issued this energy benchmarking report to provide Alexandria's agencies and the general public a better understanding of how the City's government facilities perform. This report identifies high performing buildings as well as opportunities for improvement, and is an attempt by the City to lead by example and provide transparency related to government building operations. The information provided in this report is a first step in the development of best energy management practices.

Photo: Old Town Alexandria

Alexandria's Approach to Benchmarking

Overview

The City of Alexandria has yet to adopt an ordinance requiring building owners to benchmark and publicly disclose the energy performance of their facilities. The OEM conducted this benchmark for the fiscal year of 2013 to communicate the energy use in Alexandria government facilities, and to identify cost effective opportunities to lower consumption and save money in utility expenses. The benchmark served as an experimental approach to determine best management practices. Overall, this exercise of discovering the strengths and weaknesses of generally established procedures for collecting and reporting data was extremely valuable for the City as a whole. These best practices will provide the City with clear guidance and time-saving tools to support a building benchmarking protocol in the near future.

Selection of Buildings

The Northern Virginia Government Building Energy Benchmarking and Labeling Plan provides further instruction for selecting facilities to benchmark according to best practices, and is consistent with regional peer jurisdictions. The selection of buildings for Alexandria was based solely on three general criteria (listed below) established by the OEM.

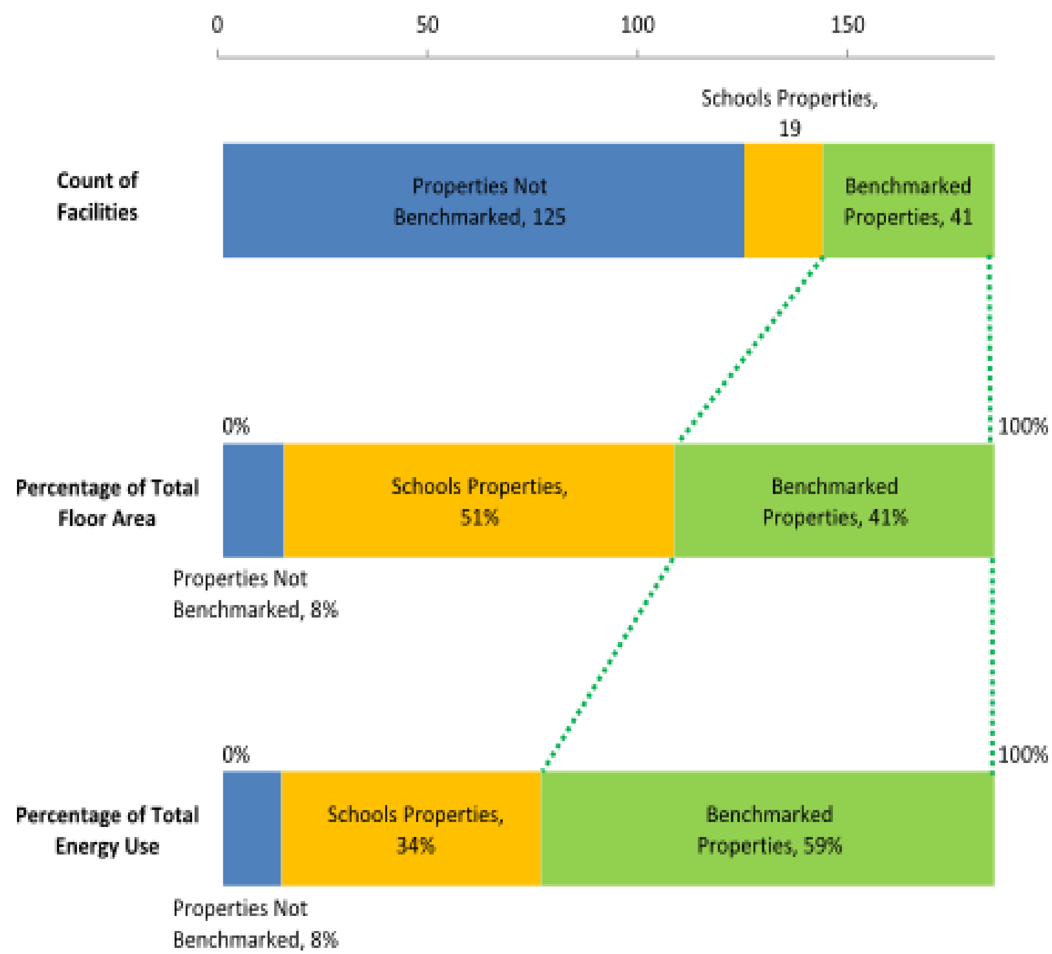
1. Building gross floor area must be at least 5,000 square feet (with exceptions for 3 out of the 41 benchmarked properties)

2. Detailed building and property data is accessible

3. Minimum 12-month electric and natural gas data is available

After applying these criteria to the City's portfolio, 41 buildings were selected for inclusion in the benchmark. It is important to note that not all of Alexandria's government properties were covered in this benchmarking report. Roughly 68 % of the City's government properties were excluded, including Alexandria public schools and parks. The figure shown below illustrates the scope of this benchmark (highlighted in green). It is shown that the 41 benchmarked facilities, although they represent less than a third of Alexandria's total number of government properties, account for nearly 60 % of the City's total energy use.

Scope of Benchmark



Data Collection

Alexandria's electricity and natural gas providers, Dominion Virginia Power and Washington Gas, respectively, provided the OEM with annual utility data for all of the government buildings included in this benchmarking report. Specifically, where applicable, 24 months of utility data were collected spanning fiscal years 2012 and 2013. The use of 24 months of utility data allowed for comparisons in building energy use for these two consecutive years. It also allowed for comparisons in other key energy performance metrics over this two year period, which provided added value to the benchmarking results.

In addition to the monthly utility data, building characteristics including year built, gross floor area, number of occupants, number of computers, operating hours, percent cooled, and percent heated (in terms of HVAC) were also collected and used to conduct the benchmarking analysis. These characteristics served to normalize differences in building operations to avoid biased and unfair comparison between buildings. However, in many cases, building characteristic information was either unavailable or out of date. In these cases, several assumptions were made to generate reasonable values to serve in place of this missing building characteristic information.

The sources used to compile this data include the Space Inventory Assessment Plan (Baker and Associates, 2001), architectural drawings, city websites, department files, and past facility assessment and renovation reports. Inconsistencies in facility data between these various sources were identified. In these situations, the OEM engaged in a thorough verification process to review and reconcile any of the identified discrepancies. Every effort was made to utilize the most accurate data available. Accurate facility data is just as important as accurate energy use data in order to reliably benchmark a building and generate sensible results.

About ENERGY STAR Scores

The 1 – 100 ENERGY STAR score shows how a building's energy consumption measures up against similar buildings nationwide. A score of 50 represents median energy performance, while a score of 75 or better indicates a building is a top performer.

The U.S. Department of Energy conducts a national survey to gather data on building characteristics and energy use from thousands of buildings across the United States. This survey data, also known as the CBECS, is used to develop ENERGY STAR scores.

Based on the information entered about a building, such as its size, location, number of occupants, number of PCs, etc., the score's algorithm estimates how much energy the building would use if it were the best performing, the worst performing, and every level in between. It then compares the actual energy data entered to the estimate to determine where the building ranks relative to its peers.

All of the calculations are based on source energy and account for the impact of weather variations, as well as changes in key property use details.

ENERGY STAR Portfolio Manager

The benchmarking analysis conducted for this report utilized the U.S. Environmental Protection Agency (EPA) ENERGY STAR Portfolio Manager. Portfolio Manager is a nationally-recognized building energy benchmarking tool made freely available to building owners and operators by the EPA. It is used to conduct building energy benchmarking analysis, comparison of building energy performance with local and national peers, energy performance reporting, and assignment of performance ratings according to the ENERGY STAR rating system.

Accounts in Portfolio Manager were created for each of Alexandria's government buildings. Collected utility and building characteristic data for each property were populated into their respective accounts. Space types were also defined for each of the properties in the portfolio. Unfortunately, not all building types are eligible to receive an ENERGY STAR score. As of July 2013, ENERGY STAR has defined twenty building types eligible for performance ratings including offices, warehouses, K-12 schools, courthouses, and data centers.

For the purpose of this benchmark, all of the Alexandria government buildings were defined by these eligible types in order to receive ENERGY STAR scores. In some cases, the benchmarked facilities contained more than one space type. For instance, the Public Safety Center is a mixed-use facility that contains both office space and jail areas. Where this would affect the ENERGY STAR rating, multiple space types were entered into Portfolio Manager. Parking areas (garages) were also defined as additional space types in Portfolio Manager. However, it is important to note that the EUI calculations in this report do not include parking garage area as part of a facility's gross square footage.

Benchmarked buildings that were less than 5,000 square feet (or consisted of space types less than 5,000 square feet) did not receive an ENERGY STAR score due to technical limitations of Portfolio Manager. However, buildings not eligible for an ENERGY STAR score still received useful tracking information such as Energy Utilization Index (EUI), or energy use intensity, and GHG emissions values. Much of the analysis discussed throughout this benchmarking report relies heavily on the site EUI data generated for each of the 41 facilities. Although the ENERGY STAR score is considered to be a more robust performance metric, the site EUI data was determined to be more reliable, considering the fact that most of the benchmarked facilities were defined by space uses that did not necessarily characterize their actual use.

Facilities **eligible** for ENERGY STAR scores:

Alexandria City Courthouse
Alexandria City Hall
Animal Welfare League
Barrett Branch Library
Beatley Central Library
Burke Branch Library
Charles Houston Recreation Center
Chinquapin Park Recreation Center
Cora Kelly Recreation Center
Del Ray Center
Duncan Branch Library
Durant Artisans Gallery
Fire Station 209
Gadsby's Tavern
Lloyd House
Mental Health Community Shelter/Detox
Mount Vernon Recreation Center
Nannie J. Lee Memorial Recreation Center / Lee Center
Patrick Henry Recreation Center
Public Safety Center
Stabler-Leadbeater Apothecary Museum
The Lyceum
Torpedo Factory
William Ramsay Recreation Center

Facilities **not eligible** for ENERGY STAR scores:

Alexandria Police Department
Black History Museum
DASH - Transit Company
Fire Station 201
Fire Station 202
Fire Station 203
Fire Station 204 (HQ)
Fire Station 205
Fire Station 206
Fire Station 207
Fire Station 208
Fleet Maintenance Facility
Friendship Firehouse Museum
Health Department (Main Office)
Old Duron Paint Building
Roth Street Building
Watson Reading Room

Characteristics of Covered Properties

There are 41 buildings included in this 2013 Benchmarking Report, all of which are owned by the City of Alexandria. The 41 benchmarked buildings were categorized into 10 departments for the purpose of comparing energy use within and between each of these departments.

Nearly all of the government buildings within this report were defined primarily as office space. Other facility types covered in this benchmark include non-refrigerated warehouses, medical offices, residence halls, and courthouses; however, the latter facility types only define roughly twenty percent of the benchmarked buildings. Performance metrics, therefore, were not compared among the different facility types due to this imbalance.

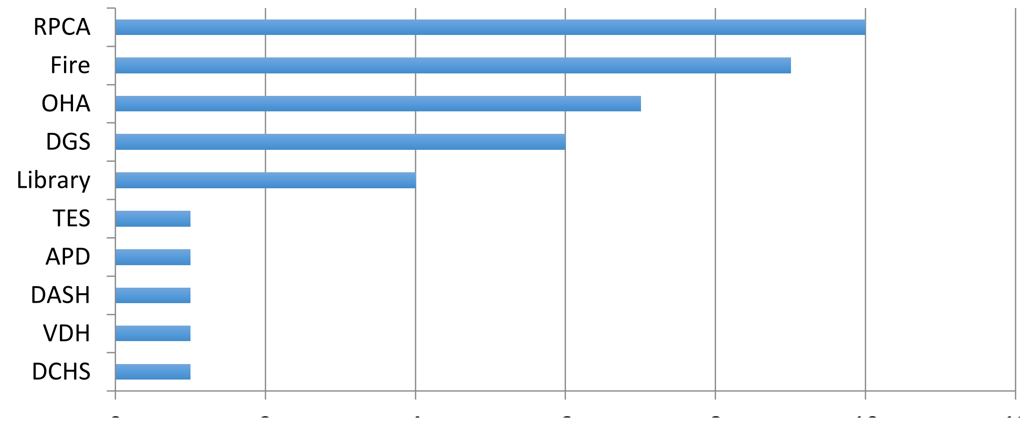
The figures on the right display the number of benchmarked buildings and square footage for each of the city departments. The RPCA, which includes Alexandria's recreational and community facilities, comprises the majority of buildings in this benchmark with a total of 10 facilities. However, the gross floor area of the RPCA facilities accounts for only 17% of the total benchmarked square footage. The DGS only constitutes 6 of the 41 benchmarked buildings, but the gross floor area of the DGS facilities accounts for 38% of the total, which is the most of any department.

Largest Facility: 218,866 square feet (Public Safety Center)

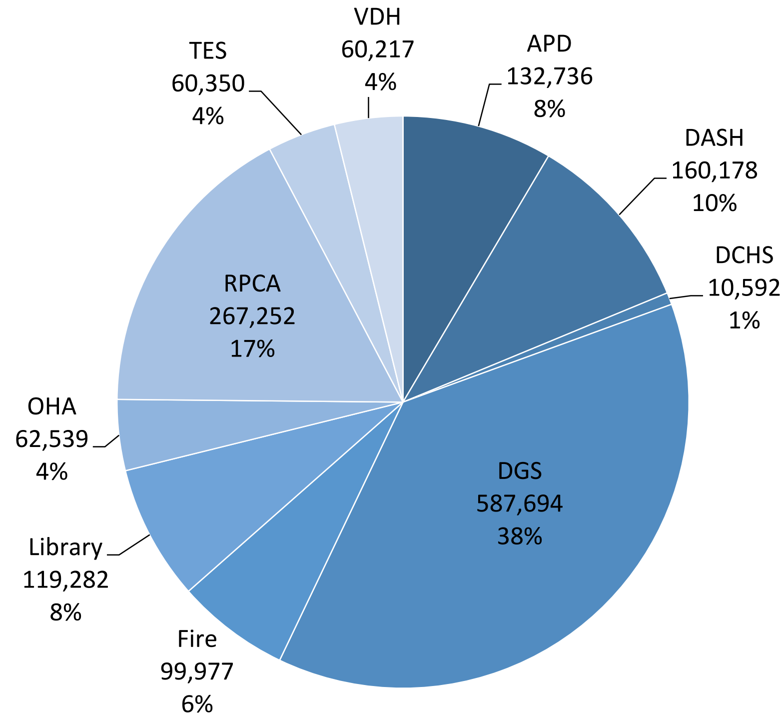
Smallest Facility: 950 square feet (Watson Reading Room)

Median Size Facility: 18,150 square feet

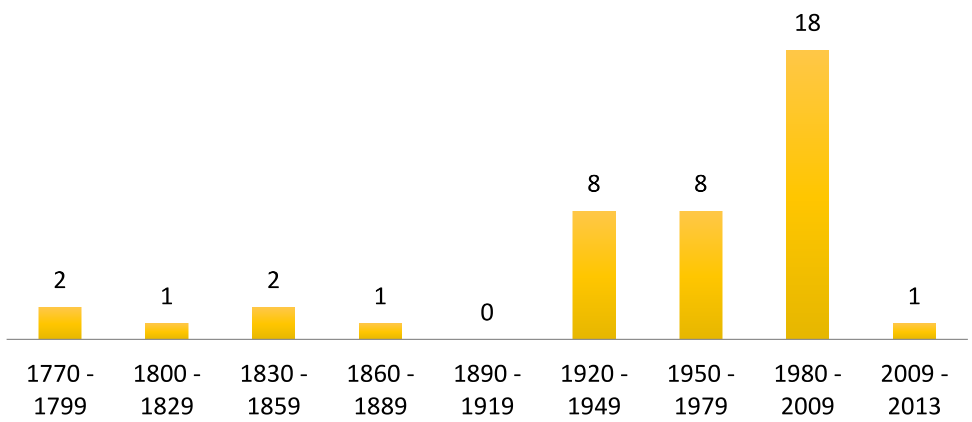
Number of Benchmarked Buildings, By Department



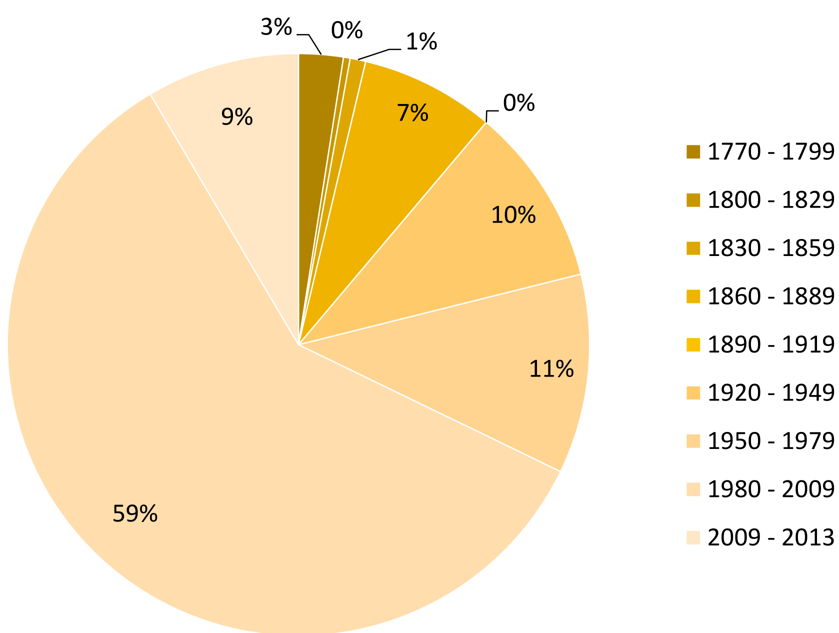
Benchmarked Square Footage, By Department



Build Date of Benchmarked Buildings



Square Footage of Benchmaked Buildings, By Build Date



Most of the facilities covered in this benchmark are located in the historic area of Alexandria also known as Old Town. According to the figure on the left (top), the range of build dates of these facilities extends from the early 1770s to present. A total of 6 facilities have been built before the start of the twentieth century, all of which are constructed from brick. As a matter of fact, most of the government buildings in Alexandria are brick or masonry constructions. Only a few of the more recently built facilities are constructed from steel frames. Most of the government buildings covered in this report were built during the mid to late twentieth century, with the majority of them constructed in the 1980s. It is also important to note that several of the benchmarked facilities have undergone renovations within the last twenty years.

