NYC CARBON CHALLENGE

December 2015

Handbook for Universities and Hospitals

The City of New York
Mayor Bill de Blasio
Mayor's Office of Sustainability

Introduction

Recognizing the mounting threat that global climate change poses on the world, there has been an growing interest over the past several decades on the part of universities, hospitals, and other institutions to mitigate their direct impact on climate change by reducing by their greenhouse gas (GHG) emissions. Because the majority of GHG emissions from universities and hospitals come from the energy they use to heat, power, and cool buildings, many of these institutions have begun investing in energy efficiency and renewable energy projects to reduce their energy use and emissions. Through these efforts, many universities, hospitals, and other institutions nationwide have become global leaders in the fight against climate change.

With the challenge critical and the stakes mounting, the need for climate leadership has never been greater. New York City launched the NYC Carbon Challenge (Challenge) in 2007 to partner with private and institutional sector leaders across the city to achieve significant GHG reductions from buildings. Since then, New York City's 17 leading universities, 11 largest hospital organizations, 11 global companies, and 18 residential property management firms have accepted the Challenge, pledging to reduce their GHG emissions by 30 percent or more in ten years.

By highlighting some of the best practices of the universities and hospitals participating in the Challenge, the NYC Carbon Challenge Handbook for Universities and Hospitals can be used as a reference manual for any university, hospital, or other institution seeking to mitigate its climate impacts by reducing its building-based energy use and GHG emissions. For building decision-makers interested in learning more about how multifamily buildings can reduce energy use and GHG emissions, more information can be found in the NYC Carbon Challenge Handbook for Multifamily Buildings, available online at nyc.gov/carbonchallenges.

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Overview

Many of the leading universities and hospitals in the country are Challenge participants—pioneering a variety of techniques and technologies to meet their climate mitigation goals. The experiences of these universities and hospitals provide best practices and valuable lessons in energy efficiency and GHG reduction strategies. Each chapter of this handbook identifies successful strategies that universities and hospitals participating in the NYC Carbon Challenge (Challenge) have employed to make progress towards their goal of a 30 percent reduction in GHG emissions intensity in ten years.[1]

This handbook is not meant to be a prescriptive guide, but rather a tool for staff at universities and hospitals to help assist their organizations in achieving significant energy and GHG reductions. The handbook intentionally highlights best management practices implemented by universities and hospitals rather than recommending specific energy efficiency or renewable energy projects. The experiences of Challenge participants show that energy efficiency and renewable energy opportunities can vary significantly between institutions, but effective management practices are essential to successfully identify and implement these opportunities. Recognizing that each institution's path will be different, this handbook highlights multiple strategies to help achieve deep reductions in GHG emissions, profiles successful case studies from universities and hospitals participating in the Challenge, and provides references to external tools and resources for additional information.

This handbook caters to universities and hospitals, but the strategies outlined here can assist any individual involved in helping an organization improve energy efficiency and mitigate their climate impact. Specifically, this handbook is a resource for anyone who plays a role in elevating conversations and accelerating action on energy efficiency and sustainability within a university, hospital, or other institutional organization.

Goals

The NYC Mayor's Office of Sustainability created this handbook to advance the objectives of the Challenge and assist other organizations in defining and meeting their energy efficiency and sustainability goals. The handbook was created through a collaborative process between staff in the NYC Mayor's Office of Sustainability and the university and hospital Challenge participants with five goals in mind:

1. Create a central source of best practices used by current Challenge participants to aid in the continuous improvement of energy efficiency and GHG emissions reduction strategies.

2. Provide a menu of possible solutions to help address the barriers to integrating energy efficiency and sustainability goals within universities and hospitals.

3. Highlight the success stories of existing Challenge participants in implementing best practices that have led to significant energy and GHG emissions reductions.

4. Identify potential pathways for Challenge participants to achieve deeper reductions in GHG emissions as they extend their commitments to as much as a 50 percent reduction by 2025.

5. Serve as a resource for other universities, hospitals, and institutions seeking to improve energy efficiency and reduce GHG emissions.

Executive Summary

The universities and hospitals in the Challenge have tested and refined the best practices outlined in this handbook through research, implementation and a willingness to revise and adapt. The strategies identified here are meant to help institutions overcome some of the largest barriers to implementing energy efficiency. These barriers include: competing priorities for senior leadership; institutional teams or departments not communicating as effectively as possible; limited staff resources aimed at identifying and implementing energy efficiency projects consistently and at scale; and unpredictable funding streams for energy efficiency investments. Depending on the institution, the strategies outlined here may be implemented individually or simultaneously to mutually reinforce the benefits. Most important to success is for each organization to develop the right mix of strategies that will align with its individual characteristics and needs.

Chapter 1 | Establish Organizational Commitment

Establishing strong leadership and an organizational commitment to sustainability is necessary to achieve significant energy and GHG emissions reductions. Aligning the institution's GHG reduction goal with other formal and public facing commitments like the Challenge creates the visibility necessary to engage senior leadership to take meaningful action to reduce energy and GHG emissions. This high-level commitment is often necessary to prioritize investments in energy efficiency and can also serve as motivation that diffuses through the organization from the top down.

Chapter 2 | Develop an Energy Management Structure

Developing an energy management structure, often led by a designated Energy Director, can help to ensure that energy management is integrated at multiple points of the institutional decision-making processes. Many Challenge participants have developed a cross-functional energy management team to help coordinate staff collaboration on energy management decisions as well as a sustainability advisory board to engage with a broader set of stakeholders to communicate the benefits of energy efficiency and sustainability.

Chapter 3 | Communicate Regularly with Stakeholders

Communicating regularly with internal and external stakeholders is important to highlight the benefits that improved energy efficiency and reduced GHG emissions has on the institutional community and helps create buy-in for efforts to continue progress towards these goals. Consistent engagement with senior leadership is particularly important to help secure staff resources and financial capital needed to meet the institution's GHG reduction goal.

Chapter 4 | Maintain Building Systems and Equipment

Maintaining and monitoring building systems is necessary to both improve the energy efficiency of existing building systems and sustain the reductions generated by energy efficiency investments. This can be accomplished by developing and implementing a robust operations and maintenance plan, retro-commissioning existing building systems, completing the commissioning process for all renovations and new construction projects, and tracking occupant interaction with energy use.

Chapter 5 | Train Building Staff

Training facilities staff and building operators in energy efficiency best practices helps ensure that investments in energy efficient equipment will realize their full potential. Moreover, such training enhances overall organizational expertise by helping staff understand the importance of building energy performance and empowers staff with the necessary information, tools, and resources to identify additional energy efficiency opportunities.

Chapter 6 | Plan Ahead to Coordinate Investments

Planning ahead to coordinate energy efficiency investments can help maximize the effects of energy efficiency projects. In order to identify where energy efficiency projects may have mutually reinforcing benefits, institutions can create a plan to retrofit lighting, heating, ventilation and air-conditioning (HVAC) equipment, envelope, and other building systems across their entire campus portfolio.

Chapter 7 | Understand Financing Options

Understanding a variety of financing options, including internal capital, incentives, rebates, loans, bonds, energy service contracts, and green revolving funds can help institutions find financial resources that can be invested in energy efficiency projects. Many Challenge participants have successfully blended internal and external funding options to maximize available capital.

Chapter 8 | Invest in Innovative Technologies

Investing in innovative new technologies, including distributed generation systems such as cogeneration plants, solar photovoltaic, solar thermal, and geothermal heat pumps, can be a highly visible way that institutions can generate awareness for their energy programs and demonstrate their commitment to reducing energy and GHG emissions. Many of these technologies also contribute to climate resiliency by providing reliable backup power in the case of a power outage. Advancing innovative technologies and strategies can also pave the path to deeper reductions in GHG emissions.

Chapter 9 | Review Design Standards

Design standards are an internally developed document that institutions use to guide project managers and design consultants through the many phases of project development. Creating an overarching energy policy within an organization's design standards provides a framework for energy use in new construction, major renovations, and capital upgrades. Developing an institution-specific design manual can help coordinate all parties involved in the planning and construction of projects and establish a minimum level of design and energy specification requirements.

Chapter 10 | Educate the Community

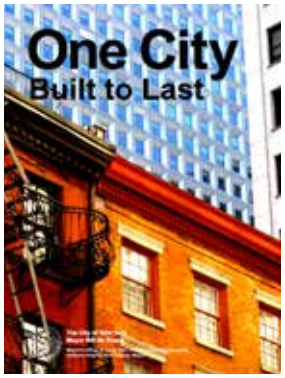
Educating the institutional community, including staff, students, faculty, and visitors about the university or hospital's commitment to sustainability encourages the community to contribute ideas and engage in actions to help meet the institution's sustainability and GHG reduction goals. Engaging these individuals in simple behavior change tactics and creating internal advocates for energy efficiency is also a low-cost and potentially high impact way to reduce energy and GHG emissions.

Background

Climate Change and Its Impacts

Global climate change is the challenge of this century, and the stakes are high. Across the globe, GHG emissions are growing at an unprecedented rate, causing a rise in average global temperature and changes to climate patterns. New York City is experiencing the impacts of climate change firsthand, from rising sea levels, increasing temperatures and heat waves, and more frequent and intense storms, such as Hurricane Irene in 2011 and Hurricane Sandy in 2012. The New York City Panel on Climate Change (NPCC) projects that average annual temperatures will increase in New York City by 4.1° to 6.7° F by the 2050s and 5.3° to 8.8° F by the 2080s. Furthermore, sea levels are projected to rise from 11 to 21 inches by the 2050s, and 18 to 39 inches by the 2080s.[2]

To address these challenges and mitigate the threats from climate change, New York City must adapt to a changing climate and take bold action to reduce the harmful GHG emissions that contribute to climate change.



New York City's Climate Mitigation Goals

On Earth Day 2015, New York City Mayor Bill de Blasio announced One New York: The Plan for a Strong and Just City (OneNYC), a groundbreaking effort to address New York City's long-term challenges, which include a population forecast of 9 million residents by 2040, changing climate conditions, an evolving economy, and aging infrastructure. OneNYC represents a unified vision for a sustainable, resilient, and equitable city, and charts the path for collectively achieving this goal.

Recognizing the existential threat that climate change poses to New York City and the world, OneNYC sets the ambitious goal to reduce citywide GHG emissions by 80 percent below 2005 levels by 2050 (80 x 50). The United Nations projects developed countries must reduce their GHG emissions to this level to limit global temperature rise and avert the most dangerous impacts of climate change. As part of the 80 x 50 goal, the City has set interim targets to reduce citywide GHG emissions by 40 percent by 2030 and its building-based GHG emissions by 30 percent by 2025. With these goals, Mayor de Blasio—joined by the City Council who passed formal legislation committing to the 80 x 50 goal in November 2014—has continued New York City's longstanding leadership in addressing global climate change.

One City: Built to Last

The energy used in New York City's one million buildings represents nearly three-quarters of citywide emissions, and it is estimated that at least 80 percent of the buildings that are here today will still be here in 2050. For these reasons, improving the energy efficiency of the city's existing building stock is the greatest opportunity to reduce citywide GHG emissions. To put New York City on a pathway towards the 80 x 50 goal, the City released a 10-year plan called One City: Built to Last – Transforming New York City's Buildings for a Low Carbon Future to improve the energy efficiency of New York City's one million public and private buildings.

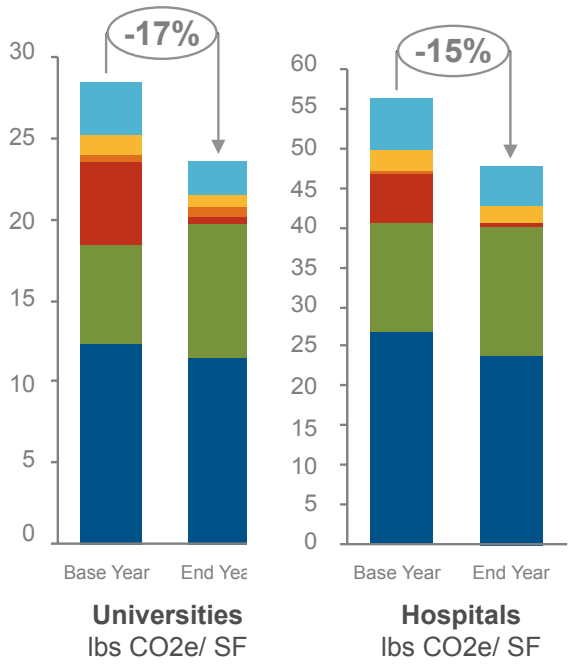
The plan is comprised of 22 specific initiatives to make public buildings models for sustainability, create a self-sustaining private market for energy efficiency and renewable energy, create the next generation of building codes, and support the emerging clean energy sector in New York City. This includes a major expansion of the Challenge program, which includes increasing the number of participants in the multifamily and commercial office sectors, adding new sectors to the program; and inviting participants that have already realized significant GHG reductions to expand their commitments to a 50 percent reduction in emissions by 2025. The plan also includes interim goals to reduce New York City's building-based GHG emissions by 30 percent in private buildings and 35 percent in public buildings by 2025, as compared to a 2005 base year. All together, the new initiatives outlined in the plan are projected to put the City on track to achieving these goals.

The NYC Carbon Challenge

The NYC Carbon Challenge has been a success. Current participants include more than 50 universities, hospitals, commercial firms, and residential management companies—altogether accounting for 245 million square feet of space, equal to the total square footage of almost 110 Empire State Buildings. These participants have acted aggressively to cut their annual emissions to meet the Challenge goal. Five universities, one hospital, and two commercial offices have already achieved the 30 percent goal, and more than half of the university and hospital participants have achieved reductions of at least 15 percent with several years left in the program.

Altogether, participating universities have achieved a 17 percent reduction in GHG emissions per square foot since 2007. Participating hospitals have achieved a 15 percent reduction in GHG emissions per square foot since they joined in 2009, demonstrating their commitment to improve public health and quality of life for all New Yorkers. Participating commercial offices have also reduced absolute carbon emissions by 17 percent, while multifamily buildings have not yet started reporting their energy use and emissions. For more information about the GHG accounting methodology used for the Challenge, please refer to Appendix A.

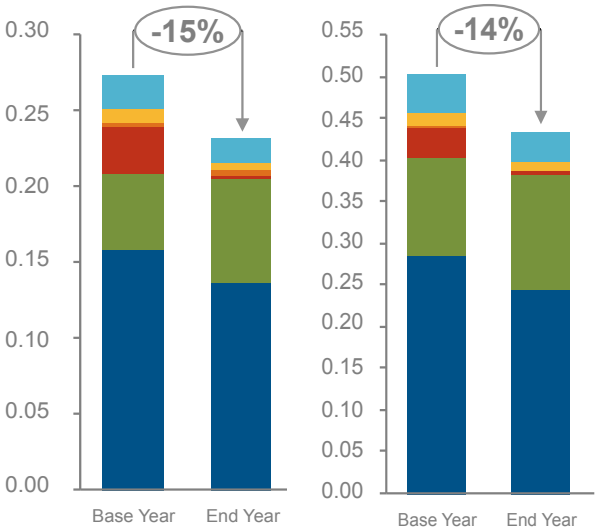
Carbon Emissions



Universities
lbs CO2e/ SF

Hospitals
lbs CO2e/ SF

Energy Use



Universities
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Hospitals
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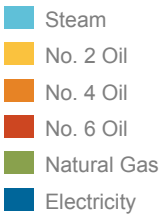
Next Steps for the NYC Carbon Challenge

Challenge participants have demonstrated that deep reductions in GHG emissions are achievable while also realizing other benefits such as: energy cost savings, energy reliability, and improved local air quality. The success of the Challenge is a powerful demonstration that New York City's largest private and institutional sector organizations can work with the City toward a common goal of fighting climate change and creating a healthier and more sustainable place to live for all New Yorkers. In September 2015, the Mayor announced a major expansion of the program, with 12 participants expanding their commitment to a 50 percent reduction in emissions by 2025, including four universities, five hospitals, and three commercial offices.

Challenge participants have achieved significant reductions so far, but there is still more progress to be made. There are two years left in the original Challenge for universities and four years left in the original Challenge for hospitals. This handbook will help current university and hospital participants further their achievements in the remaining years of the Challenge and identify pathways to achieve deeper reductions in GHG emissions as they extend their commitments.



New York City Carbon Challenge Participants

Universities

- **Barnard College***
- Berkeley College
- The City University of New York
- Columbia University
- The Cooper Union for the Advancement of Science and Art
- **Fashion Institute of Technology of the State University of New York***
- Fordham University
- The New School
- **New York University***
- **NYU Tandon School of Engineering**
- Pace University
- Pratt Institute
- **The Rockefeller University**
- School of Visual Arts*
- **St. John's University**
- Wagner College
- **Weill Cornell Medicine**

Hospitals

- Maimonides Medical Center
- **Memorial Sloan Kettering Cancer Center***
- **Montefiore Medical Center***
- Mount Sinai Health System
- **NewYork-Presbyterian/Queens***
- NewYork-Presbyterian Hospital
- Northwell Health
- NYC Health + Hosptials*
- **NYU Langone Health***

* Asterisk designates participants commited to 50 percent reduction goal.
Bold designates early achievers for 30 percent reduction goal.

Chapter 1

Establish Organizational Commitment

Establishing a strong commitment to energy efficiency and sustainability from a university or hospital's senior leadership is an essential first step to creating a framework to mitigate GHG emissions. Aligning the institution's GHG reduction goal with other formal and public facing commitments like the Challenge creates the visibility necessary to engage senior leadership to take meaningful action to reduce energy and GHG emissions. This high-level commitment is often necessary to prioritize investments and energy efficiency and can also serve as motivation that diffuses through the organization from the top down. While every organization's path will be different, the core commitment to achieving energy use and GHG reductions transcends organizational differences.

Establish Support from Senior Leadership

Because senior leadership is responsible for defining organizational priorities within a large institution, their commitment to climate and sustainability goals is essential to success. Significantly reducing energy use and GHG emissions requires both the allocation of dedicated staff and the expenditure of financial resources, both of which require senior leadership to channel limited institutional resources to this effort. At a minimum, the commitment from senior leadership must include the allocation of sufficient staff to establish a baseline of GHG emissions, develop and implement a GHG reduction strategy, and measure the organization's progress towards its goal. It also requires a commitment to expend capital and financial resources that are necessary to implement the projects to achieve the organization's goals. If the senior leadership has a sustained commitment to the importance of the institution's climate commitment, then the organizational community will accelerate change by overcoming structural barriers to work together to make progress toward a common goal.

Senior leadership also has the authority to make specific institution-wide commitments to energy efficiency and sustainability. Institutions that align this high-level commitment with a formal, public-facing goal can help create internal motivation to prioritize the energy efficiency investments often necessary to meet the goal. Additionally, creating a public-facing commitment demonstrates to the broader community that the institution is a leader in the fight against climate change. Institution-wide commitments can take the form of a quantitative target, such as the 30 percent reduction goal used for the Challenge, which allows for easy measurement of progress towards the goal, but can include more qualitative institutional goals as well. These goals can be established either before or after staff has been hired to develop and implement a strategy.

To establish support from senior leadership, staff of the universities and hospitals in the Challenge focused on demonstrating that energy efficiency generates cost savings that can be allocated to other institutional priorities. Other benefits participants have used to motivate senior leadership to support energy efficiency include: being a leader in energy efficiency demonstrates institutional leadership; reducing energy consumption improves local environmental quality and public health; and mitigating GHG emissions helps support broader institutional goals. Once support is established, it is critical for staff to continue to engage the senior leadership about the institution's commitment to energy efficiency and progress in achieving its goals. More information about communicating with senior leadership can be found in Chapter 3.

Consistently Measure GHG Emissions

An institutional commitment to a GHG reduction goal requires baselining and continuously measuring energy use and GHG emissions to understand the institution's current position and assess future progress. Baselining GHG emissions provides a reference point from which to determine the success of future institutional efforts. All Challenge participants are required to submit a "Carbon Emissions Inventory," using a Carbon Emissions Inventory Calculator provided by the Mayor's Office of Sustainability and available for download at www.nyc.gov/carbonchallenges. Participants input energy use data from all fuel

sources for a full calendar year into the calculator, along with total square footage of their covered properties. The tool then calculates associated GHG emissions in terms of metric tons of carbon dioxide equivalent per square foot per year. For more information about the GHG accounting methodology used for the Challenge, please refer to Appendix A.

The organizational commitment must include dedicated staff to complete this process annually, typically by an individual who is involved in overseeing energy management or procurement, or a third-party consultant. Regularly measuring GHG emissions also requires creating an effective information collection system to identify and aggregate the necessary energy data, which may be acquired from a variety of sources. Many participants have established an internal system that aggregates the institution's utility bills and fuel oil consumption throughout the year so that information can be easily input into the Carbon Emissions Inventory Calculator tool. Distributing the yearly results of this process to senior leadership helps maintain organizational awareness about progress toward the GHG reduction goal.

AASHE STARS®

The Sustainability Tracking, Assessment & Rating System™ (STARS®) is a transparent, self-reporting framework for colleges and universities to measure their sustainability performance. Using the STARS platform, institutions can take a comprehensive measurement of their sustainability programs, set meaningful long-term goals, and calculate progress over time. STARS® also discloses all participants' information on a central web-portal, allowing institutions to share ideas and learn best practices. More information can be found at: www.stars.aashe.org.