The second figure provided on the left (bottom) displays the gross square footage of the benchmarked buildings according to their built date. It is shown that nearly sixty percent of the benchmarked square footage belongs to government facilities erected during the period from 1980 to 2009. The two most historic government facilities covered in this report only account for a mere three percent of the total benchmarked square footage. The correlation between building age and energy use is not as strong as might be expected. The age of a building accounts for only a small percentage of the variability in energy use between buildings of different ages. This is mostly due to the fact that many of Alexandria's oldest facilities have been able to successfully integrate modern technological infrastructure to improve their energy efficiency.

Newest Facility: 2011 (Alexandria Police Department, APD)

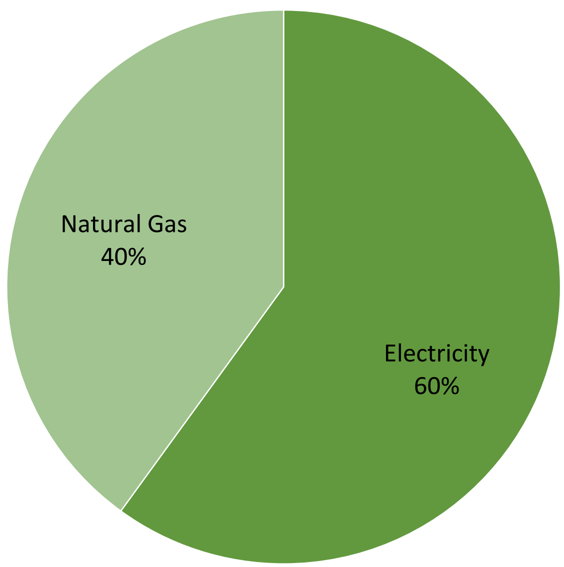
Oldest Facility: 1773 (Gadsby's Tavern, OHA)

Median Build Date: 1973

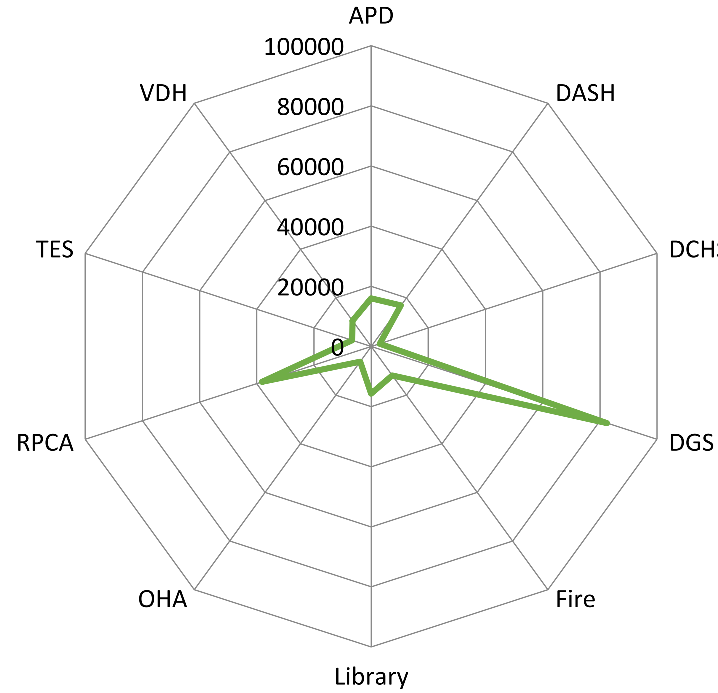
Energy Use in Alexandria Buildings

Electricity and natural gas are the two dominant energy resources used to service government building operations in Alexandria. According to the figure below, sixty percent of the total energy use in the 41 benchmarked facilities accounts for electric utility, while the remaining forty percent accounts for natural gas. The Animal Shelter in Alexandria is the only benchmarked facility that uses propane in replace of natural gas; however, the amount of propane fuel used at this facility is almost negligible in comparison to the City's total energy use. For this reason, the percentage of total propane use was excluded from the figure. Nearly all of the benchmarked facilities were observed to use more electricity than natural gas on an annual basis (including summer and winter months). There are only 4 facilities that rely solely on electricity to satisfy building lighting, heating, cooling, and ventilation needs, all of which were Alexandria historic museums. In terms of total energy use, only 10 out of the 41 benchmarked facilities were observed to use more natural gas than electricity. Fire stations comprised the majority of these dominant natural gas users.

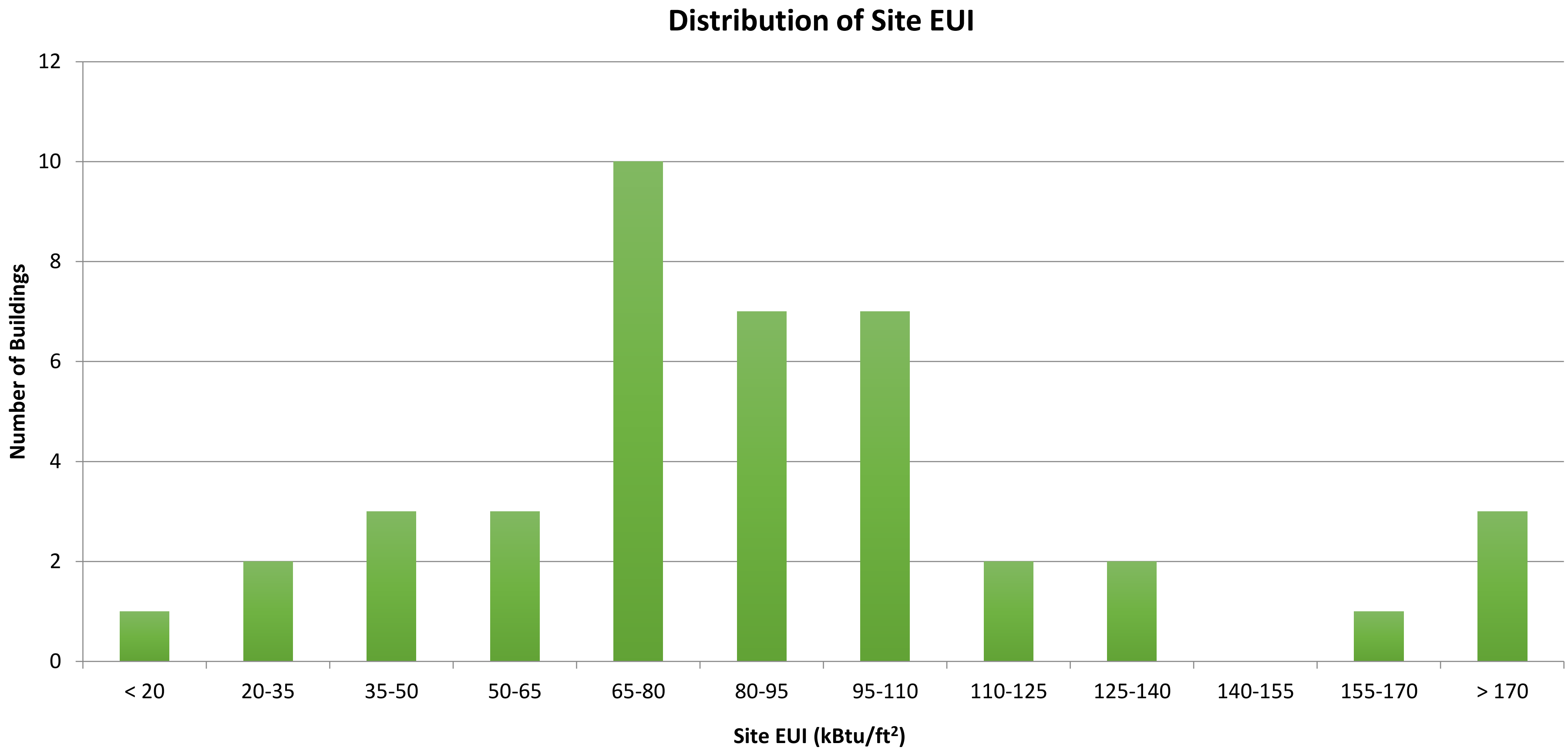
Total Energy Use By Resource



Total GHG Emissions (MtCO2e)



This figure displays the contributions to the total GHG emissions in Alexandria for each city department. For the fiscal year 2013, the GHG emissions produced by all 41 benchmarked facilities totaled to 207,590 MtCO2e. The 5 facilities under the DGS are responsible for forty percent of this total, which is more than any other department. The 10 facilities within RPCA collectively contribute to only eighteen percent. Department contributions to the total GHG emissions are nearly proportional to their respective contributions to the total benchmarked square footage. Fire Station 204, the fourteenth largest benchmarked facility, had the highest carbon footprint of 5.5 lb-CO_2/ft^2. The GHG emissions produced from Fire Station 204, however, is not representative of all other stations within the department. The average carbon footprint for the other 8 fire stations is only 1.5 CO_2/ft^2.



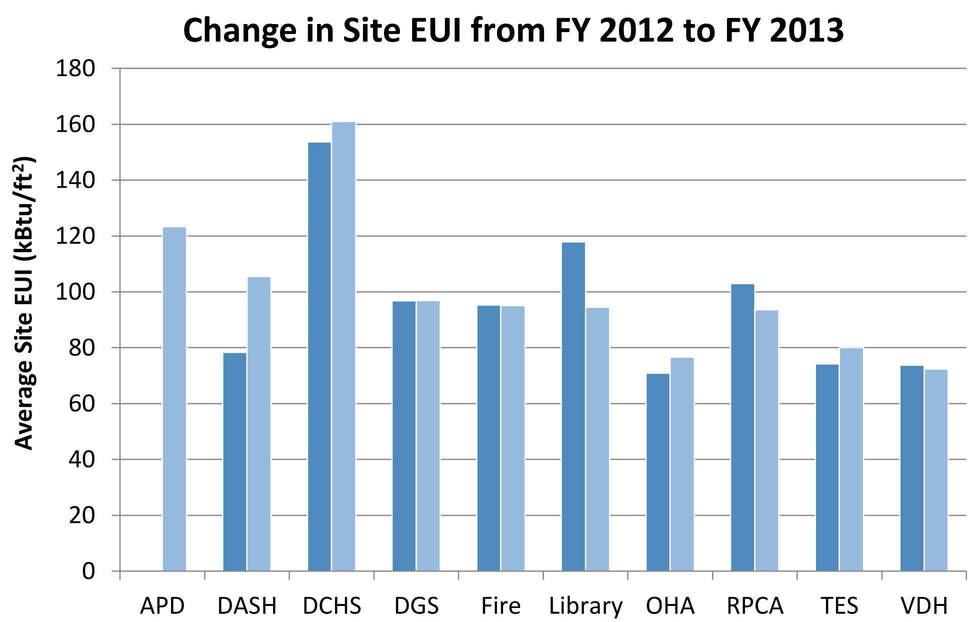
The figure above displays the distribution of weather normalized site EUIs for all 41 benchmarked buildings. Site EUI is determined by totaling the annual energy used by all utilities that serve the building (on site), such as electric and natural gas, and dividing that number by the total floor area of the building. Those buildings with lower values for site EUI consume less energy per square foot than those with higher values. This metric can serve as a coarse screen for overall energy efficiency potential and allows for comparisons in energy use between different sized buildings. The normal distribution of site EUIs provided above identifies the range of performances in the benchmarked facilities, and can be used to pinpoint concentrations of buildings that are the largest and smallest energy consumers.

According to the plot, almost a quarter of the buildings have site EUIs in the range of 65 to 80 kBtu/ft^2. These buildings can be considered average energy performers relative to the rest of the benchmarked facilities, at least in terms of site EUI, and should not necessarily take priority in the City's energy improvement efforts. On the other hand, budgeting energy efficiency investments for the 14 buildings within the range of 80 to 110 kBtu/ft^2 would be much more cost effective. Operational improvements in these facilities would not need to be significant, and could collectively reduce the overall energy consumption contributed by Alexandria government facilities. Subsequently, these reductions in energy use would lower the City's utility expenses, as well as decrease the average site EUI across the building stock. Currently, the average site EUI for the 41 benchmarked facilities is 93.4 kBtu/ft^2, whereas the median is 82.3 kBtu/ft^2. From a statistical perspective, these operational improvements would potentially narrow the distribution of EUI values and direct the city's overall performance trends toward the more efficient end of the EUI spectrum. Theoretically, capital that would be saved from continually lowering utility costs could be set aside in an annual budget for additional energy efficiency improvements.

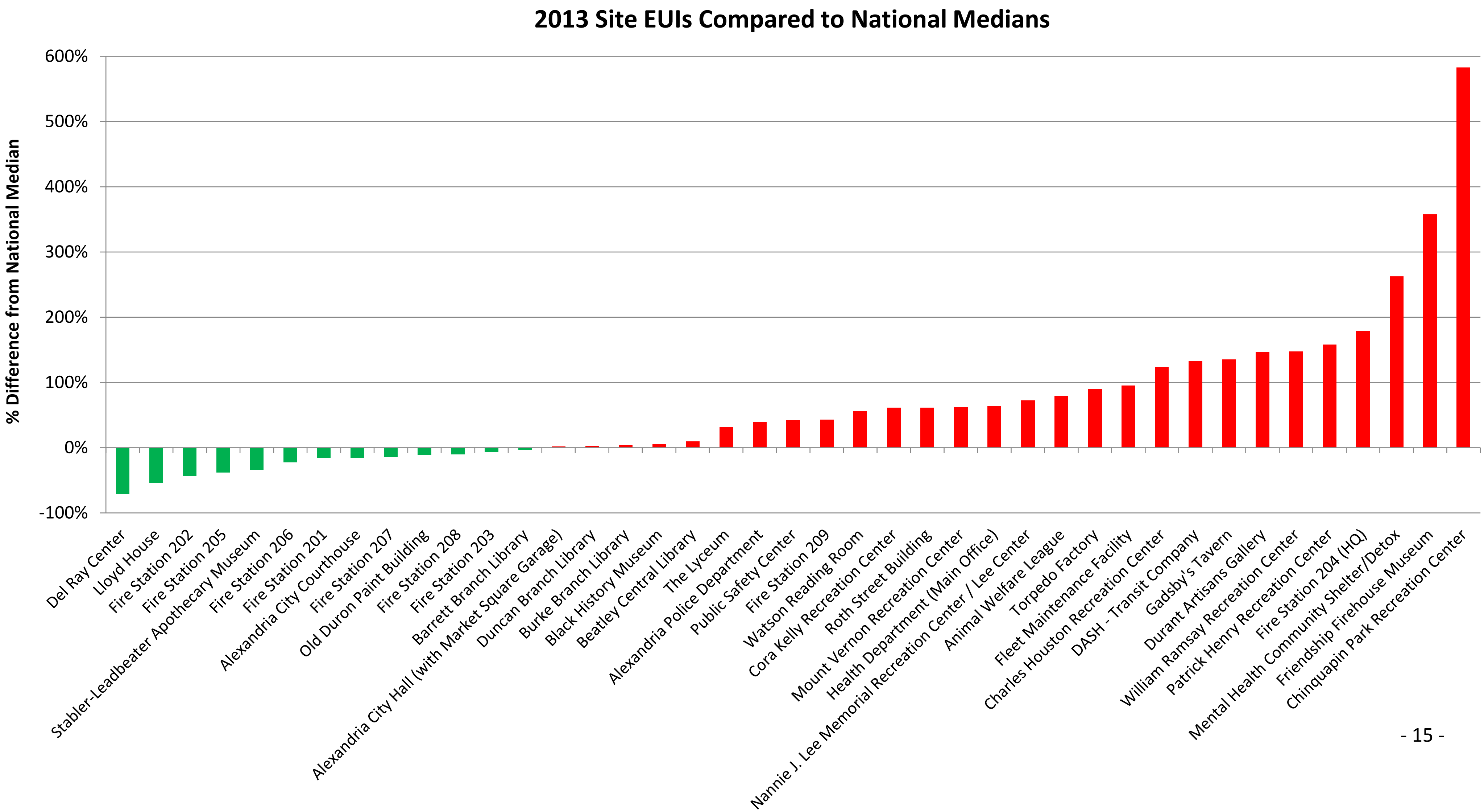
The concentrations of buildings with site EUIs greater than 155 kBtu/ft^2 attract special attention in this benchmark and will require further investigation in upcoming years. The 4 facilities within this range are identified as anomalies in the distribution and have a dramatic influence on the city's average site EUI. These facilities are the largest energy consumers and GHG emitters of all those benchmarked. It is crucial for Alexandria to set these facilities (particularly their owners) on a track towards reducing their energy use by first identifying the reasons for their over consumption habits. It is likely that some of these facilities have unique operational conditions that justify their high energy use. In particular, Chinquapin Park Recreation Center, the facility with the highest recorded site EUI of 281.4 kBtu/ft^2, is also a popular aquatic center. The pool located at this facility comprises most of the building's gross floor area and is open to the public for 92 hours per week, which is more than any of the non-emergency service facilities. For these reasons, the Chinquapin facility appears to be relatively energy inefficient in terms of site EUI alone.