Create and Regularly Update a GHG Reduction Strategy

Creating strategic long-term planning document is a crucial step in setting the strategy for achieving an institution's GHG reduction goal. As part of the Challenge, each participant is required to create and annually update a Climate Action Plan (CAP) using a template and toolkit provided by the Mayor's Office of Sustainability, both available for download at nyc.gov/carbonchallenges. The CAP creates a roadmap for Challenge participants to continuously develop and implement strategies as well as track progress toward the Challenge goal.

For the Challenge, each university and hospital's CAP includes background information about the institution, a description of additional commitments to sustainability, energy use benchmarking information required under New York City's Local Law 84 of 2009 (LL84), an inventory of annual GHG emissions using the Challenge methodology, a description of completed energy efficiency and GHG reduction strategies, highlights of projects of interest, and an explanation of next steps and strategies to meets the Challenge goal. The CAP also includes detailed tables in which participants report projected energy savings, cost savings, installation costs, and GHG reductions for each planned and completed project or strategy.

The organizational commitment must include dedicated staff to complete this process regularly. The size of this staff will depend on the size of the institution, but is typically led by an Energy Director or an employee within the institution with the primary responsibility of overseeing energy performance. This includes creating the appropriate institutional structure for developing

and implementing the plan, which is usually carried out by a dedicated energy management team. For more information about developing an energy management team, please refer to Chapter 2.

By creating a comprehensive GHG reduction plan, institutions are able to maximize the effects of energy efficiency projects by coordinating projects across the institutional portfolio. Challenge participants have been able to dramatically reduce their energy use and GHG emissions as a result of the aggregate effects of a large number of individual energy efficiency measures performed across the entire institutional portfolio. Many Challenge participants have been able to coordinate these projects by holistically evaluating all possible energy efficiency upgrades during the CAP process. For more information about coordinating energy efficiency investments, please refer to Chapter 6.

The CAP serves its best value when updated annually, reflecting the progress towards the Challenge goal and highlighting the institution's continued commitment to energy efficiency and sustainability. The process behind the yearly update helps create insights for new actions, gives staff the opportunity to contribute to and understand the energy management process, and provides specific success stories and financial results to communicate to internal and external stakeholders. The CAP should be a dynamically revised document because there will be inevitable changes in organizational and operational needs over time, as well as updated GHG emissions reduction goals. Combined with the Carbon Emissions Inventory, the results of the CAP provides an opportunity for Challenge participants to communicate with senior leadership in order to highlight successes, identify areas for improvement, and undertake the necessary corrective actions to achieve the GHG reduction goal. For more information about tracking energy use and the success of energy efficiency projects, please refer to Chapter 3.

Integrating a GHG Reduction Strategy into Campus Master Plans

One of the most reliable ways to ensure that commitments to energy efficiency and sustainability are integrated into an institution's long-term strategy is to align the CAP with other campus plans, such as a campus master plan. Because commitments to GHG and energy use reductions often extend more than five years, institutions can utilize campus master plans to develop a sustainability strategy and address system-wide energy improvements.

Once the CAP is published, institutions can take the following steps to update it annually:

1. **Implement and track projects:** Use a tracking system that tracks energy efficiency projects proactively. Tracking systems can be created using the help of outside consultants, third-party software, or an internally developed database. The tracking system ensures that energy data is readily available to set priorities and select projects for future updates.

2. **Conduct periodic reviews:** Assemble relevant stakeholders throughout the year to conduct periodic reviews on the progress of projects, programs, and strategies by assessing the effectiveness, necessary next steps, and corrective actions that must be taken to meet goals.

3. **Solicit feedback:** Convene the energy management team, sustainability advisory group and/or other key personnel to aggregate information on completed projects and collaborate on the selection of planned projects, programs and strategies moving forward.

4. **Engage senior leadership:** Coordinate directly with senior leadership to determine financial commitment for staff, energy efficiency investments, and programs.

5. **Generate content:** Use information gathered from energy management groups and other key personnel to make informed decisions about content in the yearly update.

6. **Communicate plan:** Distribute plan widely to organization to build awareness about energy performance initiatives and future projects and programs.

Fordham University

- Sustainability Council established a University Energy Master Plan subgroup that developed written plan and identified $2.2 million in energy efficiency projects.
- Periodic reports on Energy Master Plan developments and performance to the Board of Trustees and university community.

Fordham University (Fordham) has two main campuses in New York City. Lincoln Center in Manhattan is an urban campus set on a super block in the center of Manhattan and Rose Hill is a suburban style campus set on 85 acres in the Fordham area of the Bronx. In total, the university has over 60 buildings, making up more than 4.5 million square feet. President Father Joseph Mc Shane, S.J., committed Fordham University to the Challenge in 2007 and directed the Vice President (VP) of Facilities to create an Energy Master Plan for the university, with the goal of laying out a strategic plan for achieving the 30 percent reduction goal.

In 2007, the university's Sustainability Council, a joint initiative consisting of faculty, administrators and students, formed a University Energy Master Plan subgroup. Led by the VP of Facilities, the subgroup was comprised of Fordham engineering professionals and supplemented by specialized energy consulting firms. The subgroup was charged with the development of the Energy Master Plan, supervision of feasibility studies, and the design and implementation of energy efficiency measures. The first step the subgroup undertook was a detailed benchmarking study to identify Fordham's current energy usage and GHG emissions. After this, Fordham selected a qualified engineering firm to conduct an energy audit of all of its facilities on both campuses—the study identified $2.2 million in savings with an average payback of about three years.

Once this campus-wide profile and audit was complete, the subgroup developed a written Energy Master Plan that prioritized supply and demand side measures to reduce the university's GHG emissions. Supply side efforts included an analysis on the impact of switching from fuel oil to natural gas at the main boiler plants, as well as the installation of solar photovoltaic on-site generation. Demand side measures recommended in the energy audit included traditional lighting, mechanical and HVAC upgrades as well as retro-commissioning measures to fine-tune existing building systems. Since its publication in 2009, the Energy Master Plan has been Fordham's strategic guide in making energy efficiency investments. The Energy Master Plan has been periodically revised based on progress towards the Challenge goal and the availability of new technologies, such as wireless lighting controls and improved LED lighting.

Fordham has made informing the university community about the Energy Master Plan's progress a key priority. The VP of Facilities gives regular updates to the Sustainability Council, which is open to all faculty, administrators, and students. Additionally, mechanisms were established to provide periodic reporting on the developments and performance to the university community and its Board of Trustees. The updates to these entities summarize the energy performance of buildings, success of energy efficiency projects, and progress in meeting the Challenge goal. By consistently reporting this information, Fordham has been able to validate their efforts and leverage their achievements to help make the case for additional support to continuously make progress towards the Carbon Challenge goal.

Chapter 2

Develop an Energy Management Structure

Once the organizational commitment to a GHG reduction goal is in place, one of the most important steps a university or hospital can take to realize this goal is to create a robust energy management structure. One successful model includes an Energy Director, a cross-functional energy management team, and a sustainability advisory group. For many universities and hospitals in the Challenge, this model has allowed for the integration of energy management into multiple points of institutional decision-making processes and has helped promote energy efficiency as one of the organization's core strategic goals. This section describes this specific energy management structure in more detail, but the most appropriate structure will ultimately depend on specific considerations of a university or a hospital including the size of the institution, available in-house expertise, and the broader organizational framework.

Appoint an Energy Director

Appointing an Energy Director or assigning a current employee with the primary responsibility of overseeing energy performance is an important component of many successful energy programs. An Energy Director helps an organization achieve its goals by establishing energy performance as a core value through the development of strategies, programs, and projects that focus on reducing energy use and GHG emissions. Assigning or hiring someone to take on the role of Energy Director sends a message to the institutional community that the energy management process is important. Appointing an Energy Director whose sole responsibility is to oversee energy management is typically more effective in realizing GHG reductions than assigning staff with competing responsibilities to this task. Often, the cost savings generated by an experienced Energy Director can cover his or her salary.

Effective Energy Directors can come from a variety of backgrounds. Some Energy Directors have a technical background; others have financial experience or have been plant managers. Regardless of background, the Energy Director must have good communication skills because they need to be able to work with all staff levels—from maintenance to project managers to engineers to financial officers—and must have an understanding of engineering and building sciences. The Energy Director should be a champion of energy efficiency and be passionately committed to meeting the organization's GHG reduction goal.

Many Energy Directors among Challenge participants have experienced success by focusing their efforts on creating and executing a CAP. For more information about developing a CAP, please refer to Chapter 1. The Energy Director is responsible for identifying and implementing energy efficiency opportunities across all departments of the institution, measuring and verifying results, and communicating priorities and progress to senior leadership and broader institutional community. For more information about communication with stakeholders, please refer to Chapter 3. The Energy Director is also typically responsible for improving building operations by securing capital for energy efficiency projects and ensuring key facilities staff members have been trained in energy efficiency best practices. For more information on professional certification and training programs, please refer to Chapter 5 and Appendix B. For more information about budgeting and financing options, please refer to Chapters 6 and 7.

For the Energy Director to be successful, the organization must clearly define the responsibilities of the role, which should include the position's place in the organizational hierarchy and guidelines for reporting. Energy Directors should act as a point-person for all decisions regarding energy and facilitate communication between all parties involved in energy decisions, with the goal of creating a cultural shift that will help prioritize energy efficiency within the organization. These parties include:

- **Facility staff:** The facilities staff in a university or hospital is responsible for the everyday operation and upkeep of building systems. The Energy Director should be responsible for ensuring that the facilities staff enacts the institution's operations and maintenance (O&M) plan and has been sufficiently trained in energy efficiency best practices.

- **Engineering staff:** Engineers employed by a university or a hospital are typically responsible for overseeing the central plant or major building systems, including HVAC equipment, building management systems, and refrigeration systems. The Energy Director is responsible for working with engineers on the implementation of energy efficiency projects and measurement and verification of the energy savings once projects are operational. The Energy Director can also work with the engineering staff to create, implement and/or update a robust O&M plan and a site-specific energy-efficiency training program.

- **Project managers:** Project managers oversee the planning, development, and construction phases of new construction and major renovation projects. The Energy Director can work with project managers to help synchronize the planning process by serving as the point-of-contact for questions about building systems and provide continuous feedback and input when integrating energy efficiency into projects.

- **Financial officers:** Financial officers oversee the allocation of the capital, operating, and capital investment budgets to the Facilities Department. The Energy Director should work directly with the financial officers to establish a pipeline of reliable capital for energy efficiency projects based on cash availability and the budget processes, as well as incentive, rebate, and financing options.

- **Senior leadership:** Members of senior leadership typically have the ultimate power in deciding the organization's commitment to energy efficiency. The Energy Director should engage with senior leadership by establishing clear communication channels, such as monthly or quarterly meetings, to review progress and establish a case for sufficient staff and capital resources that can be dedicated toward energy projects.

Hiring Based on Size

The ability to hire a full-time Energy Director is often dependent upon the size of the organization. Hiring an in-house Energy Director requires energy-related experience and skills that can be applied to working in a complex organization like, a university or hospital organization. For smaller organizations, energy management can be integrated into an established Facilities Department by adding it as a part-time responsibility of an existing job. If a current employee demonstrates good communication skills and has indicated that he or she has the ability to generate support for projects within the institution, he or she may be able to take on the responsibilities of an Energy Director, potentially with the help of professional certifications and additional training programs focused on energy efficiency. For more information about professional certification and training programs, please refer to Chapter 5 and Appendix B.

Develop a Cross-Functional Energy Management Team

To be successful within a complex organization such as a university or a hospital, energy management must often be approached from multiple angles. One of the best ways to have a multidisciplinary approach to energy management is to create a cross-functional energy management team to provide appropriate support and collaboratively guide the direction of the energy management process. A cross-functional team will be better able to identify opportunities for reducing energy use across multiple departments and facilities.

Among the Challenge participants, many energy management teams are responsible for helping the Energy Director oversee the development of the CAP. Most energy management teams also aid the Energy Director in implementing the energy efficiency improvements outlined in the CAP, measuring and tracking energy performance, and communicating with employees and other stakeholders. The size of the energy management team will vary depending on the size of the organization. Roles and responsibilities of the energy management team may include:

- Setting specific energy and GHG reduction targets or other commitments.
- Developing or reviewing the creation of regular institution-wide inventory of energy use and GHG emissions.
- Collaborating with institutional stakeholders to create, update, and approve an organization-wide GHG reduction strategy through the development of the CAP.
- Approving energy efficiency capital projects by presenting future planned projects to senior leadership and financial officers.
- Creating periodic evaluations of energy use by measuring and verifying the success of energy efficiency projects.
- Advising on energy purchasing and identifying opportunities to expand the use of renewable energy sources.
- Communicating the organizational commitment and progress by creating a website, publishing newsletters, and making presentations to the institutional community.

Building Out an Energy Management Team

Over time, many universities and hospitals in the Challenge have hired in-house expertise to aid in the energy management process. Mature energy programs often require extra staff to oversee a greater number of increasingly sophisticated projects, better maintain installed equipment, and improve tracking and reporting. Robust energy management teams may be built out over time after demonstrating that additional staff resources lead to cost savings that can often cover the cost of the staff. Additional staff resources or energy management teams can potentially include individuals who are responsible for commissioning, retro-commissioning, or operating building management systems.

NYU Langone Health

- Energy management team led by Senior Director of Energy Services consists of energy specialists and engineers.
- Cross-functional Energy Committee responsible for tracking energy performance, guiding energy management strategy and overseeing energy projects.

Over the past two decades, NYU Langone Health has worked to establish energy efficiency as one of its core strategic goals by continuously building out its energy management structure. For hospitals like NYU Langone Health with complex organizational structures, energy management can best be addressed by using a multidisciplinary approach that includes an energy management team and a cross-functional Energy Committee. By having this structure in place, NYU Langone Health has been able to make significant headway to the Challenge goal by reducing its GHG intensity by over 26 percent and saving an estimated $34 million in energy costs since 2008.

The first Energy Analyst for NYU Langone Health was hired in 1989 under the Director of Engineering. The Energy Analyst's primary responsibility was focused on capital projects to drive down the hospital's energy use and maximize the operational performance of existing equipment. By the 2000s, as the program developed and realized savings, increased capital expenditure was secured that allowed for more significant infrastructure upgrades.

Hiring a Senior Vice President (VP) for the Facilities department in 2007 paved the way for serious investment and expansion of what would become the energy management team. In 2008, this Senior VP hired a Senior Director of Energy Services to oversee the hospital's energy efficiency projects and programs. The Senior Director of Energy Services was also given the responsibility of developing an energy and sustainability management team with in-house expertise to aid in the energy management process. The team, consisting of an Energy Engineer, an Energy & Sustainability Specialist, a controls specialist, HVAC and Energy managers and electrical and mechanical commissioning managers, was built out by demonstrating to the Administration that additional staff resources focused on energy management can lead to cost savings that are often in excess of the cost of the staff.

The cross-functional Energy Committee is in charge of tracking energy performance, guiding the strategy of the energy management program, developing guidelines and best practices, advising on energy engineering decisions for new construction projects, and building a clear dialogue with the Administration to help make energy management a priority across the organization. Led by the Senior VP for Facilities, the Energy Committee includes the VP for Facilities Operations, Senior Director of Energy Services, the energy and sustainability management team, and external energy consultants. All of these members are responsible for reviewing the status of energy projects; exploring innovative or unique energy conservation ideas; and overseeing energy procurement, large-scale infrastructure decisions and program expansion. The Energy Committee is currently in the process of engaging a larger group of representatives across multiple divisions to serve as a Sustainability Steering Committee to support growth of the sustainability program across the hospital.

The energy management team is usually led by the Energy Director, who is responsible for recruiting a diverse set of staff, with representatives from multiple departments that influence energy use. Successful teams have individuals with a variety of expertise, bringing together individuals, as shown in the diagram on the next page.

Establish a Sustainability Advisory Group

Establishing an organizational culture that includes both energy efficiency and sustainability as core missions requires collaboration among a broad set of stakeholders. Creating a sustainability advisory group with representation from key parts of the organization helps widen the scope of involvement for the development and implementation of both energy and sustainability programs. The central role of the sustainability advisory group extends beyond energy efficiency to include topics such as waste reduction, sustainable transportation, water efficiency, and socially responsible procurement.

Within the context of energy management, the group's primary function is to help coordinate and align energy efficiency and GHG reduction efforts with the institution's broader sustainability efforts. The individuals who sit on the sustainability advisory group serve as ambassadors by communicating the goals, objectives, programs, and initiatives to other institutional members. The energy management team may report progress to the sustainability advisory group, but may also make decisions that are independent from the group. Dependent upon the energy management structure, the energy management team can also be integrated into the sustainability advisory group.

The number of individuals in the sustainability advisory group depends on the size of the organization. The ideal sustainability advisory group will have a diverse set of individuals, representing key parts of the organization that have sustainability goals, as shown in the diagram on the next page.

Reducing GHG Emissions from Vehicle Fleets and Solid Waste

For the purposes of the Challenge, participants have the option to report the GHG emissions associated with vehicle fleets and solid waste. For more information about the vehicle fleet and solid waste GHG accounting methodology for the Challenge, please refer to Appendix A. Developing strategies for tracking and reducing the GHG emissions associated with vehicle fleets and solid waste can help participants make progress towards the Challenge goal. Participants have reduced the GHG intensity of their vehicle fleet by replacing their older vehicles with more compact or hybrid vehicles, or purchasing electrically charged vehicles. Additionally, participants have reduced the GHG emissions associated with their solid waste by altering their procurement practices to favor items with less packaging and establishing education campaigns about recycling.

Energy Management Team

Sustainability Advisory Group

Northwell Health

- Created a sustainability structure consisting of a Healthy Operations Committee, Employee Engagement and Healthier Foods work groups, as well as Facility Green Teams.
- The Healthy Operations Committee monitors the health system's GHG emissions.
- Facility Green Teams engage employees about sustainability initiatives.

Northwell Health, New York's largest integrated healthcare system, has developed a series of institutional groups to help reduce its GHG emissions and enhance its environmental responsibility. This structure creates an organizational culture that weaves sustainability into the fabric of the healthcare system, with goals for waste reduction, water efficiency, sustainable transportation, environmentally-responsible procurement, and green workspaces, in addition to its goals for energy use and GHG reductions.

To help carry out their sustainability program and manage participation in the Challenge, Northwell Health put into place a sustainability structure consisting of a Healthy Operations Committee, Employee Engagement and Healthier Foods work groups, as well as Facility Green Teams. The multi-tiered structure engages stakeholders on various levels of the organization, allowing all employees and staff the opportunity to contribute to the overall sustainability goals of Northwell Health.

Created in 2010, the Healthy Operations Committee develops and monitors Northwell Health's GHG emissions and is responsible for designing and implementing operational process improvements that lead to GHG reductions from energy, waste and transportation. The Healthy Operations Committee consists of representatives from Administration, Procurement, Physical Assets, Engineering and Information Technology. The committee meetings provide the opportunity for a diverse set of stakeholders to stay updated on the success of past energy efficiency projects and progress of current or planned projects. Additionally, the committee has implemented a comprehensive recycling and waste diversion program which has diverted approximately 20,000 tons of solid waste from landfills.

The Healthier Foods work group and Employee Engagement work group consist of employees from various hospitals that meet monthly to discuss and strategize activities that affect system-wide sustainability initiatives. The Healthier Foods work group focuses on increasing the availability of non-sugar, sweetened beverages and healthier food from outlets and vending machines.

The Employee Engagement work group disseminates information about sustainability to all Northwell Health employees and assists in activities such as carpooling, energy conservation, and recycling. In 2014, the Employee Engagement work group created Facility Green Teams at four hospitals to assist in the implementation of sustainability initiatives on a facility level. The Employee Engagement work group plans to expand the Facility Green Teams to other facilities to continue to integrate sustainability in all hospitals.

Chapter 3

Communicate Regularly with Stakeholders

In order to communicate the benefits that improved energy efficiency and reduced GHG emissions can have on the entire institutional community, the Energy Director and energy management team must establish a process to track the success of energy efficiency projects. To maintain institutional support for efforts to improve energy efficiency and reduce GHG emissions, results should be shared directly back with senior leadership, facilities staff, and the broader community. In particular, Challenge participants have found that consistent engagement with senior leadership is important to continue help secure staff resources and financial capital that is needed to meet the institution's GHG reduction goal.

Engage Directly with Senior Leadership

Ensuring that senior leadership is consistently updated on the energy program's progress is essential to continuing their support for an institution's energy efficiency and GHG reduction goals. One way to achieve this is to establish a direct link between the Energy Director and senior leadership to facilitate strong channels of communication.

One successful model is to create a direct reporting structure between the Energy Director and the Vice President of Facilities, Chief Operating Officer, or other positions with similar responsibilities to update them on the present progress of energy efficiency investments and communicate energy performance. For many Challenge participants, the Vice President of Facilities sits on the energy management team, so they are directly and consistently engaged in the energy management process.