The figure on the right displays the change in average site EUI for each city department from the end of fiscal year 2012 to the end of fiscal year 2013. It is important to note that the Alexandria Police Department was constructed during the start of fiscal year 2012. As a result, average site EUI for the fiscal year 2012 is not generated for APD on this figure. According to the plot, only 3 out of the 9 departments (excluding APD) have observed noticeable decreases in average site EUI values since the last fiscal year. The average site EUI for Alexandria public libraries has decreased by twenty percent from 2012 to 2013. This indicates that these 4 facilities have been able to collectively reduce their overall energy use over time, more so than any other department. It is likely that the solar panel installation at the Beatley Central Library accounts for the majority of this depression in energy consumption. Energy efficiency improvements, such as the photovoltaic (PV) installation at Beatley Central Library, can therefore be shown to help improve performance and increase energy productivity.

The figure also highlights that the remaining departments (6 out of 9) have average site EUI values that have either increased or remained constant from fiscal year 2012 to 2013. In particular, DASH (Alexandria Transit Authority) observed a 30% increase in site EUI within a single year. However, on the level of individual buildings, 21 of the 41 benchmarked facilities have lowered their site EUI from 2012 to 2013. Those facilities with the largest percent decrease in site EUI from 2012 to 2013 were, unsurprisingly, the Alexandria public libraries.

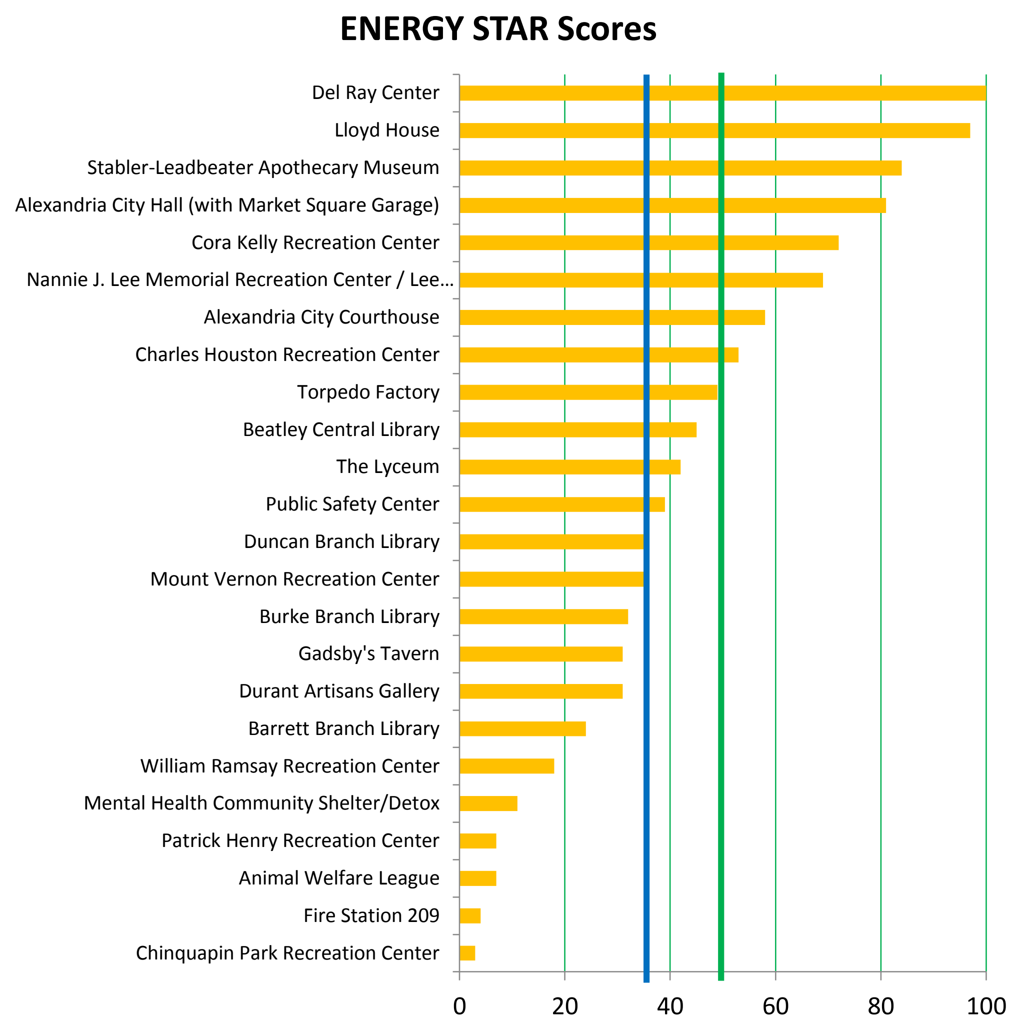


Although the site EUI can provide valuable insights about energy efficiency, it does not account for other key drivers of energy use. The site EUI values are not normalized for building parameters such as percent occupancy, weekly operating hours, and number of computers. EUI also does not adjust for differences in space use. Since facilities are designed to satisfy different functions, it is expected for site EUI values to vary for different space types. It is a simple fact that certain building types use more energy than others. For example, a county office building uses relatively little energy compared to a county hospital. Similarly, a small office building that supports 80 workers will use less energy than a skyscraper that supports a thousand workers. It would be useful to compare the site EUIs for each of the benchmarked facilities to that of similar facilities in the United States to build a better sense about current levels of efficiency in Alexandria. Comparing a particular building's EUI to these national EUI values provides a rough idea for how a building's performance stacks up to similar buildings across the country. The figure below displays the percent difference between each building's site EUI and the national medians provided by



the CBECS database. The green bars represent facilities with lower site EUI values than their national peers. Conversely, the red bars represent those facilities with higher site EUI values. To clarify, the CBECS provides median EUI values for different space types, thus, all 41 facilities were not compared to the same EUI value. According to the plot, only 13 out of the 41 facilities have site EUIs that are lower than the CBECS national medians. Specifically, 6 of Alexandria's 9 fire stations have generated site EUIs that are substantially lower than the national median for this building type. It would be safe to conclude that the fire stations in Alexandria are fairly energy efficient (with exceptions to Fire Stations 204 and 209) in this national context. On the other hand, 28 of the 41 benchmarked facilities have site EUIs that are greater than the national medians. Considering the comparisons to national peer performance, most of the buildings benchmarked in the City are determined to be operationally inefficient. There are 7 facilities with site EUIs that are nearly equivalent to the national medians, which include all 4 of Alexandria's public libraries. Evidently, the city libraries have site EUI values that fall within the range of 80 to 110 kBtu/ft^2. This supports the claim that targeting facilities for operational improvements in this range of EUIs would be cost effective and increase the number of efficient properties on the national level.

It is important to note that the inefficient facilities (red) have percent differences of much higher magnitude than those facilities deemed efficient (green). There is not a single efficient facility with a percent difference in site EUI that is greater than 100%. As a matter of fact, the largest percent difference for those facilities deemed nationally efficient is only 71 %. On the other hand, the largest percent difference for the nationally inefficient facilities is a whopping 583 %. In addition, 10 out of the 28 facilities with site EUIs greater than the national medians have percent differences greater than 100%, 3 of which have percent differences greater than 200%. The Chinquapin center is expected to undergo HVAC renovations within the next year, and as a result, should observe a decrease in its site EUI in the upcoming benchmark.



The CBECS data has not been updated since 2003, and as a result, the values for national median site EUI have most likely changed within the last decade. The EIA is planning to release a new survey that will accommodate these changes, and provide building owners with the nation's most recent building performance information. In addition, it is also important to consider that the national medians take into account all applicable buildings throughout the country. Although recreation centers, for instance, are matched with other recreation centers nationwide, those facility types in Alexandria may have different building characteristics than their so called national peers. This reasoning can explain why most Alexandria facilities have higher EUI values than the national medians provided by CBECS.

The figure on the previous page displays the ENERGY STAR scores for the 24 eligible facilities. The blue line indicates the median score for the benchmarked facilities (37.5), and the green line indicates the national median (50). According to the figure, only 8 facilities received ENERGY STAR scores that were higher than the national median. Del Ray Center, the facility with the lowest value for site EUI, also received the highest ENERGY STAR score. However, these ENERGY STAR scores should not take precedence over the site EUI comparisons due to the fact that most of the benchmarked facilities could not be defined by their true space types. To maximize the number of available ENERGY STAR scores for the benchmarked facilities, the buildings had to be categorized by only those types eligible for scores, which unfortunately, does not include fire stations, recreation centers, or museums. Since a fire station is not defined as a space type eligible for an ENERGY STAR score, the Alexandria fire stations were defined as mixed use facilities comprised of office space and a non-refrigerated warehouse (for the fire trucks). As a result, instead of comparing their performances with other fire stations nationwide, Portfolio Manager matched them with other office spaces and non-refrigerated warehouses within the CBECS. In some respects, the ENERGY STAR scores provided in this report do not accurately reflect building performance because of these limitations within the ENERGY STAR rating system. In the near future, the EPA will update the Portfolio Manager software to include additional space types that will be eligible to receive ENERGY STAR scores.

2013 Benchmarking Results

Recreation, Parks, and Cultural Activities

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
RPCA - Alexandria Average					267,252		142.9					2.6
Charles Houston Recreation Center	DGS	RPCA	22314	2009	34935		92.2					1.9
Chinquapin Park Recreation Center	DGS	RPCA	22302	1984	36371		281.4					4.5
Cora Kelly Recreation Center	DGS	RPCA	22305	1991	25840		66.3					1.4
Del Ray Center	DGS	RPCA	22301	1992	18900		11.9					0.2
Durant Artisans Gallery	DGS	RPCA	22314	1945	16575		101.4					2.0
Mount Vernon Recreation Center	DGS	RPCA	22301	1997	18084		66.7					1.4
Nannie J. Lee Memorial Recreation Center / Lee Center	DGS	RPCA	22314	1954	84822		70.9					1.7
Old Duron Paint Building	DGS	RPCA	22305	1987	4725		36.7					0.7
Patrick Henry Recreation Center	DGS	RPCA	22304	1973	8850		106.2					2.2
William Ramsay Recreation Center	DGS	RPCA	22311	2001	18150		102.0					2.6

Alexandria Library

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
Library - Alexandria Average					119,282		96.5					2.1
Barrett Branch Library	DGS	Library	22314	1937	25241		88.4					1.9
Beatley Central Library	DGS	Library	22304	2001	62400		100.3					2.1
Burke Branch Library	DGS	Library/ACPS	22304	1968	18100		94.9					2.1
Duncan Branch Library	DGS	Library	22301	1968	13541		94.4					1.9

Office of Historic Alexandria

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
OHA - Alexandria Average					62,539		95.1					2.1
Black History Museum	DGS	OHA	22314	1940	3690		47.8					1.3
Friendship Firehouse Museum	DGS	OHA	22314	1855	1960		207.5					3.2
Gadsby's Tavern	DGS	OHA	22314	1773	30211		106.5					2.3
Lloyd House	DGS	OHA	22314	1797	8400		20.5					0.6
Stabler-Leadbeater Apothecary Museum	DGS	OHA	22314	1806	5772		29.7					0.9
The Lyceum	DGS	OHA	22314	1839	11556		59.7					1.7
Watson Reading Room	DGS	OHA	22314	1994	950		64.4					1.3

Alexandria Fire Department

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
Fire - Alexandria Average					99,977		120.8					2.5
Fire Station 201	Fire	Fire	22314	1921	5770		74.2					1.3
Fire Station 202	Fire	Fire	22301	1926	7810		49.6					1.0
Fire Station 203	Fire	Fire	22302	1948	5910		82.3					1.5
Fire Station 204 (HQ)	Fire	Fire	22314	1961	20590		245.9					5.5
Fire Station 205	Fire	Fire	22314	1949	8140		54.4					1.1
Fire Station 206	Fire	Fire	22304	1958	8330		68.3					1.3
Fire Station 207	Fire	Fire	22314	1963	7350		75.4					1.5
Fire Station 208	Fire	Fire	22304	1976	11300		79.0					2.0
Fire Station 209	Fire	Fire	22305	2009	24777		126.1					2.3

Alexandria Police Department

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
Police - Alexandria Average					132,736		123.3				NA	2.7
Alexandria Police Department	DGS	APD/DEC	22304	2011	132736		123.3				NA	2.7

Department of General Services

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
DGS - Alexandria Average					808,222		106.2					2.2
Alexandria City Courthouse	DGS	Courts/Sheriff	22314	1980	112130		78.7					1.9
Alexandria City Hall (with Market Square Garage)	DGS	Mulitple	22314	1875	116308		68.3					1.7
Animal Welfare League	DGS	AWL	22314	2002	15280		119.5					2.3
DASH - Transit Company	DGS	DASH	22314	2009	160178		105.5					2.1
Fleet Maintenance Facility	DGS	DGS/Fire	22314	1980	43120		96.7					1.7
Public Safety Center	DGS	Sheriff	22314	1985	218866		132.7					2.5
Roth Street Building	DGS	TES/RPCA	22314	1987	60350		80.1					2.0
Torpedo Factory	DGS	TFAA/OHA	22314	1920	81990		85.8					2.1

Department of Health / Community and Human Services

Property Name	Managing Agency	Occupants	Zip Code	Year Built	Gross Floor Area (ft2)	Fiscal Year 2013 Total Site Energy Use (MMBtu) 0–40000	Site EUI (kBtu/ft2)	Comparison to National Median	Site EUI by Energy Resource (kBtu/ft2) 0–300	Monthly Site EUI (kBtu/ft2)	Change FY2013 vs. FY2012 (%)	Carbon Footprint (lb-Co2/ft2)
VDH/DCHS - Alexandria Average					70,809		94.8					2.0
Health Department (Main Office)	DGS	VDH/DCHS	22302	1990	60217		72.4					1.6
Mental Health Community Shelter/Detox	DGS	DCHS	22314	1989	10592		161.0					3.2

* The facilities in the above tables are categorized by their primary occupants, not by their overseeing city department.

Plan for Future Action

The challenges the City faces conserving resources used at its facilities are not uncommon, particularly among holders of large portfolios of buildings. This is further complicated by the great diversity of facility age, physical characteristics, and specialized functions that are somewhat unique to the building stock in Alexandria. Operating and maintaining facilities to provide a safe and productive environment for accomplishing critical functions is one of Alexandria's primary concerns. Although much can be learned about the energy performance of City-owned buildings relative to national benchmarks, the larger goal is to simply reduce energy use. Since energy use reductions are critical to meet long-term carbon neutrality and sustainability goals outlined in the Eco-City Charter, the City needs to continually focus on improving facility management and operation.

Without a focused effort to maintain systems, buildings tend to operate less efficiently over time. Buildings need to be regularly "tuned-up" and well managed to keep them operating efficiently. The basic premise of effective resource conservation management is a cycle of evaluation and assessment, improvements, continued monitoring and assessment, and response. To proactively accelerate energy conservation, the City needs to increase its efforts through improved tracking and assessment, operations and maintenance, and physical upgrades. The following are some recommendations that will help the City support such an effort:

• Implement centralized resource accounting for all government buildings, to cover electricity, natural gas, and other district-supplied energy.