Because resources are limited, one of the Energy Director's roles is to convince senior leadership to allocate resources for energy-related projects among an institution's many competing priorities. When speaking with the senior administration, it is important to demonstrate key metrics such as realized cost-savings and GHG emissions reductions associated with energy efficiency investments. Key benefits to highlight to senior leadership could demonstrate that energy efficiency is a way to:

- **Generate energy cost savings.** By reducing utility costs, energy efficiency can generate significant cost savings, which can be reinvested on an on-going basis into other organizational priorities such as lab equipment, student facilities, or research.
- **Improve the institution's asset management strategy.** Improving the efficiency of building operations helps mitigate rising operating costs, improves tenant and occupant comfort, and can increase property values, thereby improving the underlying value of the institution's assets.
- **Complement broader organizational goals.** For hospitals, energy efficiency can increase patient comfort and provides public health benefits. For universities, making energy efficiency investments can serve as a valuable learning opportunity for students and staff.
- **Demonstrate institutional leadership.** Being a leader in energy efficiency reduces GHG emissions and demonstrates that the institution is a leader in the global fight against climate change. Additionally, reducing GHG emissions is a way to improve the environment and health of local communities.

Create a Mechanism to Communicate Success

To maintain support for efforts to improve energy efficiency and reduce GHG emissions, results of completed projects and strategies should be shared directly with all relevant stakeholders, including senior leadership, facilities staff, and the broader institutional community. Maintaining transparency and communicating achievements is important because a diverse set of stakeholders are involved in meeting the institution's GHG reduction goal. Examples of successes can help solidify the institutional commitment to energy efficiency and

City University of New York (CUNY)

- "Project-Based Change Management" platform aimed at engaging all stakeholders in energy efficiency projects.
- Established $1-million revolving fund that invests in energy efficiency projects across campuses.
- Created a"Boots to Suits" program to educate senior administration on equipment O&M and energy efficiency investments.

The City University of New York (CUNY), the country's largest urban university, has led a transformational change on its campuses through the work of Sustainable CUNY, a sustainability program comprised of three key pillars: CUNY Sustainability, Solar, and Energy Resiliency. Sustainable CUNY developed a "Project-Based Change Management" platform to enable participants in any given large-scale project or initiative to take ownership of the outcomes by identifying the changes needed. By adopting this platform, Sustainable CUNY is able to engage stakeholders across campuses, departments, and agencies, to find common ground on project implementation plans and enable members of the campus community to collaborate and monitor projects.

Utilizing this platform, Sustainable CUNY convened all CUNY institutions, engaging key departments as Campuses developed individualized Campus Sustainability Plans and identified over 800 projects to reduce the institution's energy use and GHG emissions. After the plans were created, Sustainable CUNY created CUNY Conserves, a platform to provide assistance in implementing energy efficiency projects and communicating the benefits. Campus facility officials and operators are engaged in the identification and implementation of these energy projects, leading to an understanding how they contribute the institution's energy use and GHG reduction goals.

To help fund identified energy projects, Sustainable CUNY initiated the Sustainable Investment Fund (SIF), a $1-million philanthropist sponsored internal revolving fund. Data and outcomes from the first round of SIF projects were highlighted as case studies and working groups were formed to address future actions to improve operations and maintenance (O&M) procedures. Sustainable CUNY is now preparing to launch the third round of SIF funding.

In an effort to continue to educate all campus stakeholders, Sustainable CUNY rolled out a "Boots to Suits" program in the fall of 2015. The program aims at providing a unique educational opportunity for members of the senior administration to understand the technicalities of equipment O&M, as well as the benefits of energy efficiency investments through meetings and building tours with facilities staff.

Sustainable CUNY also utilized the "Project-Based Change Management" platform to gather solar stakeholders in New York City and New York State to collaboratively create strategic plans and working groups to remove barriers to solar. Now supported by over 86 partners, Sustainable CUNY leads the implementation of multiple city, state and federal solar initiatives. This work helped lead to a growth in, New York City's installed solar capacity from barely 1 megawatt (MW) in 2006 to 53 MW by mid-2015.

sustainability, validate these efforts as a strategy to improve the operations of the institution, and help secure additional staff resources and financial support.

Many Challenge participants have communicated progress to the institutional community by distributing the yearly results of their Carbon Emissions Inventories and CAPs, which helps build awareness about energy performance initiatives and future projects and programs. Additionally, many institutions have created a website, a monthly newsletter, or visual displays in frequented spaces, which include information about planned and completed energy efficiency projects, progress to the GHG reduction goal, and/or upcoming energy-related events.

To communicate relevant information to particularly important stakeholders, institutions have also created tailored reports specific to these audiences. For example, institutions have created reports for senior leadership that concisely summarize the energy performance of buildings, financial results of energy efficiency projects, and progress in meeting the GHG reduction goal. For the facilities management team, Challenge participants have created reports that detail their involvement in O&M, as well as planned and completed energy efficiency projects and the benefits these will deliver to institution.

Track Energy Use and the Success of Energy Efficiency Projects

Measuring energy use regularly is important to understand how an institution uses energy, the factors that contribute to energy use, and whether implemented energy efficiency strategies are working. Institutions can use the Carbon Emissions Inventory Calculator developed for the Challenge or other tools such as United States Environmental Protection Agency's (U.S. EPA) ENERGY STAR Portfolio Manager®, or internally developed tracking documents to measure annual energy use. Utilizing these tools is a way to baseline energy use and GHG emissions and benchmark progress, but these are limited in their capacity and do not provide information that is granular enough for sophisticated energy analysis. Many Challenge participants have used third-party software or the services of an energy consultant to measure real-time energy use to provide facilities staff with actionable recommendations to optimize building systems.

In addition to tracking overall progress, many participants have supplemented this information by creating processes to track the success of specific energy projects in order to determine whether the improvements have delivered the expected results. Measuring realized cost-savings and GHG reductions from specific projects better informs future budget decisions and allows staff to make the case for additional energy efficiency projects. The energy management team can also analyze the data to determine energy trends, gain a better understanding of the factors that affect energy performance, and identify steps to further reduce energy consumption. Many Challenge participants have also made efforts to assess non-quantifiable benefits as well, which include educational opportunities for faculty, staff, and students, or the development of institutional knowledge about project implementation.

The appropriate level of measurement and verification (M&V) for energy-related projects will vary according to the value of the project, its expected benefits, and the risk associated with

NYC Health + Hospitals

- Creation of Energy Liaison roles to communicate between facility managers, facilities engineers and energy management team.
- Circulation of data sheets to facilities managers outlining monthly energy consumption and cost.

Totaling over 21 million square feet, NYC Health + Hospitals is the largest integrated municipal healthcare system in the United States. With a grant from the NYC Department of Citywide Administrative Services (DCAS) in 2014, NYC Health + Hospitals created an Energy Management Plan (EMP). The plan recommended establishing an energy management team, which would be tasked with identifying and implementing energy conservation measures, and providing support and leadership to the overall energy management processes. The team was assembled in the summer of 2014.

By communicating directly with the senior administration, establishing an energy liaison in each facility, and distributing monthly data sheets, NYC Health + Hospitals has created a strong communication sharing network throughout its organization that fosters inter-departmental and inter-agency collaboration on energy management.

As part of the EMP's implementation, the energy management team acts as the main point of contact for all energy management decisions by communicating with key organizational stakeholders such as the senior administration, DCAS, and the facilities manager in each of the hospitals to implement the initiatives outlined in the EMP. For example, the team created a direct reporting structure to the senior administration by meeting semi-annually with the Capital Committee and the Board of Directors where they provide updates on current energy efficiency projects and other energy initiatives. The team must provide supporting documentation to gain approval from the Capital Committee and Board of Directors for all capital energy projects in excess of $3 million dollars. The team also meets with DCAS' Division of Energy Management quarterly to report on status of all energy projects.

To aid in the communication with the facilities personnel across 11 acute care hospitals; each facilities manager is responsible for serving as an "Energy Liaison" to the energy management team by being the main point of contact regarding energy decisions. The facility manager is responsible for being the onsite advocate of the EMP by promoting its implementation at the facility level. The liaison also tracks utility consumption and proactively communicates information that may significantly impact energy consumption or costs. The energy management team also participates in monthly facility management meetings and informs facility personnel of current projects and other energy related initiatives.

The energy management team also circulates a data sheet to each facility manager outlining their facility's energy consumption. The data sheet graphically displays information about the facility's historical costs and consumption for each type of fuel. The data sheets also compare where each facility's energy performance sits historically and compared to the rest of the network, so that facilities managers can evaluate the success of the implementation of their energy efficiency strategies.

not achieving the benefits. Oftentimes, energy efficiency projects that are funded by an external organization like a utility or state authority include funding for M&V. Aside from these projects, many Challenge participants have aligned their M&V protocol with the Efficiency Valuation Organization's International Performance & Verification Protocol.[3] To complete M&V for specific projects, the energy use of the piece of equipment that is scheduled to be fixed, modified, or replaced must be measured to get a point of comparison post-upgrade. To complete M&V for a whole building, the baseline energy consumption must be established by gathering sub-metering or utility bill information on a building level. Once the baseline has been set and the upgrade has been installed, an institution can perform three different types of M&V methods:

1. **Retrofit Isolation:** Sub-meter specific equipment and use the data to calculate energy reductions, GHG emissions reductions, and cost savings, while taking into account conflating factors like weather and usage patterns.

2. **Partially measured retrofit isolation:** Measure the energy use of individual pieces of equipment and extrapolate the energy savings for the full set of equipment installed.

3. **Whole building:** Institutions can gain insight into how well a building is performing due to energy efficiency improvements by measuring energy consumption at the building level through the use of sub-meters or utility bills.

Track the Success of Project Implementation

It is also important to analyze and improve upon the project implementation processes used to move energy efficiency improvements from inception to completion. Many Challenge participants have used the energy management team to gain stakeholder input on these processes in order to refine them over time. By taking steps to streamline the energy efficiency implementation process, energy-saving projects can be implemented more quickly and with greater frequency.

St. John's University

- Invested $20 million in Energy Capital Project Plan.
- Utility tracking system and building energy dashboards to monitor building performance.
- Staff training in CUNY Building Performance Lab's "Building Re-Tuning" training.

Founded in 1870, St. John's University (SJU) is a private, Catholic and Vincentian University with over 21,000 students. Since committing to the Challenge in 2007, SJU has reduced its GHG emissions intensity by more than 23 percent through a combination of large-scale capital improvements, re-commissioning and new energy efficient construction. In order to ensure that the energy efficiency improvements have delivered their expected cost savings and GHG reductions, as well as maintain their effectiveness, SJU has put into place a robust energy monitoring system and has made ongoing re-commissioning a top priority.

In 2009, SJU conducted an ASHRAE Level III investment grade audit of existing university buildings to discover the biggest opportunities for energy efficiency improvements. After the audit was complete, SJU assembled an Energy Capital Project Plan and received approval from its Board of Trustees to borrow $20 million for project implementation. Using this funding, SJU employed a diverse set of improvements. While the shortest returns on investment came from projects like the lighting and steam trap maintenance, it was the new high efficiency chilled water central plant that accounted for almost two-thirds of SJU's GHG reductions from capital investment. Currently, the $2.1 million in annual savings from energy projects offsets the cost of debt for these projects. Aside from the projects in the Energy Capital Project Plan, SJU also invests millions of dollars annually in capital renewal and replacement. Some of these upgrades include: motors and speed drives in HVAC equipment, central heating plant upgrades, LED light bulbs, and instantaneous hot water heaters.

SJU has proactively tracked the success of these projects by developing a utility tracking system that helps show the effects of energy efficiency investments by graphically displaying cost-savings as well as energy and GHG reductions from utility accounts. Every building is also equipped with an energy dashboard that gives building operators a tool to compare energy consumption profiles and peak demand information. These dashboards help make the University community aware of energy consumption and help engage students in behavior change campaigns like the Campus Conservation Nationals – an annual energy reduction tournament for the university's residence halls.

SJU also trains their facilities team to understand how to effectively operate equipment to advance the energy performance of both new and existing building systems. In 2015, some of SJU's facilities staff achieved certification in "Building Re-Tuning" through CUNY's Building Performance Lab. This training helps staff learn specific strategies to "tune-up" buildings for optimal and consistent performance. In particular, the training helps develop the technical skills needed to examine trend log data in HVAC systems to analyze how systems are performing and helps identify programs to be correct resulting in significant cost-savings and GHG reductions.

Chapter 4

Maintain Building Systems & Equipment

Maintaining and monitoring building systems is necessary to both improve the energy efficiency of existing building systems and sustain the reductions made from energy efficiency investments. This can be accomplished by developing and implementing a robust operations and maintenance (O&M) plan, retro-commissioning existing building systems, completing the commissioning process for all renovations and new construction projects, and tracking occupant interaction with energy use.

Create a Robust Operations and Maintenance Plan

Building O&M encompasses all the services required to ensure that a building's systems and equipment perform at least as efficiently as they were originally designed and constructed. According to the U.S EPA, O&M programs designed to enhance the operating efficiency of HVAC and lighting systems can save between 5-20 percent on utility bills without significant capital investment.[4] Commissioning procedures and retro-commissioning strategies for existing building systems often exist separately, but could be included in the O&M plan.

All university and hospital facility management staff engages in some degree of O&M, but it is not always a standardized process. Creating a written or electronic O&M plan helps to formalize a strategy that integrates energy efficiency into regular and preventative maintenance as well as operating procedures. Regular maintenance consists of regularly scheduled diagnostic and repair activities designed to ensure building systems are operating correctly. Regular maintenance also refers to the framework for planned maintenance activity, including the generation of planned work orders to correct potential problems identified by inspection. Preventative maintenance are actions which extend the life of the equipment, such as lubricating, cleaning, adjusting and replacing minor parts like drive belts, gaskets, or filters. To help aid in this component of the O&M plan, many Challenge participants utilize an online work order management system that helps record and streamline ongoing maintenance processes.

A written O&M plan should also outline procedures for periodic review and monitoring of operating sequences and schedules to ensure that building systems operate as efficiently as possible. Potential procedures include reviews of HVAC, lighting schedules, and temperature set-points that are informed by occupant/tenant use to ensure that equipment runs only when needed. Additionally, the plan should outline the facilities staff's tools and equipment to detect for building system malfunctions, such as an energy management control system or electronic data loggers.

As a starting point, if an institution has not created an O&M plan, an appropriate staff member can be assigned to aggregate the manufacturer's documentation for specific pieces of equipment.

Benefits of an O&M Plan

Implementing a robust O&M plan has the opportunity to save costs in a number of key ways:

- Improves the energy efficiency of equipment, thereby reducing energy costs.
- Extends the useful life of building systems and equipment, reducing the need to spend capital on new equipment.
- Increases equipment reliability, helping to prevent costly repairs.
- Helps maintain the cost savings from previous investments in energy efficiency.
- Reduces the need for employee overtime and costly emergency repairs.

This staff member, in conjunction with the facilities managers, can work to develop current operating standards and procedures for major building systems. Once this is accomplished, the staff member can begin developing the O&M plan by aligning current operating procedures with the minimum manufacturer specifications. This process can often by aided by a third-party retro-commissioning provider.

After this, the appropriate staff member can develop operating documentation for recording scheduled work, including actions for regular and preventative maintenance. Accurate operating documentation creates a resource that can help cut labor costs by reducing the time spent replacing equipment and prevent energy losses associated with steam, water, and air leaks, as well as maladjusted or inoperable controls. The operating documentation can include a manual or a computerized management system that tracks maintenance operations electronically. Operating documentation typically includes:

- Schedules for maintenance and protocols for common equipment systems.
- Templates to record all changes in equipment, sequences of operation, set points, control strategies, and schedules.
- Operating schedules for all equipment that is not required to run continuously, which may include lighting, HVAC equipment, cooking equipment, and office equipment.

The energy and cost savings from O&M are not always highly visible because it is difficult to quantify avoided costs, but O&M is essential to realizing and sustaining efficiency gains. For more information on training building staff on the procedures and benefits of the O&M plan, please refer Chapter 5.

Consider an O&M Pilot Program

Generating buy-in for major changes to operating procedures can be difficult, particularly at large institutions and when it requires the commitment of staff and financial resources. Starting small is often an effective strategy to create buy-in for these initiatives. To start, many Challenge participants began by conducting a pilot program to develop and implement an O&M plan in selected facilities. Pilot programs can be an effective way to ease transitions into major changes in operating procedures and address concerns or criticism. The most effective pilot programs often include program evaluation procedures to understand lessons learned, applicability, and replicability for broader implementation.

Retro-commission Existing Building Systems

Retro-commissioning is the testing and tune-up of existing building systems to operate as originally designed and as efficiently as possible. It is a systematic process to optimize how equipment and systems operate individually and how they function together. The retro-commissioning process is often a way to reassess an institution's O&M plan by identifying maintenance, calibration, and operations errors within building systems that are often easily corrected and, when implemented, will save energy and improve equipment reliability.

Retro-commissioning projects are often led by a third-party provider, with varying degrees

of involvement from facilities staff. When reviewing a retro-commissioning provider's qualifications, it is important to consider the provider's certifications, technical knowledge, and relevant experience. To develop a scope of work, the retro-commissioning provider visits the site, examines the building systems, and talks with facilities staff and occupants. This provides an in-depth assessment of how the facilities staff operates and maintains building systems and what facilities staff and occupants consider the most significant problems in the building. The retro-commissioning provider then identifies areas of opportunity in the building for energy savings, determines the most cost effective measures, and implements the recommendations.

Challenge participants have often involved facilities staff to assist with or observe the retro-commissioning process to improve their understanding of building systems and control strategies. This will enable facilities staff to re-test or re-commission systems periodically as part of their ongoing O&M plan. Without integrating the changes in operating procedures into the O&M plan, the energy reductions that accrue during the retro-commissioning process will not last.

New York City's Local Law 87: Energy Audits and Retro-commissioning

NYC Local Law 87 of 2009 (LL87) requires buildings that are greater than 50,000 gross square feet to complete a third-party ASHRAE Level II energy audit and retro-commission their building systems once every ten years. LL87 requires retro-commissioning of all base building systems, including the building envelope, HVAC systems, elevators and escalators, domestic hot water supply, and electrical and lighting systems. Some Challenge participants have also coupled their LL87 compliance with retro-commissioning for buildings less than 50,000 square feet, allowing them to realize economies of scale and greater energy savings. For more information about the requirements of LL87, visit: nyc.gov/LL87.

Mount Sinai Health System

- Developed a robust O&M plan with written instructions for operating procedures of major building systems.
- Established trainings for facilities stafff focused on operation of advanced control systems and active monitoring of building equipment.
- Implemented measures from energy audit and retro-commissioning will yield will $1.25 million in cost savings.

Founded in 1852, the Mount Sinai Hospital, is a 1,171 bed, tertiary-care teaching facility acclaimed internationally for excellence in clinical care. While significantly upgrading the hospital's aging infrastructure and expanding the hospital's campus, Mount Sinai has created a robust operations and maintenance (O&M) plan that includes a plan to commission all new equipment and retro-commission its existing facilities.

Since the beginning of the Challenge, Mount Sinai has completed a series of major energy efficiency upgrades. In 2009, Mount Sinai began a major project to increase its chilled water generation capacity. This was necessary to support major infrastructure improvements, such as the addition of medical imaging equipment and the addition of new construction. Mount Sinai has also added more than 950,000 square feet to its North Manhattan Campus in the last few years, including the addition of a residential tower and the LEED-Silver Leon and Norma Hess Center for Science and Medicine.

Over the past two years, Mount Sinai's facilities team focused on creating a robust O&M plan that includes written operating procedures for major building systems, such as chillers and chilled water pumping, HVAC systems, boilers, and burners. For example, the newly upgraded chillers have formal guidelines for chiller water temperature and pressure supply which prevent controls from being maladjusted and guard against wasted energy.

As part of the O&M plan, the Director of Plant & Energy Operations has developed staff training programs for its Stationary Engineers and HVAC Operations Team, which focus on the operation of advanced control systems and active monitoring of building equipment. The trained facilities staff will be able to execute the O&M plan and prevent any potential energy loses in building systems. Based on the experience of similarly sized hospitals, Mount Sinai expects to realize a 5 percent reduction in energy use and associated GHG emissions intensity as a result.

For existing building systems, Mount Sinai has completed retro-commissioning for many of its North Manhattan Campus buildings to optimize energy performance and comply with New York City's Local Law 87 (LL87). This includes auditing its existing North Campus buildings and identifying deficiencies and low-cost improvements to equipment controls that will optimize system performance. The implemented measures are expected to reduce electricity consumption by an estimated 8 million kWh annually, reducing the hospital's GHG emissions intensity by an additional five percent. This strategy will reduce energy costs by another $1.25 million per year and is expected to cost only $1.7 million to implement, implying a payback period of just 1.4 years.

Rockefeller University

- Specialized in-house mechanics provide daily optimization of existing equipment.
- Knowledgeable in-house operations teams provided more energy efficient equipment designs based on their hands-on experience with the university's building systems.

Founded in 1901 on the Upper East Side of Manhattan, Rockefeller University (Rockefeller) is a world renowned research institution for biomedical sciences, chemistry, bioinformatics, and physics. As a Challenge participant, Rockefeller University has reduced its GHG emissions intensity by 25 percent and has cumulatively saved an estimated $10.5 million in energy costs. A key factor in Rockefeller's ability to achieve and maintain significant GHG reductions has been the development of an in-house O&M team capable of performing ongoing retro-commissioning activities for existing equipment.