Comprehensive resource tracking is fundamental to conservation and will enable better linkage between actual utility usage and operations and maintenance staff, as well as building occupants. Currently, the City's buildings have utility data tracked in a variety of a resource accounting systems and acquisition software. This effort will implement a common accounting system and expand the effort to cover the City's entire portfolio. Compiling this data in a single location will also facilitate future facility management projects and help save a substantial amount of time in the data collection process.

• Perform walk through and standard audits.

Characteristic audits will help the City better understand how their facilities use energy, where they use it, and what drives their energy use. By highlighting building energy demands and conservation opportunities within these facilities, the City can then prioritize their efforts for energy efficiency improvements. Audit candidates should be targeted on the basis of high EUI and total energy consumption.

• Create facility action plans.

Facility owners should conduct preliminary assessments of select buildings to identify operational and resource conservation upgrades. These assessments will result in facility action plans that outline strategies facility owners can use to achieve resource conservation.

These efforts are part of comprehensive strategy by the City of Alexandria to reduce greenhouse gas emissions and improve the efficiency of both public and private buildings. Alexandria will continue to implement energy-saving strategies in city buildings and operations to make progress towards adopted goals. Subsequent reports and multiple years of data will allow the tracking of performance over time, in publicly- and privately-owned buildings across the city.

Appendix A: List of Acronyms

APD	Alexandria Police Department
CBECS	Commercial Buildings Energy Consumption Survey
DCHS	Department of Community and Human Services
DGS	Department of General Services
EIA	Energy Information Administration
EPA	Environmental Protection Agency
EUI	Energy Use Intensity
GHG	Greenhouse Gas
HVAC	Heating, Ventilation, and Air Conditioning
OEM	Office of Energy Management
OHA	Office of Historic Alexandria
RPCA	Recreation, Parks, and Cultural Activities
TES	Transportation and Environmental Services
UAP	Urban Affairs and Planning
VDH	Virginia Department of Health

Appendix B: Basic Property Information

Property Name	Address	Zip Code	Year Built	Year Renovated	Floor Area (sq. ft.)	Primary Property Type	Secondary Property Types	Parking Space
Alexandria City Hall (with Market Square Garage)	301 King Street	22314	1875	Not Applicable	116,308	Office	Not Applicable	Yes
Alexandria City Courthouse	520 King Street	22314	1980	Not Applicable	112,130	Courthouse	Not Applicable	Yes
Alexandria Police Department	3600 Wheeler Avenue	22304	2011	Not Applicable	132,736	Office	Data Center	Yes
Animal Welfare League	4101 Eisenhower Avenue	22314	2002	Not Applicable	15,280	Office	Not Applicable	No
Barrett Branch Library	717 Queen Street	22314	1937	1995	25,241	Office	Not Applicable	No
Beatley Central Library	5005 Duke Street	22304	2001	Not Applicable	62,400	Office	Not Applicable	No
Black History Museum	902 Wythe Street	22314	1940	Not Applicable	3,690	Office	Not Applicable	No
Burke Branch Library	4701 Seminary Road	22304	1968	Not Applicable	18,100	Office	Not Applicable	No
Charles Houston Recreation Center	901 Wythe Street	22314	2009	Not Applicable	34,935	Office	Not Applicable	No
Chinquapin Park Recreation Center	3210 King Street	22302	1984	Not Applicable	36,371	Office	Not Applicable	No
Cora Kelly Recreation Center	25 West Reed Avenue	22305	1991	Not Applicable	25,840	Office	Not Applicable	No
DASH - Transit Company	3000 Business Center Drive	22314	1992	2009	160,178	Non-Refrigerated Warehouse	Office	Yes
Del Ray Center	2704 Mount Vernon Avenue	22301	1992	Not Applicable	18,900	Office	Not Applicable	No
Duncan Branch Library	2501 Commonwealth Avenue	22301	1968	2005	13,541	Office	Not Applicable	No
Durant Artisans Gallery	1605 Cameron Street	22314	1945	Not Applicable	16,575	Office	Not Applicable	No
Fire Station 201	317 Prince Street	22314	1921	Not Applicable	5,770	Non-Refrigerated Warehouse	Office	No
Fire Station 202	213 E. Windsor Avenue	22301	1926	Not Applicable	7,810	Non-Refrigerated Warehouse	Office	No
Fire Station 203	2801 Cameron Mills Road	22302	1948	Not Applicable	5,910	Office	Non-Refrigerated Warehouse	No
Fire Station 204 (Headquarters)	900 Second Street	22314	1961	2001	20,590	Office	Non-Refrigerated Warehouse	No

Fire Station 205	1210 Cameron Street	22314	1949	2001	8,140	Non-Refrigerated Warehouse	Office	No
Fire Station 206	4609 Seminary Road	22304	1958	Not Applicable	8,330	Office	Non-Refrigerated Warehouse	No
Fire Station 207	3301 Duke Street	22314	1963	2005	7,350	Office	Non-Refrigerated Warehouse	No
Fire Station 208	175 N. Paxton Street	22304	1976	Not Applicable	11,300	Office	Non-Refrigerated Warehouse	No
Fire Station 209	2800 Main Line Boulevard	22305	2009	Not Applicable	24,777	Office	Non-Refrigerated Warehouse	No
Fleet Maintenance Facility	133 S. Quaker Lane	22314	1980	Not Applicable	43,120	Non-Refrigerated Warehouse	Office	No
Friendship Firehouse Museum	107 S. Alfred Street	22314	1855	1992	1,960	Office	Not Applicable	No
Gadsby's Tavern	134 N. Royal Street	22314	1773	Not Applicable	30,211	Office	Not Applicable	No
Health Department (Main Office)	4480 King Street	22302	1990	Not Applicable	60,217	Office	Medical Office	No
Lloyd House	220 N. Washington Street	22314	1797	Not Applicable	8,400	Office	Not Applicable	No
Mental Health Community Shelter / Detox	2355 Mill Road	22314	1989	Not Applicable	10,592	Residence Hall / Dormitory	Office	No
Mount Vernon Recreation Center	2701 Commonwealth Avenue	22301	1997	Not Applicable	87,958	Office	Not Applicable	No
Nannie J. Lee Memorial Recreation Center / Lee Center	1108 Jefferson Street	22314	1954	Not Applicable	84,822	Office	Not Applicable	No
Old Duron Paint Building	4109 Mount Vernon Avenue	22305	1987	Not Applicable	4,725	Office	Not Applicable	No
Patrick Henry Recreation Center	4623 Taney Avenue	22304	1973	Not Applicable	8,850	Office	Not Applicable	No
Public Safety Center	2001 Mill Road	22314	1985	Not Applicable	218,866	Residence Hall / Dormitory	Office	No
Roth Street Building	2900 Business Center Drive	22314	1987	Not Applicable	60,350	Non-Refrigerated Warehouse	Office	No
Stabler-Leadbeater Apothecary Museum	105 - 107 South Fairfax Street	22314	1806	2006	5,772	Office	Not Applicable	No
The Lyceum	201 S. Washington Street	22314	1839	Not Applicable	11,556	Office	Not Applicable	No
Torpedo Factory	105 N. Union Street	22314	1920	Not Applicable	81,990	Office	Not Applicable	No
Watson Reading Room	906 Wythe Street	22314	1994	Not Applicable	950	Office	Not Applicable	No
William Ramsay Recreation Center	5650 Sanger Avenue	22311	2001	Not Applicable	18,150	Office	Not Applicable	No

Appendix C: Glossary

Btu - British thermal unit
A unit of energy, which can represent both thermal energy and electricity. One BTU is the amount of energy required to raise one pound of water one degree Fahrenheit. It takes about 300 Btus to raise the temperature of one quart of cold tap water from 50 to 200 degrees F. These are some Btu conversions for other units of energy:

1 kWh of electricity = 3413 Btu
1 therm of natural gas = 100,000 Btu
kBtu = 1,000 Btus
mmBtu = 1,000,000 Btus

Commercial Building Energy Consumption Survey (CBECS)
A national sample survey that collects information on U.S. commercial buildings, their energy-related building characteristics, and their energy consumption and expenditures.

ENERGY STAR Rating
The 1-100 ENERGY STAR score was developed by the Environmental Protection Agency (EPA) and provides a metric for comparison with other similar buildings across the country. The score accounts for differences in climate, occupancy and operating hours. A score of 50 represents median energy performance, while a score of 75 or better indicates a building is a top performer. For more information, read How the 1-100 ENERGY STAR score is calculated.

Energy Auditing
An energy audit is a performance evaluation of current energy use and energy conservation potential typically involving both a site visit to the building and a review of energy consumption history.

Energy Benchmark
The process of comparing a building's energy performance to other similar properties, based on a standard metric. ENERGY STAR Portfolio Manager was the software used to benchmark the public buildings in this report, and the metric for comparison is Energy Use Intensity (EUI).

Energy Use Intensity (EUI)
A unit of energy, which represents the energy consumed by a building relative to its size. It is calculated by taking the total energy consumed in one year (measured in kBtu) and dividing it by the total floor space of the building (measured in square feet).

Site EUI
Site energy represents the amount of heat and electricity consumed by a building as reflected in your utility bills. This is a relevant metric for facility managers, to understand how a building's energy use has changed over time. Site EUI does not, however, account for the environmental impacts of transmission and delivery of energy. Site energy sources for public buildings in this report include: electricity, natural gas, chilled water and steam.

Source EUI
Source energy represents the total amount of raw fuel that is required to operate the building. It incorporates all transmission, delivery, and production losses. By taking all energy use into account, the metric provides a complete assessment of energy efficiency in a building.

This report does not include Source EUI for all in the benchmarking analysis.

ENERGY STAR Portfolio Manager
A free online tool (developed by the EPA) that allows building owners to measure and track energy and water consumption, as well as greenhouse gas emissions. It can be utilized to benchmark the performance of one building or a whole portfolio of buildings, all in a secure online environment. The ENERGY STAR Portfolio Manager tool was used to complete the benchmarking analysis for Alexandria government buildings

ENERGY STAR Rating
A numeric 1 – 100 score developed by the EPA that reflects the comparable performance of the rated building to other representative buildings across the country, while accounting for differences in climate, occupancy and operating hours. A high score represents high efficiency. An ENERGY STAR score of 75 denotes that the rated building performs in the 75th percentile of buildings within its category.

Environmental Protection Agency (EPA)
An agency of the U.S. federal government which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress. The EPA is the developer of ENERGY STAR Portfolio Manager tool.

Energy Signature Analysis
An analysis technique where billing data is converted to an average hourly value and plotted against average daily temperature for the billing period. When used in segment analysis it can identify differences in heating, cooling and base load consumption between buildings.

Facility Action Plan
A written action plan based on a walk through or standard audit outlining operations and maintenance issues to be addressed to reduce building energy use.

Fiscal Year
A period that a company or government uses for accounting purposes and preparing financial statements. The fiscal year may or may not be the same as a calendar year. For the OEM in Alexandria, the fiscal year starts on July 31 and ends on June 30 (of the next calendar year).

Total GHG Emissions (MtCO2e)
The metric used in this report for greenhouse gas emissions, which represent a million metric tons of carbon dioxide equivalents. Equivalent CO2 (CO2e) is a universal standard measurement for greenhouse gasses and their ability to trap heat in the atmosphere. These greenhouse gasses include carbon dioxide, methane, nitrous oxide and chloroflouro-carbons. Greenhouse gas emissions for individual buildings are calculated using the ENERGY STAR Portfolio Manager Methodology for Greenhouse Gas Inventory and Tracking Calculations.

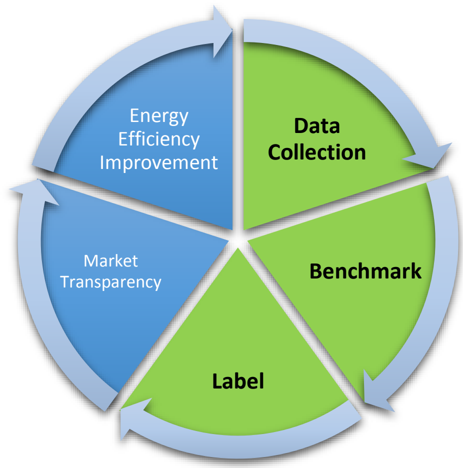
Weather Normalized
Weather normalizing adjusts building energy use data to account for year-to-year weather differences, allowing for comparison of a building to itself over time. Through this procedure, the energy in a given year is adjusted to express the energy that would have been consumed under 30-year average weather conditions.

Northern Virginia Government Building Energy Benchmarking and Labeling Plan

A GUIDEBOOK TO BUILDING ENERGY BENCHMARK

The building sector accounts for 40% of the United States primary energy consumption. Improving buildings' energy efficiency is an effective way to save energy, reduce resulting emissions, and cut energy cost.

The building energy efficiency process below shows how building benchmarking and labeling could help improve energy efficiency.



This document provides best-practice guidance to Northern Virginia Regional Commission (NVRC) member jurisdictions to implement a government building energy benchmarking and labeling program. This guidance aims to inform NVRC-member jurisdictions how to apply energy benchmarking specifically to their government buildings.

1.0 Government Building Benchmark

1.1 Background

This plan is based upon the following facts and assumptions:

1. This plan is designed for energy benchmark of existing government buildings.
2. This plan focuses on the buildings' energy Performance Benchmarking, not on Asset Benchmarking.
3. Water and sewer performance benchmarking are not included; however, they can be benchmarked using similar methods.
4. This plan uses the EPA's ENERGY STAR Portfolio Manager Tool to benchmark government buildings' energy performance.[1]

1.2 Building benchmark management

Assign a building benchmark team with access to jurisdiction's utility data and building information, knowledge on energy, and the ability to communicate across different government departments. Ideally, this team should be led by the jurisdiction's energy manager, facility manager, etc.

1.3 Select buildings to benchmark

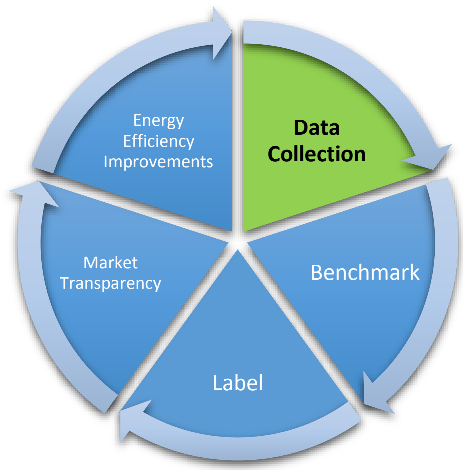
The jurisdiction's building benchmarking team should use the following criteria to select buildings to conduct benchmarking analysis:

1. Buildings with gross floor area greater than 5,000 ft^2.
2. Buildings with reliable information needed to define the buildings' characteristics, including name, address, gross floor area, year built, etc.
3. Buildings for which you can collect at minimum 12 full consecutive calendar months of energy utility/usage data.

[1] Most of NVRC's member jurisdictions are using EPA's ENERGY STAR Portfolio Manager for energy management. For those haven't been using Portfolio Manager, it is free to register and use through *EPA ENERGY STAR Portfolio Manager Website*.

1.4 Data Collection

Data collection can be challenging depending on the amount of data readily available. This section covers methods for the building benchmarking team to collect and organize required data.



Tools to collect and manage buildings' utility and property data:

Free Platforms:

- **ENERGY STAR Portfolio Manager** is a free online platform for building energy management developed by the Department of Energy.
- **Microsoft Excel** provides the ability to manually create spreadsheets to input and maintain data. You can generate simple analysis and reports using Excel.

Commercial Platforms:

- **EnergyCAP** is a utility bill and energy efficiency software for businesses, governments, and educational institutions. EnergyCAP integrates with ENERGY STAR Portfolio Manager by exporting utility data for benchmarked buildings and import performance measures.
- **Aquicore** is a web based software for utility analysis and energy savings. It provides various solutions including energy benchmarking, reporting for both government and private buildings.
- **JouleX Energy Management (JEM)** offers energy management solutions for data centers, distributed offices, and PCs.

In this plan, EPA's ENERGY STAR Portfolio Manager is recommended for building benchmarking.

1.4.1 Collect buildings' utility data

To collect building's utility data:

- **Contact jurisdiction energy management, building management, and financial office**

  Contact the jurisdictions' energy manager, building manager, or financial officer since they typically manage and pay the bills for government buildings' energy use.

- **Contact utility companies**

  Electricity and natural gas usage data may be available from the jurisdiction's utility companies. Contact the jurisdiction's electricity and natural gas utility companies to inquire about obtaining usage data for buildings that are subject to benchmarking.

- **Contact management of leased buildings**

  Contact private property managers to acquire separated utility data. A commercial building could be partially leased by government agency, thus separating utility data of the agency's office with other businesses in the building is needed.

- **Calculate energy use data by invoices**

  Calculate energy use data by invoices and time between deliveries for bulk fuels such as propane and diesel.

- **Energy Audit**

  If available, energy audit can be a good source of data.