In 2015, Rockefeller hired an absorption chiller mechanic to work with the existing boiler plant staff, including the boiler-operators and a steamfitter. This team works together to maintain an efficient steam system and perform ongoing retro-commissioning work by identifying and implementing calibration and operations errors. Typically, absorption mechanics are contracted out to third-party providers, however, by hiring these positions in-house, Rockefeller has been able to decrease costs and realize improved efficiency of building equipment. Having developed an O&M team dedicated to overseeing specific building systems increases the frequency in which system operations are reviewed and calibrated, which in turn reduces GHG emissions and improves equipment reliability. Instead of annual maintenance visits by the third-party contractor, the absorption chiller mechanic can perform daily adjustments to increase chiller efficiency. Additionally, the in-house steamfitter can repair steam leaks and reroute steam lines as needed. Retro-commissioning is constantly occurring in all aspects of the boiler plant, with continual training of the boiler plant staff in system optimization and efficiency provided by the university through retained outside experts.

The expertise acquired by Rockefeller's in-house operations team through its ongoing retro-commissioning work has also been beneficial for the university when installing new equipment. In 2014, a new piece of high energy use research equipment was installed, which required significant cooling. Instead of the dedicated 30-ton electric chiller called for in the original design, Rockefeller's in-house team was able to design a smaller and more efficient thermal storage system that would use existing infrastructure to provide cooling. Seeing the success of this system, Rockefeller has since decided to implement this in-house design for similar pieces of research equipment in the future.

Commission New Building Systems

Commissioning is a process by which new building systems and equipment are tested to make sure they are performing according to the original design intent. Because it is the last step in the construction process, commissioning is sometimes neglected when opening a new space or completing a renovation, but can result in an average of 16 percent energy savings in existing buildings and 13 percent energy savings in new construction.[5]

The commissioning process should begin at the same time the project team determines the project scope, schedule, and budget. The commissioning process can be completed by an in-house facilities manager or by an independent third-party, such as the architectural or engineering firm responsible for design and construction. The party responsible for the commissioning will create the commissioning budget, written plan, schedules for inspection, and documentation of the process.

Regardless of who completes the commissioning process, it is important to include facilities staff because they will be responsible for ensuring that the equipment continues to function at optimal efficiency. Facilities staff should be involved in integrating information about the new equipment into the O&M plan and creating operating documentation for controls and scheduled maintenance.

Track Occupant Interaction with Energy Usage

Another way to collect information about potential building system deficiencies is by creating an early detection system where employees, staff, and students can report energy waste or energy reduction opportunities. For example, individuals using the early detection system can report on heating and cooling issues or ways to decrease electric lighting. Many Challenge participants have set up a hot line, e-mail account, or online application to collect this information. The Energy Director and the energy management team can then use this information to directly target building systems that need to be modified, fixed, or replaced.

Organizations may also use qualitative building information to understand how occupants/tenants interact with building equipment and systems. For example, as part of the commissioning process for newly constructed buildings or major renovations, the energy management team can conduct post-occupancy surveys to evaluate occupant comfort which can help fine-tune the operating conditions of building systems. The energy management team can also collect this type of information through occupant interviews and use it to tailor tenant education programs to address the misconceptions occupants have regarding equipment and devices. For example, employees in office spaces should be familiar with lighting controls and occupancy sensors in their work environment and should know how to operate them as efficiently as possible.

Chapter 5

Train Building Staff

Training facilities staff to be well-versed in energy efficiency will help employees operate equipment properly, aids in the effectiveness of capital investments in energy improvements, complements O&M plans, and opens new opportunities for energy efficiency. Universities and hospitals can build the expertise of their employees by providing multiple training opportunities and encouraging professional certifications.

Provide Incentives or Subsidizes for Third-party Energy Efficiency Training

There are dozens of certifications and training opportunities for facilities staff, engineers, senior leadership, and other employees to learn best practices in energy efficiency. Many Challenge participants have made third-party energy efficiency certification and training programs accessible to a variety of individuals to build organizational capacity, empower staff to develop new skills, and enhance employee morale. Challenge participants have trained facility staff, engineers, members of the energy management team, and other organizational leaders to enhance their awareness of energy efficiency opportunities and technologies, as well as O&M practices.

Opportunities to provide the energy management team with up-to-date training include conferences, workshops, and professional certifications. Because energy management practices continuously improve, it is important to encourage facilities staff to continue training for new operating methods or procedures designed to reduce energy use. For a full list of energy efficiency training programs, please refer to Appendix B.

Ways to Encourage Staff Participation in Third-party Energy Efficiency Training

- Allocate a portion of the annual operating budget to pay for training, instructional materials and testing fees.
- Offer paid time off for employees to receive training.
- Provide the opportunity for raises to employees who become credentialed in energy efficiency training.
- Supply employees with information about specific energy efficiency training opportunities.

Hiring Tip

Organizations can save money by hiring facilities staff with energy efficiency experience. Individuals with energy efficiency expertise can provide substantial value through increased cost savings.

Memorial Sloan Kettering Cancer Center

- 60 building operators trained in "Building Operator Certification" (BOC) Level I and II; 20 also trained in CUNY Building Performance Lab's "Building Re-Tuning" training.
- Five facilities managers trained as "Certified Energy Managers" (CEM).
- Doubled budget for training facilities staff between 2011 and 2014.

Founded in 1884, Memorial Sloan Kettering Cancer Center (MSK) is one of the world's oldest and largest private cancer centers, with its main campus covering over 3.7 million square feet on the Upper East Side of Manhattan. MSK's commitment to training its building staff in professional certifications has given facilities personnel the opportunity to enhance their awareness of energy efficiency opportunities and technologies, as well as O&M practices.

Beginning in 2011 with ten of its building operators, MSK started providing funding for its staff to be certified in Building Operator Training (BOC®) courses. To obtain this training, MSK sent their facilities staff to classes offered by the City University of New York (CUNY) Building Performance Lab (BPL). Founded in 2011, the BPL trains New York City's building workforce in the benefits of maximizing efficient building systems by offering courses in building operations, re-tuning, maintenance, energy auditing, energy efficiency, and energy control systems. Building Operator Certification (BOC®) Level I and Level II are nationally recognized, training and certification programs focused on energy efficient building operations and preventative maintenance procedures. Independent research shows that training building operators in BOC certification can save facilities up to 172,000 kWh per year in energy consumption.

After the initial round of training in 2011, MSK began to provide annual in-house classes for all building operators in both levels of BOC. To date, 60 building operators have received certification in BOC Level I and II and 20 of those 60 MSK staff members have completed the Building Re-Tuning course, which covers the protocol for energy monitoring and optimizing building performance. Additionally, MSK has provided funding to train five of its building managers as Certified Energy Managers (CEM) to help teach them how to optimize the energy performance of their buildings and be leaders in the implementation of the energy efficiency projects outlined in MSK's Climate Action Plan.

The facilities staff at MSK have given positive feedback about participating in these training and certification programs, reporting that these courses have benefited their work by offering them new skills and enhancing their awareness about energy efficiency. Leadership of the facilities department has reported that the courses have led facilities managers to be inspired to look for energy efficiency opportunities and has created a strong culture of energy management. Building off of the success that MSK has seen with its certified building operators, the facilities department has instituted a hospital-wide policy that all new and current building operators must take the BOC class. To help fund this new requirement and encourage other types of training programs, MSK has further committed financial resources by doubling the training budget in the last five years.

Develop an Organization-Specific Training Program for Building Staff

Even with extremely energy efficient equipment and a robust O&M plan, energy efficiency is not guaranteed without proper training of building staff. In addition to third-party energy efficiency training and certification programs, Challenge participants have created organization-specific training programs aimed at educating new hires and existing building staff about energy efficiency. These site-specific training programs are aimed at helping building staff understand how the O&M plan relates to energy efficiency, how to install and operate energy efficient equipment, what the benefit is, and why they are doing it. By doing so, institutions can generate a culture focused on energy efficiency and empower facilities staff to contribute new ideas and become champions of the O&M plan that can lead to greater energy savings.

A successful organization-specific training program helps new hires develop a unique understanding of the institution's building systems and their role in the O&M plan. Current staff experience can augment the organization-specific training program, working closely with employees that have years of experience to contribute. A training program helps prevent unintentional misuse of new technologies that can undermine the effects of energy efficiency investments. Changes in the O&M plan due to new equipment and retro-commissioning procedures can be communicated to the staff by including them in the process, but it is often difficult to keep all facilities staff involved because of time constraints. The training can help facilities staff understand these changes by integrating training into reoccurring facilities staff meetings or setting up specific classes to provide easy-to-understand information on equipment operation. The training program is often led by the Energy Director or the individual responsible for overseeing the installation and operations of new equipment.

The training program can also help educate facilities staff about the institution's energy efficiency and sustainability goals, their role in meeting the goals, and progress-to-date. For the facilities management team, Challenge participants have created reports that detail their involvement in planned and completed energy efficiency projects and the benefits these will deliver to the O&M of building systems. The training program can offer scheduled time to present these reports to the facilities staff. For more information about creating mechanisms to communicate success, please refer to Chapter 3.

Maimonides Medical Center

- Energy Awareness Program, part of monthly Engineering Department meeting, trains facilities staff on energy efficient equipment operation and installation.
- Trained facilities workers have identified and implemented a full lighting retrofit, gas and steam trap upgrades, insulation projects, and water efficiency projects.

Implemented in 2011, Maimonides Medical Center (MMC) created an organization-specific training program for facilities staff, called the Energy Awareness Program (EAP). The EAP is the baseline training for all facilities staff on O&M procedures and opportunities for reducing energy use and GHG emissions. The program focuses on informing the facilities staff about the institution's commitment to the Challenge and how their work contributes to meeting the hospital's GHG reduction goal. Additionally, the training teaches facilities staff how to install energy efficient equipment, understand the benefits, and successfully operate it through proper O&M. Run by the Director of Facilities and Engineering, the program has become a part of MMC's monthly Engineering Department meeting.

Through the EAP, employees are educated about the hospital's commitment to the Challenge and the cost of energy to understand the carbon impact and full costs of operating the hospital. The goal is that with increased awareness about their role in the management of GHG emissions and energy costs, facilities staff will find opportunities to implement energy efficiency measures and optimize building systems. The program also allows facilities staff to look for new energy efficiency opportunities by inviting contractors to speak and allowing employees paid-leave to visit trade shows and energy expos.