In general, collecting utility data takes time but relatively easy to accomplish since buildings' utility data are values that had been defined, monitored, and stored.

1.4.2 Collect building property data

Building property data are essential for ENERGY STAR Portfolio Manager to perform benchmark and rating. The table below outlines required building property data for most property types relevant benchmarking of NVRC member jurisdictions.

	Building Data	Definition
Basic Information	Name	Name of the building
	Address	Address of the building
	Postal Code	Zip code of the building
	Year Built	Year the building was built
	Number of Buildings	Part of a building/one building/multiple buildings
	Occupancy Level	Percentage of the occupancy level
Property Use Details	**Type(s)**	**Type(s) of the building**[2]
	Gross Floor Area	Total floor area in squared feet or squared meters
	Weekly Operating Hours	Weekly operating hours of the building
	Number of Computers	Total number of computers in use of the building
	Number of workers on main shift	Number of workers/staffs on main shift in the building
	Percent That Can Be Cooled	Percentage of floor area that can be cooled
	Percent That Can Be Heated	Percentage of floor area that can be heated

Building property use details may vary depending upon types of buildings, for more information about what property use details data are needed, refer to: *Identify your property type*.

1.4.3 Define buildings' single/multiple type(s)

Portfolio Manager provides benchmark results for all buildings. However the 1 – 100 ENERGY STAR scores are limited to 20 of the more than 80 property types defined in Portfolio Manager. Property types have different space and energy use characteristics. Refer to: *Identify your property type* and *Property types eligible to receive a 1-100 ENERGY STAR score* for more information.[3]

Two methods for defining a building's type:

[2] For more information of field "Type(s)" highlighted in blue, refer to following section 1.4.3.

[3] For clarification, this plan unifies the terms: "primary function", "type of use", and "property type" into "building type". Portfolio Manager web-based software uses "primary function" and "type of use" while its official documentation uses "property type".

When defining building types, there are two methods available depending on the desired benchmark metrics:

1. **EUI Only Benchmark (Preferred)**

   This method is for the building benchmark team to keep track of their buildings' energy performance such as EUI (Energy Use Intensity). It also helps jurisdictions join a regional ENERGY STAR Portfolio Manager Master Account for all 80 types of buildings. As an example, it is named as "EUI Only" and shown in the yellow box below on the left.

2. **For all buildings to receive ENERGY STAR scores (Optional)[4]**

   This method is for building benchmark team to normalize their buildings' types into 20 types to get rating scores. Therefore you can compare the buildings' energy performances with similar buildings nationwide. As an example, it is named as "EUI + ENERGY STAR Score" and shown in the blue box below on the right.

EUI Only	EUI + ENERGY STAR Score
Define building functions as exactly what their functions are into the 80 functions available. E.g. A fire station should be defined as a "fire station".	Normalize building types into the 20 functions that can be rated with a score to see buildings' energy performance among similar buildings across the nation. E.g. A fire station can be defined as "office" and "non-refrigerated warehouse".

These two methods will be used throughout the following sections of the Plan.

<u>Three approaches:</u>

1. **Single type buildings**

   Single-function buildings are easy to define in Portfolio Manager. For example, Office buildings are defined as "office" for its space use.

2. **Multiple type buildings[5]**

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[4] For more information of eligibility of getting an energy performance score, see *Eligibility criteria for the 1-100 ENERGY STAR score*.

[5] For more information of defining space types, refer to: *Identify your property type* and *List of Portfolio Manager property types, definitions, and use details*.

Multiple type buildings are common. For instance, some buildings may have a data center, a library could be used as library and office, and a school might include a community center. Portfolio Manager define different types as space uses. Each different space use have its own property details. A normalized example as shown:

	Building Data		Definition
Property Use Details	**Type 1**		**Type of this space**
		Gross Floor Area	Total floor area in ft^2/m^2 of this function space
		Weekly Operating Hours	Weekly operating hours of this function space
		Number of Computers	Total number of computers in use of this function space
		Number of workers on main shift	Number of workers/staffs on main shift in this function space
		Percent That Can Be Cooled	Percentage of floor area that can be cooled
		Percent That Can Be Heated	Percentage of floor area that can be heated
	Type 2		**Type of this space**
		Gross Floor Area	Total floor area in ft^2/m^2 of this function space
		Weekly Operating Hours	Weekly operating hours of this function space
		Number of Computers	Total number of computers in use of this function space
		Number of workers on main shift	Number of workers/staffs on main shift in this function space
		Percent That Can Be Cooled	Percentage of floor area that can be cooled
		Percent That Can Be Heated	Percentage of floor area that can be heated
	Type 3		**Type of this space**
	⋮		⋮

3. Buildings with non-governmental uses

There are buildings partially rented by government and owned by commercial building owners or buildings owned by government which partially rent to commercial uses. In these cases, there are commercial space uses for other businesses in the benchmark buildings. The building benchmark team should contact building manager to extract the utility and property data of government space uses.

In general, building types are essential for Portfolio Manager to categorize different buildings for better benchmark results and rating scores.

1.5 Verify data quality

The ENERGY STAR Portfolio Manager requires reliable data to generate effective energy performance benchmark and rating. The following methods help building benchmark team verify integrity and reliability of building utility and property data.

1.5.1 Site Visits

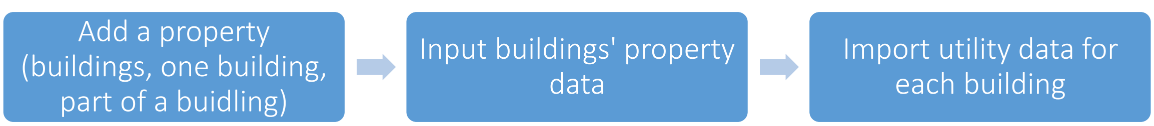
Visiting the building helps determine building type/space uses by doing field investigations. For instance, one building can have multiple space uses.

1.5.2 Communication within jurisdiction government

Communicating with various government department managers is another way of verifying data quality. For instance, such communication can be used to verify operating hours, number of PCs (where applicable), number of occupants, etc.

1.6 Input data into Portfolio Manager[6]

After all the needed data are collected, the building benchmark team should input data into Portfolio Manager. For easier data maintenance in Portfolio Manager, inputting data after completing data collection is recommended[7].



1.7 Test run Portfolio Manager benchmarking system

Once building utility and property data are entered and saved in Portfolio Manager, the benchmark results should automatically be calculated:

EUI Only	EUI + ENERGY STAR Score
Every building should have its EUI performance results.	Every normalized building should receive its Score on a 1 – 100 scale, together with EUI performance results.

[6] For more information of how to add a property/building and input utility and property data into Portfolio Manager, see: *Get started with the benchmarking starter kit* and *Enter data into Portfolio Manager*.

[7] For those jurisdictions using Portfolio Manager to collect data, verify the data inputted is recommended.

1.8 Verify data quality using Portfolio Manager

1.8.1 Data Quality Checker[8]

This built-in function of Portfolio Manager is designed to check for errors and anomalies after the data are inputted.

The building benchmark team can run a simple report to compare the building's data with typical values. This helps identify energy values and property use details that are unusual given the building's uses. It also helps identify possible typos, incorrect meter readings, missing information, incorrect units of measure, and other common data entry problems.

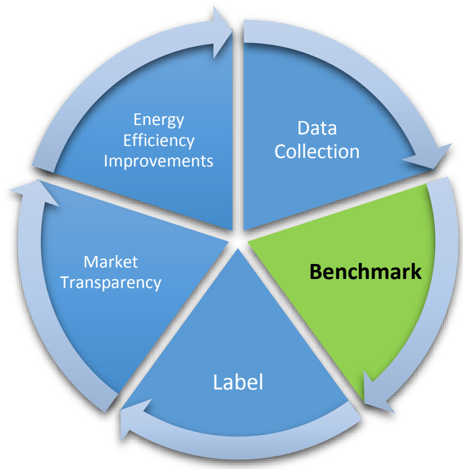
1.8.2 Sensitivity Analysis

EUI Only	EUI + ENERGY STAR Score
No need for sensitivity analysis	Check the normalization quality of building's types by changing some of the building's property use details that are estimated under certain assumptions. If some of the property use detail effect the score significantly, the team should work on getting a more precise and reasonable estimate. For instance, number of computers and number of workers on main shift.

[8] For more information of using Data Quality Checker, see: *Verify your information with the data quality checker*.

1.9 Portfolio Manager Benchmark results

After data verification using Portfolio Manager, the building benchmark team should finalize reliable results such as buildings' EUI performance or ENERGY STAR scores[9].



1.10 Produce EPLs for benchmarked buildings

Refer to 2.5 for more information to produce Energy Performance Label (EPL) for benchmarked buildings.

1.11 Generate building energy benchmark reports with analysis[10]

With benchmarking and labeling results, the building benchmark team is able to produce a report with analysis for energy efficiency improvements in government buildings. This report is ought to be updated annually b ased on yearly benchmark.

A building energy benchmark report with analysis should contain:

- List of Benchmarked buildings with distribution analysis
- Total energy consumption analysis
- Energy usage analysis by different types
- Energy use trend analysis
- Comparison of EUI among different buildings
- Top energy efficacy performing buildings
- Analysis for improvements

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[9] For more information of how the 1 – 100 ENERGY STAR score is calculated, see *ENERGY STAR score details by property type* and *ENERGY STAR® Performance Ratings Technical Methodology*.

[10] A report example: City of Alexandria's 2013 Energy Benchmark Report.

1.12 Use a regional building energy database

In addition to benchmarking and labeling government buildings, this plan also provides the basis for Northern Virginia jurisdictions to join two regional ENERGY STAR Portfolio Manager Master Accounts. In other words, this plan provides a better chance for jurisdictions to compare each of its government buildings within a regional Portfolio Manager Government Building Database for future energy efficiency improvements.

A master account is a designated Portfolio Manager account with which multiple Portfolio Manager Users can share building and energy use information.

One regional Portfolio Manager Master Account exists for use by northern Virginia jurisdictions:

- Virginia Energy Purchasing Governmental Association (VEPGA)[11]

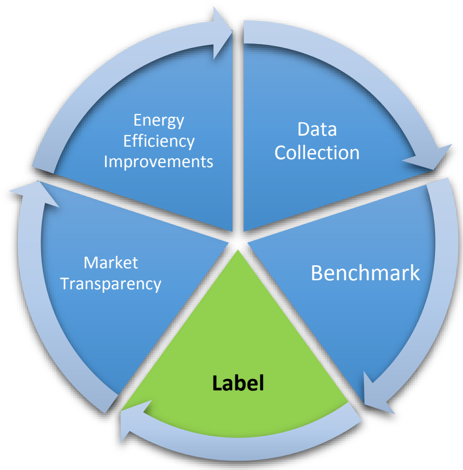
  Sharing with the VEPGA Master Account includes jurisdictions with membership in the VEPGA and covers the whole Dominion Virginia Power's service territory. This Master Account enables jurisdictions to compare the energy use of their buildings with other VEPGA members through a shared platform for peer-to-peer comparison.

EUI Only	EUI + ENERGY STAR Score
VEPGA Helps build a regional database for those building types that cannot have a score using Portfolio Manager such as Fire Stations, Animal Shelters, and Community Centers in order to compare across these types of buildings regional wide.	This method is not suggested to use for joining regional ENERGY STAR Portfolio Manager Master Accounts. For jurisdictions used this method and want to join a Master Account, it is recommended to update building types' information using "EUI Only" method.

[11] For joining the VEPGA Master Account, refer to *Share Energy Performance Data with the VEPGA Master Account*.

2.0 Building Energy Performance Label for Northern Virginia

With buildings' energy performance benchmark results, a regional government building Energy Performance Label (EPL) for Northern Virginia is needed for public display.



2.1 Purpose and expectation of the EPL

The purpose of the EPL is to increase market transparency of government buildings' energy performance in Northern Virginia; subsequently, helping Northern Virginia jurisdictions promote energy efficiency improvements in their government buildings which reduce energy use and costs, and reduce GHG (Greenhouse Gas) emissions.

The EPLs should be displayed in the entrance or other highly-visible areas of a buildings for public display. Additionally, jurisdictions may consider displaying EPLs in areas accessible to building managers and employees to promote energy efficiency improvements and energy reduction activities.

EPLs should be designed considering the following requirements:

- Clearly represents the building's energy performance
- Shows building's energy performance trend
- Easy for audience to understand
- Visually appealing

2.2 Information to display

A label should display the following building information:

- **Name and address**
- **Built date, gross floor area, weekly operating hours**
- **Energy performance score**

The ENERGY STAR Score if available, the score can be generated using "EUI + ENERGY STAR Score" benchmark method.

- **EUI performance and trend**

  The building's annual EUI performance and trend on a three-year basis.

- **Comparison with national/regional average**

  Comparison with national/regional similar type buildings' average performance. Or a green model average performance.

- **Resulting GHG emissions**

  The building's resulting GHG emissions showing a three-year trend.

- **Energy use detail and equivalences[12]**

  The building's energy use detail and equivalences in understandable terms.

  - Total electricity use XXX kBtu = XXX number of typical U.S. households (annually)
  - Total natural gas use XXX kBtu = XXX number of typical U.S households (annually)

- **Energy efficiency improvements**

  The past or undergoing energy efficiency implementations/improvements in the building.

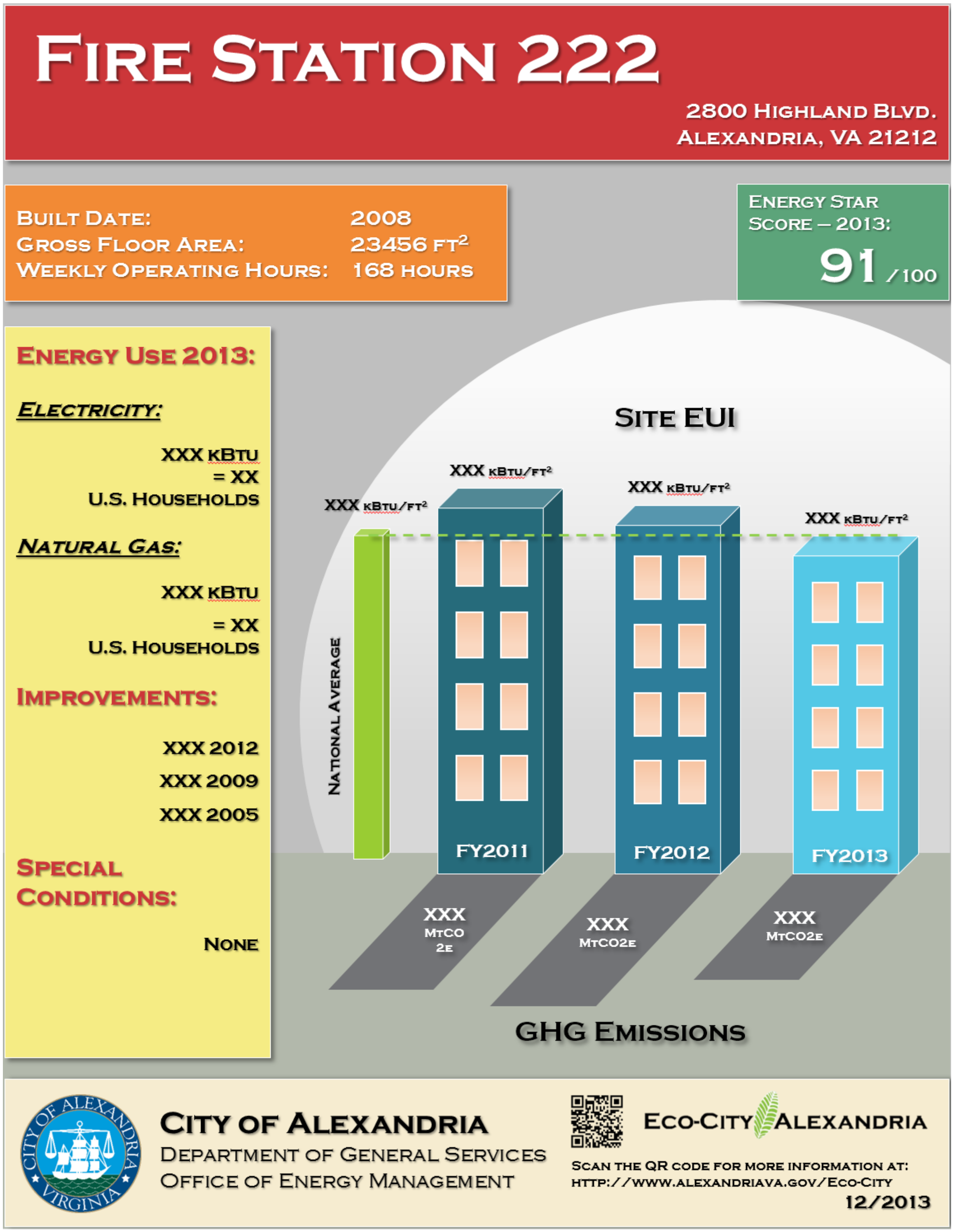
- **The jurisdiction's information with available reference link or QR code.**

2.3 Label graphic prototype

The following example EPL displays recommended information and graphic design elements.

[12] For information of equivalences to a number of U.S. Households, use the data available at *EIA's AEO Table browser* to calculate. Notice always use the most current year's information to calculate.

Formula:
$$\textit{Electricity equivalence} = \frac{\text{The building's Annual Electricity use}}{\frac{\text{Purchased Electricity Delivered Energy}}{\text{Total Households}}},$$
$$\textit{Natural Gas equivalence} = \frac{\text{The building's Annual Natural Gas use}}{\frac{\text{Natural Gas Delivered Energy}}{\text{Total Households}}},$$



2.4 EPL Instruction

Instruction for reading the EPL and the included information and design elements is provided. Jurisdictions may wish to publish an instruction guide similar to below that provides the public an overview of how to read an EPL.

The building's Name and address.

The basic building characteristics and use properties.

Energy Use:

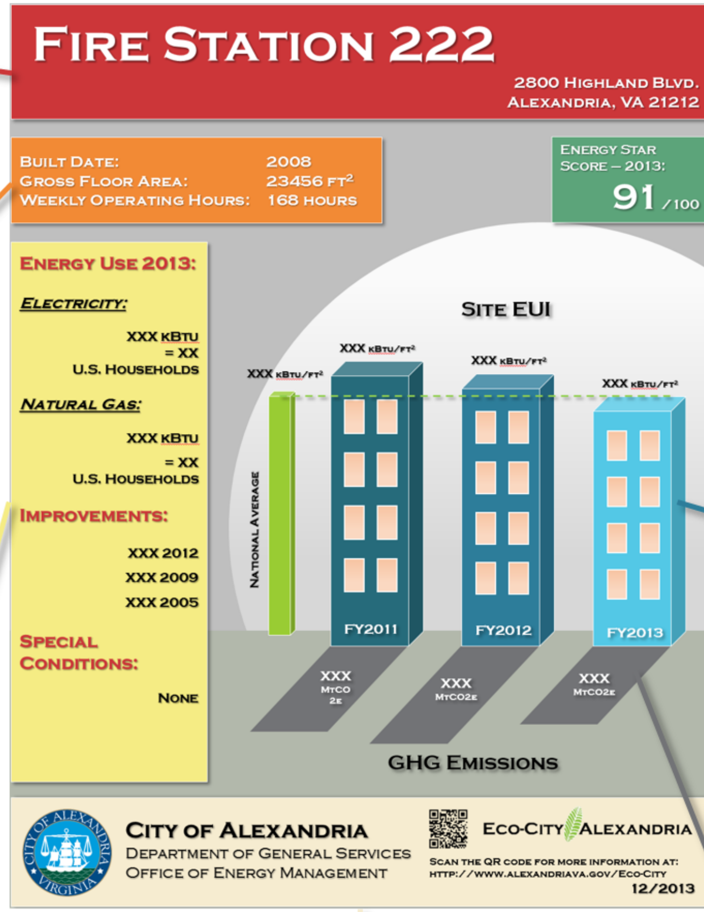
The building's most current energy use information including both electricity and natural gas usage with equivalence to a number of average U.S households.

Improvements:

The past or undergoing energy efficiency improvements.

Special Conditions:

The building's uniqueness, e.g. a building entirely powered by electricity.



Left:
The jurisdiction's information with logo and building benchmark team's information.

Right:
The jurisdiction's local energy program if applicable, reference link with QR code for more information, and the time the label was produced.

The building's ENERGY STAR score rated by Portfolio Manager if applicable.

Site – EUI:

The building's annual EUI (Energy Use Intensity, measured in kBtu/ft²) performance trend during the most recent 3 fiscal years. The building height is linearly related to the building's annual EUI performance.

National Average:

The national/regional average site EUI performance for similar type buildings. The green line represents the baseline for these averages.

The building's annual GHG (Green House Gas, measured in MtCO2e) Emissions trend for the most recent 3 fiscal years. The shadow height of the building is linearly related to the building's resulting GHG Emissions..

2.5 General process to produce a label

The EPL is designed using ENERGY STAR Portfolio Manager Benchmark results. Most of the information displayed on the label is easy to generate using Portfolio Manager.

1. Checklist for information needed to generate an EPL[13]:

	Elements	Definition
	Building Basic Information	Name, Address, Year Built, Gross Floor Area, Weekly Operating Hours
	Jurisdiction's Information	Jurisdiction Logo, Energy Benchmark Team, Online sources reference link
	Building Special Conditions	Special Conditions
	Energy efficiency improvements	Past/Undergoing applications/implementations of Energy Efficiency improvements of the building
	Energy performance score	ENERGY STAR score
	EUI performance data	EUI values for most recent 3 years
	Total Electricity and Natural Gas use	Electricity and Natural Gas use of the most current year
	Energy use equivalences	Total electricity use past fiscal year Total natural gas use past fiscal year
	GHG emissions	GHG emissions for most recent 3 years
	National/Regional Average	The national average EUI performance of similar type buildings provided by ENERGY STAR Portfolio Manager

2. EPL customization:

   The example EPL is designed using Microsoft PowerPoint. The EPL template is available on Google Drive at *Northern Virginia Government Building Energy Performance Label Template*. However, jurisdictions may wish to use other graphic design or publishing software to design and produce an EPL.

3. Generate QR code to jurisdiction's website using Scanlife

   Refer to *Get Started* to create a QR code and generate simple analysis of the QR code generated for free using Scanlife.

4. Input information to the right section of the label using EPL instruction as guidance. Building height and shadow height are easily scalable.

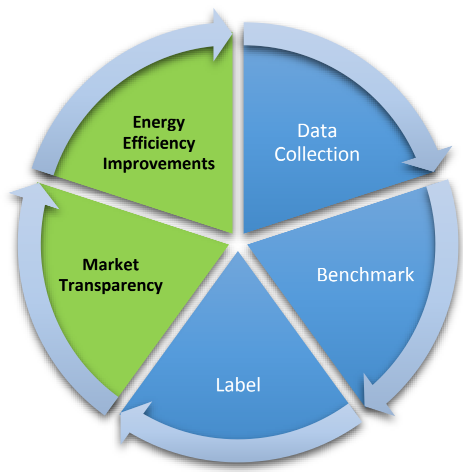
[13] For more detailed explanation, refer back to 2.2.

2.6 Feedback and future improvements on the label

The example EPL's suggested information and graphic design elements are intended to be continually improved through feedback, innovations in public communication of energy efficiency information, and best practice in public engagement. Jurisdictions should consider using the provided example as a prototype to engage their stakeholders to solicit feedback and suggestion in order to develop a final version. The example EPL's content is intended to be updated annually; however, EPLs may be updated more frequently depending on capabilities and desired outcomes.

3.0 Future Efforts

Through NVRC member jurisdictions' efforts to performing benchmarking and labeling, this plan outlines a path to influence market transparency and inform and promote energy efficiency improvements in the region's local government buildings. In addition, this plan serves as a foundational model for guiding private commercial buildings to conduct voluntary benchmarking and labeling in the Northern Virginia. Ultimately, using this plan to inform and promote energy efficiency investments in Northern Virginia jurisdictions' government buildings, will contribute to Northern Virginia jurisdiction's efforts of reducing energy use and costs, and greenhouse gas emissions



Appendices:

Appendix A: List of Acronyms

Acronym	Definition
NVRC	Northern Virginia Regional Commission
EPA	Environmental Protection Agency
JEM	Joulex Energy Management
EUI	Energy Use Intensity
GHG Emissions	Greenhouse Gas Emissions
EPL	Energy Performance Label
VEPGA	Virginia Energy Purchasing Government Association
MtCO2e	Million Metric tons of Carbon Dioxide equivalence
kBtu	kilo British thermal unit
ft^2	Squared feet
QR Code	Quick Response Code

Appendix B: List of Definitions

Term	Use	Definition
Performance Benchmarking	Used in this plan	The operational performance benchmark of the building energy use
Asset Benchmarking	Not in consideration in this plan	The designed hardware benchmark of the building
Property	Building *Property* Data	The properties of a substance or object are the ways in which it behaves in particular conditions.
	Property Use Details	A property is a building and the land belonging to it.
	Property Type	
Building type	*Type of use*	All mean the building type
	Primary function	
	Property type	
	Space type	

Implementing Voluntary Commercial Building Energy Benchmarking,

Disclosure, and Labeling Programs in Northern Virginia:

Key Considerations

Purpose

Buildings comprise about 40% of energy use in the United States. Significant energy and cost savings opportunities exist in buildings in both the public and private sectors where appropriate efforts and energy efficiency improvements are made. The public is generally not aware such savings are available, and it is essential to increase market transparency to gain public awareness – to increase demand so they will ask for proof that the buildings they purchase or rent are energy efficient. The purpose of the building energy benchmarking and labeling program is to increase public awareness of energy efficiency in commercial buildings.

Voluntary Program

Commercial building benchmarking programs have recently been implemented in many cities across the United States, including Washington, DC, New York City, Philadelphia, Minneapolis, San Francisco, and Chicago. These programs include mandatory participation from private commercial building owners and operators meeting program requirements. Unlike these programs, commercial benchmarking program implementation in Northern Virginia cannot be made mandatory. Therefore, participation in any benchmarking programs in Northern Virginia must be completely voluntary. The advantage of volunteer format is that doesn't require new policy implementations to address privacy issues. Avoiding new policy creation would save time and money designing and launching the program. In light of the requirement that program participation only be voluntary, one recommendation for implementation may be to establish a friendly competition among participants. By implementing a voluntary commercial building benchmarking program as a competition, a jurisdiction can leverage the competitive nature of participants to encourage continuous effort towards community energy reduction goals.

Policy Considerations

Many policy considerations exist to implement a voluntary commercial building benchmarking program. Data privacy is an important consideration to address regarding a commercial building benchmarking program. Building owners have a proprietary right to their utility data. Utility data from a building belongs to the building owners, tenants, or building managers who occupy the space. Moreover, business sensitive buildings and operations, such as data centers, may not wish to share energy use or building benchmarking information in order to maintain business advantage over competitors. Therefore, it is at the discretion of the program participant to share their utility use and building benchmarking information.

Target Audience

It is critical to target the right audience to participate in the program. Keeping program participants motivated and engaged is a key factor to a successful voluntary building benchmarking program competition. One key way is to find and encourage participation by “early adopters”. Such early adopters may be building owners or operators who are already conducting building benchmarking and may wish to compete against peers. To identify early adopters, program administrators may wish to reference participants in the US Department of Energy’s Better Buildings Alliance and Better Buildings Challenges or the United States Green Building Council’s Green Building Information Gateway (GBIG).

The Better Buildings Alliance is a U.S. Department of Energy (DOE) effort to promote energy efficiency in U.S. commercial buildings through collaboration with building owners, operators, and managers. Members of the Better Buildings Alliance commit to addressing energy efficiency needs in their buildings by setting energy savings goals, developing innovative energy efficiency resources, and adopting advanced cost-effective technologies and market practices. There are a number of companies participating in the Better Buildings Alliance that also own property in the Northern Virginia market.

The Better Buildings Challenge supports commercial and industrial building owners by providing technical assistance and proven solutions to energy efficiency. The program also provides a forum for matching Partners and Allies to enhance collaboration and problem solving in energy efficiency. Both Partners and Allies are publically recognized for their leadership and innovation in energy efficiency and would likely be early adopters to a commercial building benchmarking and labeling program.

Administrative Requirements

Two important administrative requirements should be considered to organize a voluntary building benchmarking program. First, identifying an organization who will play a leadership role. Second, identify a way to obtain utility data from participating buildings. Ideally, one organization will be in charge of preparing for the program, from start to the end, to avoid confusion and miscommunication between multiple partners. Utility data is a necessity for benchmarking in this program. Make sure that participants have access to their energy use each month to monitor their improvements.

Technology Infrastructure

There are multiple tools available to use when benchmarking a building's energy performance. These tools are reviewed below. The program administrator should select one tool for consistency across the program.

ENERGY STAR Portfolio Manager

U.S. EPA ENERGY STAR Portfolio Manager is a free online building energy benchmarking program developed by the U.S. EPA. Portfolio Manager generates ratings based on world-wide average energy performance. It measures the as operated performance of the building. There are 80 benchmarkable building types, and 20 ratable building types. This means that an Energy Use Index can be calculated for 80 building types, and 20 building types can be scored on a 1-100 scale, allowing comparison with other similar buildings nationwide.

Energy IQ

Energy IQ is building performance benchmarking tool for non-residential buildings. This was developed by Lawrence Berkeley National Lab. This program provides a deeper (and complementary level of analysis) compared to more generalized whole-buildings tools such as the ENERGY STAR Portfolio Manager. EnergyIQ benchmarks energy use, costs, and features for 72 building types. The program provides a carbon-emissions calculation for the energy consumed in the building, and overall carbon footprint.

Commercial Building Energy Asset Scoring Tool

The Commercial Building Energy Asset Score is a national standard for a voluntary energy rating system evaluating the physical characteristics of building as built and its overall energy efficiency independent of occupancy and operational choices. This Asset Scoring Tool will generate an asset score and system evaluations for the building envelope and mechanical and electrical systems. The Asset Scoring Tool will also identify cost-effective upgrade opportunities, to help the building's owners and occupants gain insight into the energy efficiency potential of the building. This Commercial Building Energy Asset Score program is in the pilot stage as of 2013, and only Pilot Participants are granted access to the Asset Scoring Tool. Though it is not available to public, development of this program should be monitored as it moves forward.

Partner and Trader Organizations

The corporation with partner and trader organizations would greatly help the success of the program. Some of the suggested partner organizations and their contact information are listed below.

Commercial Real Estate Development Association (NAIOP)

Website: http://www.naiop.org/
Phone: 703 – 904 – 7100
Fax: 703 – 904 – 7942
Address: 2201 Cooperative Way, Suite 300, Herndon, VA 20171 – 3034

Since 1967, NAIOP, the Commercial Real Estate Development Association, has become the leading organization for developers, owners and investors of office, industrial, retail and mixed-use real estate. NAIOP comprises 15,000+ members and provides strong advocacy, education and business opportunities through a North American network.

NAIOP is a leading commercial real estate industry provider of unparalleled networking opportunities, educational programs, research on trends and innovations and strong legislative representation.

Apartments and Office Building Association (AOBA)

Website: http://www.aoba-metro.org/
Phone: 202 – 296 – 3390
Fax: 202 – 296 – 3399
Address: 1050 17th Street, NW, Suite 300, Washington D.C. 20036

The Apartment and Office Building Association of Metropolitan Washington (AOBA) is the leading membership organization representing commercial and multi-family residential real estate in the Washington D.C. area. Serving members since its establishment in 1974, AOBA continues to protect and enhance the value of its members' investments through effective leadership and advocacy, information exchange, and professional development.

AOBA members are owners or managers of commercial and multi-family residential properties, as well as companies that provide products and services to the real estate industry. Currently, the combined portfolio of AOBA's membership is approximately **170 million square feet** of commercial office space and **245,000 residential units** in the District of Columbia, Maryland and Virginia.

With six lobbyists on staff, AOBA's non-partisan government affairs activities in DC, Maryland and Virginia provide members with substantial savings in utilities, property taxes and other regulatory fees-- savings that enhance value to owners, tenants and residents.

Building Owners and Managers Association Internationals (BOMA)

Website: http://www.boma.org/Pages/default.aspx

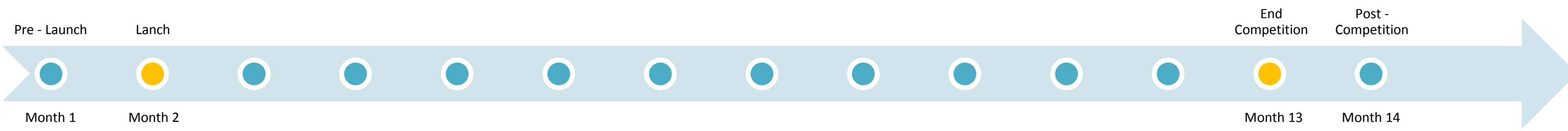
The Building Owners and Managers Association (BOMA) International is a federation of 93 BOMA U.S. associations, BOMA Canada and its 11 regional associations and 13 BOMA international affiliates. Founded in 1907, BOMA represents the owners and managers of all commercial property types including nearly 10 billion square feet of U.S. office space that supports 3.7 million jobs and contributes $205 billion to the U.S. GDP. Its mission is to advance the interests of the entire commercial real estate industry through advocacy, education, research, standards and information.

BOMA International is a primary source of information on building management and operations, development, leasing, building operating costs, energy consumption patterns, local and national building codes, legislation, occupancy statistics, technological developments and other industry trends.

BOMA International's members are building owners, managers, developers, leasing professionals, corporate facility managers, asset managers, and the providers of the products and services needed to operate commercial properties

Marketing Plan

This marketing plan is for 1 year energy benchmarking competition. It has been developed with a similar approach to what was used in the Arlington Green Games. The timeline for the program would be as follows.



Pre-Launch Period

This is the most important part of organizing a program; preparation. During this time, an operator needs to identify building owners who would be willing to participate, especially those early-adopters mentioned above. Personally visiting these potential competitors is one of the most effective ways to stay in touch, but this method would take time. Besides site visits, potential participants can be reached by cold calls and meetings, whether face to face or conference calls. The key thing is to keep those who are motivated involved as much as possible.

Launch the Program

When launching the first program, an opening ceremony might be appropriate to celebrate the start. This is not recommended that a ceremony be repeated each year of the program since event like this requires considerable time, effort and money.

Running the Competition

During the competition, it is important to keep participants motivated through special events and recognitions. To raise awareness on "green building", to the program administrator can engage building owners by organizing site visits to recycling centers, wastewater treatment plants, utility companies and other facilities that are related to contributing building's overall energy usage. This will help owners understand how energy is generated/distributed to the site, and how waste materials are treated. Familiarizing with such processes will increase transparency of issues around energy use and waste.

Another way is to have training sessions on how to reduce energy use. Webinars might be helpful for building owners who cannot attend session. These regular meetings will help those motivated owners stay in touch with each other to encourage further improvements.

To encourage those facilities that are doing well in the competition, they could be recognized by being announced on the official Website for the program or other form of advertisement.

Post-Launching Period

After the competition is completed, it is important to recognize those who have shown significant improvements. Press coverage on the local newspaper, celebration event with the mayor or the area, special incentives on tax or rebates would be a nice way to congratulate their efforts. This could have an impact on the number of participants for future competition if this marketing could draw general public's attention. Conducting a case study on successful examples is another way to recognize, and also to analyze how some buildings performed better than the others. By doing this, it will help preparing for the future competition.

Marketing Items

Marketing items can be a strong tool to attract people's attention to the program. Flyers, pens, posters, and giveaways are typical way to advertise. Not only these items help promote the event, but they also encourage participants to stay active in the competition. For example, a template of the event flyer could be customized by building owners for their internal use. Depending on the types of building, the owner may want to focus on reducing the materials waste, increasing the recycling awareness, or energy savings efforts. Restaurants may want to encourage employees to reduce the food waste, while offices may want employees to recycle papers. By expressing the needs personalized to the building, the occupants will be more likely to put effort toward the goal.

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Appendices

A. Alexandria

Alexandria (2013a) is an independent city (Virginia cities have no county affiliation), which derives its governing authority from a charter granted by the Virginia General Assembly. Changes in the structure and powers of the City government are made by amending the Charter. This requires action by the General Assembly, usually upon the request of the City Council, following public hearings. The present City Charter was granted in 1950; it was amended extensively in 1968, 1971, 1976, and 1982.

Figure A-1: View of the City of Alexandria (The Next Web, 2013)

By referendum in 1921, an overwhelming majority of the voters approved the adoption of the council-manager form of city government, which went into effect in September 1922. This form of government centralizes legislative authority and responsibility in the elected City Council. Administrative authority and responsibility are held by the City Manager, who is appointed by the City Council.

The Alexandria City Council (City of Alexandria, 2013a) is composed of a Mayor and six Council members who are elected at-large for three-year terms. Any in-term vacancy is filled by a special election unless the vacancy occurs within six months of the end of the term, at which time a judicial appointment is made. The Mayor, who is chosen on a separate ballot, presides over meetings of the Council and serves as the ceremonial head of government. The Mayor does not have the power to veto Council action. Council members traditionally choose the person receiving the most votes in the election to serve as Vice Mayor. In the absence or disability of the Mayor, the Vice Mayor performs the mayoral duties. The Mayor receives $30,500, and other Council members receive $27,500 per year.

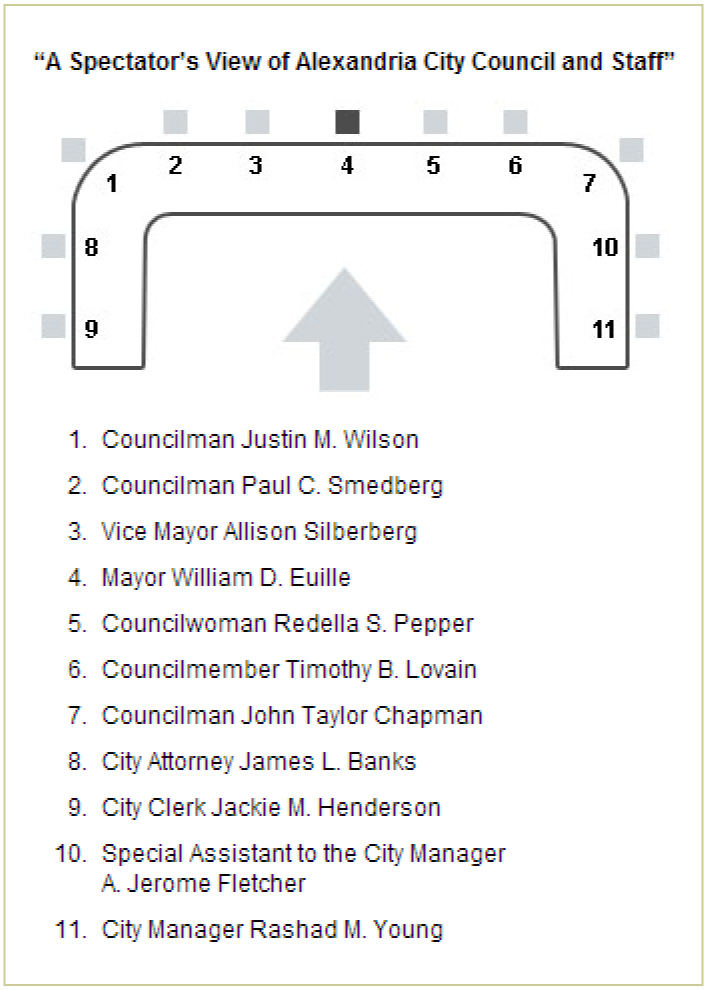

Figure A-2: "A Spectator's View of Alexandria City Council and Staff" (City of Alexandria 2013a)

Council determines the needs to be addressed and the degree of service to be provided by the administrative branch of the City government. Under Alexandria's Charter, the Council has power to:

- Determine policy in the fields of planning, traffic, law and order, public works, finance, social services, and recreation;
- Appoint and remove the City Manager;
- Adopt the budget, levy taxes, collect revenues, and make appropriations;
- Appoint and remove the City Attorney;
- Authorize the issuance of bonds by a bond ordinance;
- Appoint and remove the City Clerk;
- Establish administrative departments, offices, and agencies;
- Appoint members of the Planning Commission, and other City authorities, boards, commissions, and committees;
- Inquire into the conduct of any office, department, or agency of the City and make investigations into municipal affairs;
- Provide for an independent audit; and
- Provide for the number, titles, qualifications, powers, duties, and compensation of all officers and employees of the City.

Legislative meetings of City Council are held on the second and fourth Tuesdays of each month at 7:00 p.m. in Council Chambers, located on the second floor in City Hall. Public hearings are generally held on the Saturday following the second Tuesday in each month at 9:30 a.m. During July and August, City Council is in recess; however, special meetings may be held if the Council finds them necessary. The City Council operates under the Virginia Freedom of Information Act, which bars closed executive sessions of the Council, except for discussions on matters relating to personnel, pending litigation, and land acquisition.

Rules of procedures and speaker forms for those who wish to appear before the Council can be obtained from the Office of the City Clerk and in Council Chambers immediately before the convening of any public hearing. In addition, persons wishing to speak may telephone the City Clerk's Office during business hours and ask staff to prepare a speaker's form for them in advance of the Council meeting. Speaker's forms may also be submitted electronically by using the form posted on the City's website. Electronic forms must be transmitted by 5:00 p.m. on the day preceding the public hearing.

Each Council member has one administrative assistant to help with secretarial and administrative tasks as required. Administrative assistants may assist any Council member in any election campaign in Virginia except the member for whom the assistant works.

The City of Alexandria (2013b) has a long tradition of leadership in community environmental and energy action. In 2009, the Alexandria City Council adopted the Eco-City Alexandria Charter establishing guiding principles for environmental sustainability for the Alexandria community. In 2011 and 2012, the Alexandria City Council adopted the City's Environmental Action Plan 2030 and Energy and Climate Action Plan, respectively. As a result, the Office of Energy Management was formed to manage the City's energy use and implement energy efficiency, energy conservation, and clean energy solutions in City operations and reduce the City's greenhouse gas emissions.

B. NVRC

The Northern Virginia Regional Commission (NVRC) was established pursuant to Articles 1 and 2, Chapter 34, of the Acts of the Virginia General Assembly of 1968, subsequently revised and re-enacted as the Regional Cooperation Act under Title 15.2, Chapter 42 of the Code of Virginia. The mission of NVRC is to encourage and facilitate local government cooperation in addressing environmental, social, and economic issues within the North Virginia district. The Commission's chief roles and functions have focused on providing information, performing professional and technical services for its members, and serving as a mechanism for regional coordination. NVRC is recognized as the primary representative of the Northern Virginia perspective, relating the region's interests to state government, to other geographic areas of Virginia, and to the nearby metropolitan area.

Figure B-1: Map of Northern Virginia

Current programs and projects address a wide array of local government interests including energy security, energy efficiency, renewable energy integration, and environmental sustainability. Specifically, NVRC leads the development and implementation of community energy planning (CEP) programs in Northern Virginia, promoting large-scale energy efficiencies for new and existing homes and buildings, both publicly and privately owned.

NVRC is a regional council of fourteen member local governments in the Northern Virginia suburbs of Washington DC. According to Virginia's Regional Cooperation Act, NVRC is recognized as a political subdivision (a government agency) within the Commonwealth. The current member governments of NVRC include the counties of Arlington, Fairfax, Loudoun, and Prince William, and the towns within their boundaries; and the Cities of Alexandria, Fairfax, Falls Church, Manassas and Manassas Park (NVRC Bylaws, 2008).

Any county, city or town in Northern Virginia may become a member of the Commission, provided it has a population of more than 3,500 and adopts and executes the Commission's Charter Agreement. The Commission is composed of representatives of the member governmental subdivisions, on the basis of one member of each governmental subdivision who shall be the chief elected officer from the governing body or his/her designee. Each appointed representative is obligated to serve on NVRC's board of 25 Commissioners. In addition, each governmental subdivision appoints one additional representative from its governing body for each population of 150,000 or fraction thereof, in excess of 100,000 residents (NVRC Bylaws, 2008). Only elected officials may be appointed, and the number of representatives per jurisdiction is strictly population-based.

The Commission is comprised of three officers including Chairman, Vice Chairman, Treasurer, and Executive Director. The Chairman is responsible for signing all acts or orders necessary to carry out the will of the Commission. In the Chairman's absence, the Vice Chairman will assume all duties and exercise all the powers of the acting Chairman. The Treasurer is the official custodian of Commission funds and is responsible for ensuring their security and records the source of all monies. Authorization for expenditures is the responsibility of both the Treasurer and the Executive Director. In addition, NVRC has five primary standing committees consisting of an executive committee, operations committee, legislative committee, communications committee, and a nominating committee, all of which have responsibilities outlined in the NVRC charter agreement and bylaws.

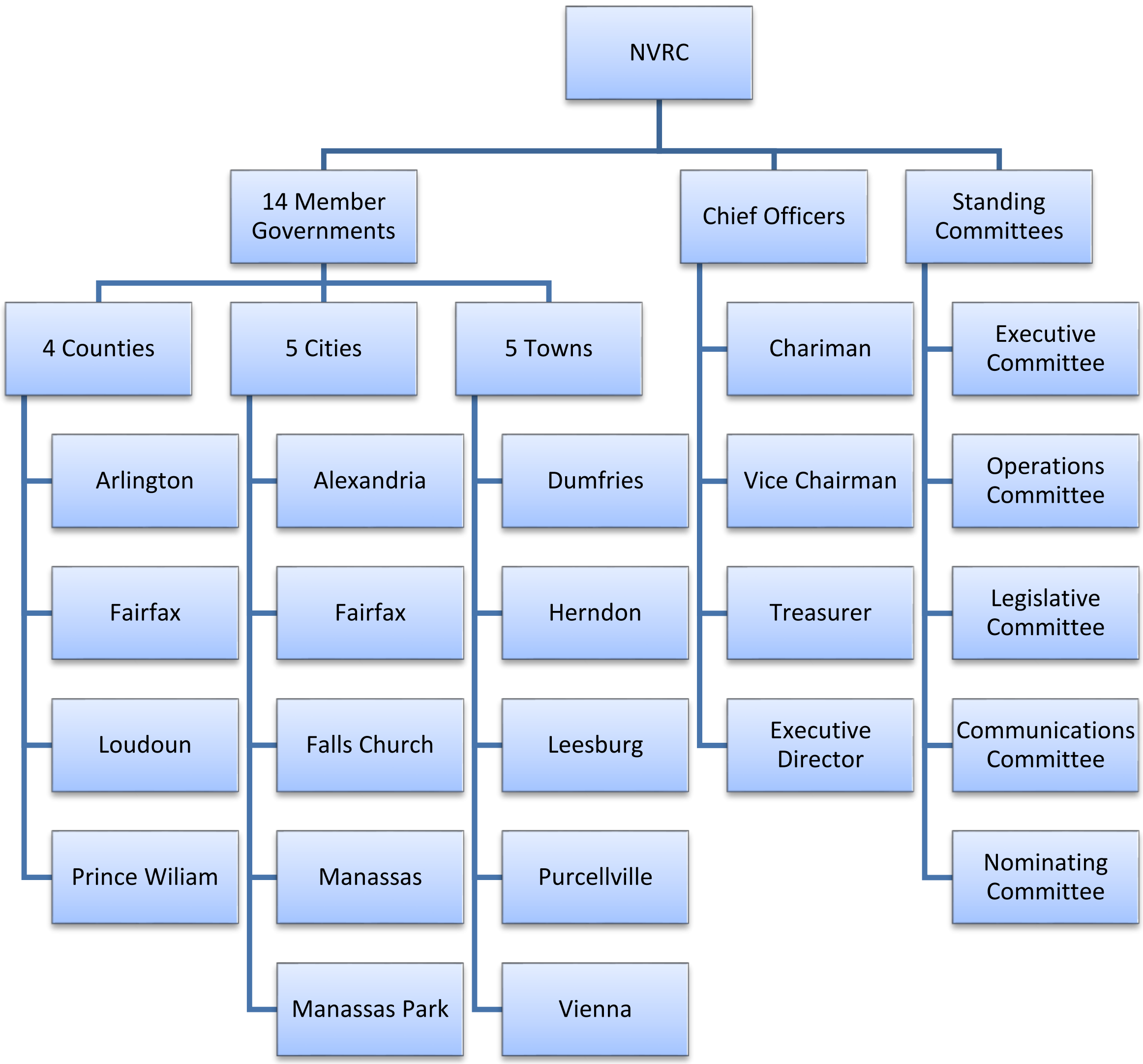

Figure B-2: Structure of NVRC

NVRC is identified as a public and non-profit organization. The work of the NVRC is supported by annual contributions from its member local governments, by appropriations of the Virginia General Assembly, and by a variety of grants, contracts, and fees from both governmental and private sector sources. The Commission is served by a highly trained staff, including a demographer and research analyst, regional planners, a civil engineer, human services professionals, technicians, and administrative support personnel (NVRC, 2013). NVRC has employed twenty-two full time individuals, five of which are devoted to the development and implementation of a Regional Energy Strategy that complements and supports local energy plans.

The core objective of NVRC's Regional Energy Strategy is to facilitate implementation of regional actions to achieve energy efficiencies, meet greenhouse gas emission reduction goals, and increase the region's overall sustainability (NVRC Regional Energy Strategy, 2011). The communities in Northern Virginia have created a new paradigm for addressing energy and climate issues. Arlington and Loudoun counties have partnered with the Commission to complete comprehensive energy planning processes that link efficiency, heat recovery, renewables, distribution, transportation and land-use development with quantitative short, medium and long-term goals and performance benchmarks.

In order to uphold the newly adopted Regional Energy Strategy, NVRC is partnering with the Local Energy Alliance Program (LEAP) and local governments in the region to offer a new energy efficiency service to homeowners in Northern Virginia (NVRC Regional Energy Strategy, 2011). LEAP has initiated a soft launch, working with certified contractors to complete the first Home Performance with ENERGY STAR (HPwES) jobs. NVRC ad hoc Energy Committee, the most relevant office to our project work, provides direction on the development of the Regional Energy Strategy, ensuring that the effort remains on target to achieve local energy planning goals. In addition, NVRC has also partnered with the Metropolitan Washington Council of Governments (MWCOG) and the Climate, Energy and Environment Policy Committee (CEEPC) to help assist the efforts outlined in the Regional Energy Strategy.

The Department of Energy (DOE) and the United States Environmental Protection Agency (US EPA) are two well-known government organizations helping to promote environmental sustainability and the use of renewable energies. In particular, NVRC continues to utilize the US EPA ENERGY STAR Portfolio Manager as an online tool to measure and track energy and water consumption, as well as greenhouse gas emissions. The Commission also adopted the US DOE Asset Rating System, which measures the "as-built" efficiency of commercial buildings, similar to the MPG rating for cars. It allows building owners and managers to receive a score based on the energy performance data extract of existing mechanical and electrical systems, and other major energy-using equipment in the building. By interfacing with the Portfolio Manager, building managers are able to benchmark their actual energy use against the building's potential energy efficiency.

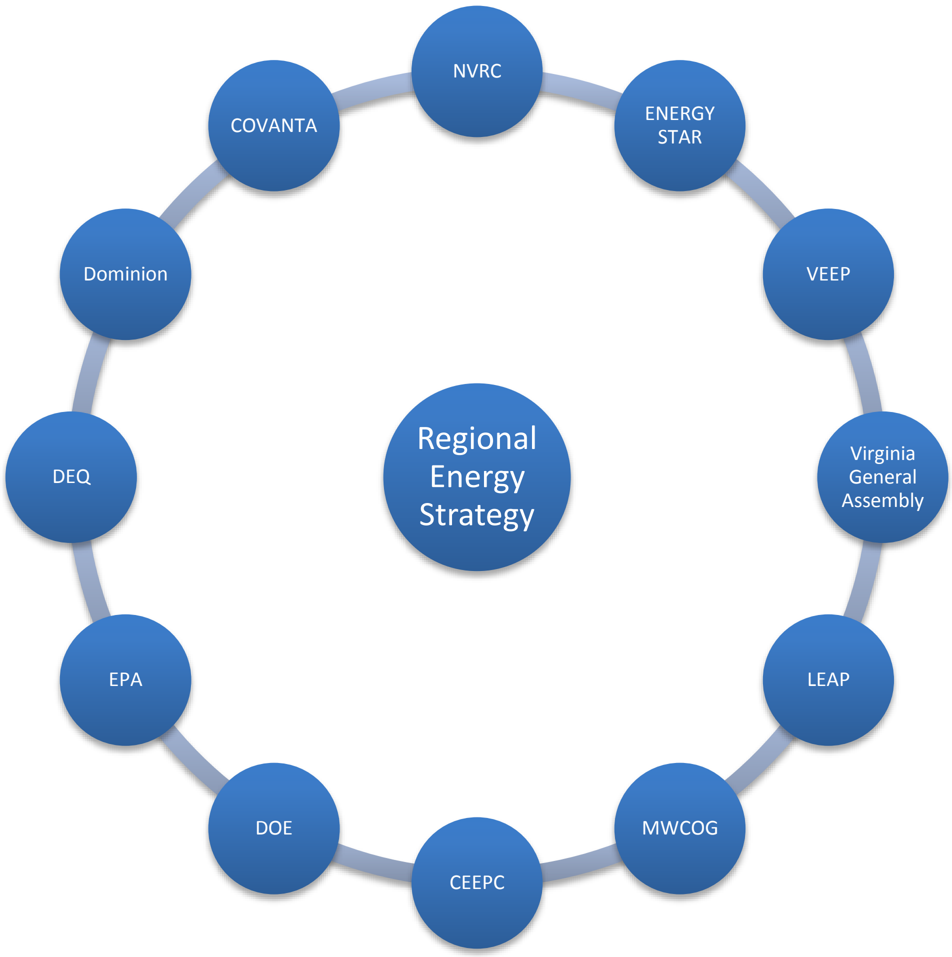

Figure B-3: All affiliated (public and private) agencies and programs supporting the Regional Energy Strategy

The Virginia Environmental Excellence Program (VEEP), sponsored by the Department of Environmental Quality, was established to encourage superior environmental performance. VEEP drives environmental excellence by encouraging facilities and organizations within the Commonwealth that have strong environmental records to go above and beyond their legal requirements. The program has been in place since 2000 and currently has over 450 members. In

2012, VEEP participants contributed to lowered levels of waste disposal, energy and water usage, which led to total savings of over $107 million (DEQ, 2013). NVRC is also directly affiliated with the Department of General Services in the City of Alexandria, which proactively manages the City’s assets to support the delivery of services to the City of Alexandria, and responding to these service requests in a timely manner.

Several private sector businesses also help NVRC pursue their green energy objectives. For instance, the Commission is known to coordinate regional solar demonstrations with Dominion Virginia Power, one of the nation's largest producers and transporters of energy, with a portfolio of approximately 27,000 megawatts of generation, 11,000 miles of natural gas transmission, gathering and storage pipeline and 6,400 miles of electric transmission lines (Dominion, 2013). COVANTA Alexandria/Arlington, Inc., also known as the Alexandria/Arlington Resource Recovery Facility, has three 325 ton-per-day furnaces process 975 tons of solid waste, generating up to 23 megawatts of renewable energy that is sold to Dominion Virginia Power Company (COVANTA Energy, 2013). In 2011, the COVANTA facility was named the Large WTE Facility of the Year in the combustion category by the American Society of Mechanical Engineers (ASME) in recognition of its strong environmental and safety performance record.

C. Interview with IMT personnel

Interviewee: Andrew Burr
Interviewers: Nathan Costa, Mai Tomida, and Jiedong Wang
Topic of Discussion: Building Energy Performance Policy
Type: Structured

Date: November 7, 2013
Location: 1707 L St. NW #1050, Washington, D.C. 20036
Recorded By: Nathan Costa

Background of Interviewee:

Andrew Burr is the Director of Building Energy Performance Policy and is responsible for overseeing IMT's policy and advocacy initiatives related to building energy performance and transparency. Andrew is a frequent advisor on legislative and regulatory policy to local, state, and federal government agencies, as well as environmental groups and large companies in the real estate and power sectors. He leads IMT's work on the City Energy Project, a joint initiative with the Natural Resources Defense Council to advance integrated energy efficiency policy frameworks in America's largest cities.

Questions (and Answers)**:**

1. What is IMT's building energy performance policy? What were some of the steps needed to implement this policy? What types of people were involved?

IMT has assisted nine U.S. cities including New York City, Seattle, Austin, San Francisco, and Washington, D.C. in developing energy performance policies that involve:

- Benchmarking building energy use
- Creating building energy codes
- Selecting building sizes/types to target
- Ensure compliance from utilities
- Reaching out to building owners
- Deciding when policies take effect
- Creating sustainable policies
- Prioritizing goals of city council to coordinate energy strategies
- Committing to work with city following implementation

2. How has IMT evaluated the success of current building energy benchmarking practices in cities/states across the U.S.?

There are three types of success:

- Raising awareness about energy efficiency
- Creating transparency within the market
- Actualizing energy savings

3. In your opinion, which cities/states have successfully implemented energy benchmarking policies? What has made them successful?

U.S. cities and states have adopted both mandatory benchmarking requirements and voluntary programs. There needs to be support for both cases, and the community outreach education effort is critical for success.

Pilot programs are not necessary if the policies are crafted properly. In other words, we already know what works and what does not work.

4. What are some of the barriers preventing policy implementation in other cities/states? How can these barriers be avoided beforehand?

The issue is that the utility companies are involved in the process. Benchmarking requires utility bills, and most of the utility companies do not want to take the risk of sharing customers' building information. Also, different buildings have different number of tenants and meters, which makes the benchmarking process even more complicated. If tenants choose not to share their utility bills, the building owner has no legal right to collect such information. The solution to this problem would be to help owners benchmark by engaging utility companies and getting them to "sum up" or aggregate energy data of the building as a whole. The best way to engage utility companies is to have them see the benefits of providing utility data.

5. How do you determine the right mix of policies and programs that are likely to succeed in a local market? What are some of the relevant factors?

- Simply look at the goals.
- Ask building owners what will work for them. What sounds reasonable to you? In NVRC's case, what is the goal that they are trying to achieve? What is the focus of the project (new buildings, existing buildings, or both)?

6. What types of benchmarking policies and programs do you think would serve well for Northern Virginia communities?

Arlington County will be very helpful, in addition to serving as a model for the rest of Northern Virginia. The challenge type program that Arlington has done would probably work well, and it is imperative for leaders to commit to work together and actually organize such a program. People like to be recognized for their efforts, whether they are photographed with the mayor or covered in a local newspaper article. Creating incentives will be something that you need to be creative with in order to motivate locals to participate. It could be creating tax incentives, or providing special rebates for energy efficient lighting in coordination with utility providers.

The purpose of the NoVA plan is get people to act on improving building energy efficiency and thus save energy, reduce emissions, and cut energy costs. Gather Arlington, Fairfax, and Alexandria as leading participants to agree on initiating the benchmark program and then spread it to the rest of the region.

7. Is it common to use a phased policy approach for benchmarking building energy performances? By size, age, or building type?

It is common to see a "phase-in" approach for required/mandatory programs. If the program is voluntary, however, this is not the case. Some kind of threshold could be used for benchmarking government buildings.

8. What type of rating should be used to benchmark a building's energy efficiency? Would the rating type be different for government and commercial buildings?

No, there is no difference between government and private facilities in terms of rating type. Space use is different since government buildings tend to have larger and mixed uses. There are more operational ratings, which are easier to implement and communicate than asset ratings, which require physical investment such as replacing windows. This will be a good question to address in your interview with Arlington County staff. When talking about energy efficiency, the energy source does not necessarily matter.

9. What metrics influence these ratings? Would the metrics for private commercial buildings be different from those used for government buildings?

Occupancy influences operational ratings. This does not refer to how many people are in the space, but how the space is used. For example, dentist or buildings with medical equipment will obviously have different space use than parks. Vacant space will be normalized with the benchmarking tool.

10. Should performance ratings compare buildings to each other (*statistical*) or to high-performance goals (*technical*)?

Asset ratings will be measured on an absolute scale, and operational ratings will be measured on a relative scale with most benchmarking tools such as ENERGY STAR Portfolio Manager. Ask yourselves the question: would it be more effective to show how a building is performing relative to its neighbors (or relative to national peers)? Which is more appealing to owners? Do you think they are willing to display labels indicating their performance in the first place? Again, these questions enter the marketing realm.

11. Should energy audits be required along with performance ratings, or would this be too much of a burden for building owners?

Energy auditing requirements could be effective under the right circumstances. The point is to encourage owners to pay to improve buildings, not to pay for the auditor. To do so, you need to incentivize!

12. Are building owners/managers responsible for benchmarking their buildings?

Owners are responsible, whether they like it or not.

13. Should there be a minimum qualification for owners/managers conducting building energy benchmark? If so, what minimum qualifications should be required?

Yes, workforce requirements would be great. Although IMT does not offer such a service, other organizations have been known to do so.

14. Should the procedure for rating building performances be continual? If so, how often should the ratings be updated?

Many building owners update ratings every month. The performance (operational) rating process is not time consuming.

15. Should the energy use data for buildings be publicly disclosed? How will this information be disclosed?

Absolutely. Government building performance should be publicly disclosed on a label or report card. It is really important to be creative.

18. What efforts should be used for public outreach on energy efficiency and benchmarking?

It is recommended to reach out to the community and have a variety of people involved. Utilize stakeholder meetings to get feedback. Arlington County does a great job at this as well.

D. Interview with Alexandria City personnel

Interviewee: Bill Eger
Interviewers: Nathan Costa, Mai Tomida, Jiedong Wang
Topic of Discussion: Energy Performance Label
Type: Un-Structured

Date: December 4, 2013
Location: 110 N Royal St., Suite 300, Alexandria, VA 22314
Recorded By: Nathan Costa

Background of Interviewee:

As the Alexandria Energy Manager, Bill Eger has implemented energy management for over 300 facilities and operations including office facilities, data centers, fire stations, recreation centers, a convention center, two airports, municipally-supported housing units, the eighth largest water treatment and distribution operation in the US, and a large public power system. He has also managed over $60 million in electricity, natural gas, district steam and chilled water, and vehicular fuel consumption. Bill's energy management program leadership includes utility data management, facility assessments, capital improvement and efficiency measure implementation, education and training, behavioral influence, measurement and verification, and reporting to City staff and leadership.

In addition, Bill manages energy efficiency capital improvement projects, renewable energy systems installation, smart grid technology deployment, vehicular upgrades, design of LEED-certified/high-performance facilities, greenhouse gas emissions inventory quantification and development, Climate Action Plan development, and design and implementation of comprehensive community-wide energy efficiency programs for the City of Alexandria.

Interview Topic:

Government Building Energy Performance Label

- Use Arlington's energy performance label as a starting point
- Need to incorporate a temporal component on the label to show trends in energy use over time
- Need to include some sort of metric comparison (whether it is relative to Alexandria building performance or national building performance)
- Must be easily communicable to the general public as well as building owners
- Site energy use intensity and GHG emissions should be visually represented on the label
- Building parameters such as square footage, operating hours, and built date should be included
- Note any building renovations/improvements

- Use of color contrasts and shapes can be utilized to attract attention to specific information

E. Interview with Arlington County Office of Environmental Services

Interviewees: John Morrill, Jeannine Altavilla, and Kelly Zonderwyk
Interviewers: Nathan Costa, Mai Tomida, and Jiedong Wang
Topics of Discussion: Energy Performance Labels, Report Cards, Voluntary Benchmarking
Type: Un-Structured

Date: November 13, 2013
Location: 2100 Clarendon Blvd., Suite 705, Arlington County
Recorded By: Nathan Costa

Background of Interviewees:

John Morril, CEM, joined the staff or Arlington County government in July 2000 as its first energy manager. Previously, he spent 15 years with the American Council for an Energy Efficient Economy (ACEE) in Washington, D.C. John directs facility planning staff on energy efficient aspects of green buildings in new construction and renovation, including compliance with the LEED program.

Jeannine Altavilla is the Energy Program Analyst for Arlington County and is credited for maintaining the building report cards. She is responsible for updating these report cards with information including basic building characteristics, annual electric and natural gas use, site and source energy use intensity, carbon footprints, and ENERGY STAR ratings.

Kelly Zonderwyk is the Energy Program Specialist for the Arlington Initiative to Rethink Energy (AIRE). Kelly was responsible for initiating Arlington Green Games, a voluntary private commercial building benchmarking competition designed to reduce energy consumption and greenhouse gas emissions across the Arlington building stock.

Interview Topics:

Arlington Green Games

- In total, one-third of Arlington's office space was benchmarked through participation in this program (which attracted roughly 150 participants).
- Annual competition started in 2010 and ended in 2011. The competition was mainly focused on energy efficiency in buildings, but also included green recycling and transportation.
- Keys to advertising the program:
    - Cold calls (to property managers)
        - Talked with property managers to receive feedback about the challenge program

        - Returned after baseline score cards were collected at the beginning of the year.

    - Posters

        - Eye-catching posters for each of the seven challenge areas: Energy, Transportation, Waste, Water, Materials, Employee & Outreach, and Innovation.
        - The posters could be customized by property managers for unique use in their buildings.

- Property managers provided their building energy data once at the beginning of the year and again at the end of the year in order for Environmental Services to conduct a benchmark and appropriate awards (Gold, Silver, Bronze, and Recognition).
- Office tenants have created the action plan based on their score cards.
- The voluntary program should be a fun and friendly competition.

Energy Performance Label

- Extensive discussion took place when brainstorming ideas for the label, and it took about six months to complete the design process.
- Received suggestions from utility companies/stakeholders
- The label is updated annually and displayed on the entrance of each building.
- First performance labels only included libraries and offices (2011) and included comparisons with national averages.
- Community centers and fire stations were added to the EPL and included comparisons with similar Arlington County buildings.
- Labels are used mostly on government buildings and encourage performance improvements.
- Aims to pressure commercial business owners to conduct voluntary benchmarking for their facilities in the future.
- A-B-C rating scale was avoided because these letter grades have no credibility. Each facility is designed to satisfy a different function.
- Staff from the communications department designed the EPL using *Adobe InDesign* software.
- 12-month utility bills are combined, not calendarized, for calculating the performance metrics.
- Energy use targets are provided by Arlington County. Specific target values such as % reduction in total energy use are set for each building
- Improvements following benchmark are mostly around technology and operational controls (better behavior control)

Report Cards

- Serve as internal catalysts
- Design has changed at least one since initiation

- Includes additional information that does not appear on performance label

Suggestions

- NVRC should create a master account for a regional energy use database using the ENERGY STAR Portfolio Manager
    - Those that are highly involved with this issue, such as EPA and DOE staff, actually live in the Northern Virginia area.
- "Have no fear" sharing such a database. Portfolio manager can generate a lot of information in the same format
    - Makes it easy to sort and analyze
    - Having a master account feature will build richer data comparisons
- Implementing regional policy and codes will be challenging.
- Should be a priority for the years ahead