The Director of Facilities and Engineering motivates facilities staff to "work smarter, and not harder," encouraging them to identify and implement simple energy efficiency projects and improve building equipment O&M. The EAP has inspired many MMC facilities workers to become passionate about reducing energy and GHG emissions, motivating them to continuously look for new opportunities to reduce energy use and GHG emissions. Since the creation of the EAP, facilities workers at MMC have been able to successfully identify, plan, and implement a major lighting retrofit, gas and steam trap upgrades, insulation projects, and water efficiency projects such as reduced flow toilets and aerators for sinks.

One of the biggest successes of the program was a lighting retrofit project that was carried out by the facilities management team after a comprehensive lighting energy audit. Identified by the facilities staff after the founding of the EAP, the MMC zone mechanics removed about 1,200 T-12 ballasts and installed T-8 bulbs. As of 2015, there are no T-12 bulbs in operation at MMC. Since 2011, the facilities staff as also employed an active plan for exchanging incandescent floods and recessed light bulbs with LEDs. An important aspect of this project was replacing the lighting in the corridors and stairs, which operate continually, with 4 inch LED bulbs. Additionally, MMC has installed light sensors in areas where the lights were continuously left on. To date, 250 sensors have been positioned in storage rooms, utility rooms, medication rooms, mechanical areas, and offices.

Chapter 6

Plan Ahead to Coordinate Investments

To maximize the effects of energy efficiency projects, universities and hospitals can coordinate projects across their campus portfolios. It is important that evaluation of possible efficiency upgrades be conducted with a holistic focus—a change to one system may alter the conditions of other systems throughout the building. This can be accomplished by creating a plan to retrofit lighting, HVAC equipment, envelope, and other building systems.

Strategically Plan Project Implementation

Challenge participants have been able to dramatically reduce their energy and GHG emissions as a result of the aggregate effects of a large number of individual energy efficiency measures performed across their entire institutional portfolios. Energy efficiency upgrades in one system may alter the conditions of other systems throughout the building. For example, efficiency upgrades to a lighting system will reduce heat from lighting and will lower the cooling load of the air-conditioning (AC) system. Because of this, it is important to evaluate all possible efficiency upgrades with a holistic focus.

To maximize the effects of energy efficiency projects and coordinate projects across the institutional portfolio, institutions can create a plan to retrofit lighting, HVAC equipment, envelope, and other building systems. The plan can include an analysis of how much energy can be saved and GHG emissions reduced with a given measure and the necessary financial and staff resources to implement it. Many Challenge participants have this process led by the energy management team and have integrated it into the development of the Climate Action Plan. For more information about the Climate Action Plan, please refer to Chapter 1. For more information about an energy management team, please refer to Chapter 2.

During the planning process, all energy efficiency project analyses should bring timeline into the equation. Integrating energy efficiency into projects that are already being completed can help ease project implementation and improve the condition of existing facilities by bringing them to a state of good repair. Additionally, it is helpful to consistently look for energy efficiency opportunities in required work that does not explicitly involve energy, such as compliance with the American with Disabilities Act.

In determining the relative benefits of different GHG emissions strategies, institutions should compare cost and savings over different timeframes to determine the energy and GHG reductions. Once all cost-benefit data is determined, project options can be ranked by one or more criteria to determine which are most feasible and likely to achieve the needed levels of GHG reductions. The plan should include an analysis of how much energy can be saved with a given energy conservation measure (ECMs) and the necessary financial and institutional resources to implement it.

Bundle Projects with High and Low Payback

It is often assumed that it makes most sense to start with investments in ECMs that are easiest to complete and have the shortest payback period. However, institutions can make energy efficiency projects with longer paybacks more attractive by combining the most cost-effective ECMs with less cost effective ECMs. For example, lighting retrofits often have short paybacks, while more capital-intensive retrofits such as heat recovery systems or new boilers or chillers may be costly but yield significant GHG reductions. If both types of measures are combined within the same project, the end result can be an attractive combined payback and return on investment, which will be easier to justify financially.

Evaluate Projects Based on Life-Cycle Cost Analysis

One of the most accurate ways that Challenge participants have demonstrated the comprehensive benefits of energy efficiency improvements is by using a life-cycle cost (LCC) analysis when determining the financial feasibility of projects. LCC analysis is the evaluation of a project based on the total costs of using equipment over its entire expected life. Using LCC considers the initial operating expense or capital investment as well as the avoided energy and maintenance expenses associated with the equipment, discounted into present value equivalent dollars. Knowing the LCC of a piece of equipment is important because it fully demonstrates the costs and benefits associated with a particular investment opportunity over the life of the equipment.

Life-cycle costs analysis can include the following components:

- Initial investment (including installation costs)
- Energy expense avoided through the efficiency upgrades
- Estimated maintenance expenses avoided (cost of replacement, labor, downtime)
- Maintenance expenses (cost of replacement, labor, downtime)
- Disposal costs at end of useful life
- GHG emissions reduction benefits
- Non-financial benefits (risk reduction, resiliency, environmental benefits)

A common barrier to utilizing LCC analysis is that energy efficiency projects are funded from the capital budget but result in savings to the operations budget, which usually includes energy costs. Most organizations plan separately each year for capital, operating, and capital investment budgets, each with its own independent review and approval processes. The case for LCC analysis is more effective when organizations use a methodology that transfers the savings from the operations budget into the capital or investment budget. Quantifying and allocating the savings associated with the operating budget to the capital budget and vice versa can help staff secure additional funding for future energy-related projects. The other expenses associated with LCC are often difficult to quantify, so they should be omitted in the budget transfer process, such as avoided maintenance expenses, disposal costs at end of useful life, and GHG emissions reductions.

Chapter 7

Understand Financing Options

One of the major barriers that Challenge participants face is finding capital to fund the costs of energy efficiency projects. Understanding a variety of financing options, which include internal capital, incentives, rebates, loans, bonds, energy service contracts, or green revolving funds can help institutions find financial resources that can be invested in energy efficiency projects. Many Challenge participants have successfully blended internal and external funding options to maximize their available capital.

Dedicate Funding within Budgets for Energy-related Improvements

Internally financed energy-efficiency improvements that are paid directly with available cash drawn from an organization's current operating or capital funds is the simplest and most direct way to pay for improvements. One attraction of internal financing is that it allows the institution to retain all energy-cost savings. It also allows quick project implementation by avoiding complex contract negotiations or transaction delays often associated with other financing mechanisms.

Different types of budgets can be consolidated across the institution or decentralized with different departments or schools. Regardless of the breakdown of budgets within an institution, budgetary processes need to be structured in ways that allow for sufficient and reliable access to capital for energy efficiency projects. This helps ensure that these projects are funded on an on-going basis.

Institutions typically have three types of budgets from which energy efficiency funds can be drawn:

1. **Operating budgets:** For low-cost opportunities that cost less than the organization's defined capital investment threshold. Examples of operating expenses allocated toward energy efficiency include low cost projects like lighting replacements, insulation upgrades, or funding towards energy efficiency training programs.

2. **Capital budgets:** For purchases to replace failing or aged equipment or for new construction that is not initiated purely to meet energy efficiency objectives, yet often present an energy efficiency opportunity. Examples of capital expenditures can include projects such as steam system upgrades, window replacements, or HVAC improvements.

3. **Capital investment budgets:** For major capital energy efficiency upgrades that do not fall in the capital budget because they exceed a defined capital threshold. Examples of capital investments include upgrading major aging infrastructure such as chillers, boilers, and air distribution systems.

Within operating budgets, staff members are often encouraged to maintain spending at or below specific budgeting levels in a given year and are not rewarded for saving operating costs in future years, which disincentivizes investments in energy efficiency projects. Within capital budgets and capital investment budgets, funding for energy efficiency projects is often in direct competition with other projects. Moreover, energy efficient equipment that requires more capital is often value-engineered out during project planning despite the fact that the equipment will generate cost-savings over time.

To help alleviate this problem, some Challenge participants have created dedicated funding in a separate fund or within their capital, operating, and capital investment budgets specifically for energy efficiency improvements. By dedicating specific funding for energy efficiency projects, organizations can close project funding gaps for budgets that have funding for basic equipment replacement and deferred maintenance projects, but not incremental amounts to enable purchases of higher energy efficiency equipment. This lowers the marginal cost of the energy efficiency investments by capitalizing on the work that is already being completed.

New York University

- Created an Energy Fund to establish a source of capital for energy efficiency projects separate from capital and operating budgets.
- Funding source for Energy Fund comes from demand response rebates and efficiency incentive programs.
- Energy Fund is under the direction of an Associate Vice President who reviews and approves potential efficiency projects.

With over 58,000 students, New York University (NYU) is the largest non-profit institution for higher learning in the United States. NYU's main campus is located in lower Manhattan, and the university covers over 13.7 million square feet throughout New York City. Committing to the Challenge in 2007, NYU was one of the first institution's to sign on to the 30 percent reduction goal.

At the time of the initial commitment, NYU established an Energy Fund to ensure there was a sufficient pool of capital that could be utilized throughout the course of the Challenge to implement energy efficiency projects to meet the GHG emissions reduction goal. The Energy Fund was conceived as a vehicle for rebates and incentives received from energy efficiency projects to be reinvested back into further efficiency gains. Energy conservation programs, like demand response, are also used as a source of capital to replenish the Energy Fund.

Falling under the direction of the Associate Vice President of Sustainability, Energy & Technical Services, the Energy Fund operates separately from NYU's general capital and operating budgets, ensuring a reliable and specific source of funding for energy efficiency projects. The Energy Fund revenue varies annually depending on the incentive and rebate application approvals and when projects are complete. All money in the fund is annually reinvested in energy efficiency projects, which continuously support progress toward the Challenge goal.

The Energy Fund allocates capital to a portion of NYU's energy efficiency projects. Proposed projects are submitted as a memo to the Associate Vice President of Sustainability, Energy & Technical Services, where they are individually evaluated based on estimated energy savings, GHG reductions and payback. For these projects—funding is made available to completely fund projects or pay for the incremental cost of higher efficiency equipment. Some of the projects that the Energy Fund has been utilized for include lighting retrofits, variable frequency drive installations, occupancy sensor based smart thermostats, and automated demand response measures.

After making significant reductions in their GHG emissions in the first few years of the Challenge and achieving the Challenge goal, NYU has expanded their commitment by setting out to reduce its GHG emissions by 50 percent by 2025.

Utilize External Funding Sources

Institutions can also utilize external funding sources to leverage the available dollars and take advantage of transactions as they occur. Options of external funding sources include, but are not limited to:

- **Energy Performance Contracts:** An energy performance contract is an agreement with a private energy service company (ESCO) to manage a group of efficiency projects from inception to completion. The savings that the projects generate are used to cover the entire cost of the project, and any surplus savings are allocated between the contracting organization and the ESCO as stipulated in the contract. A major benefit of this approach is that no upfront investment is required, and there is little risk attached to the investment due to the minimum guaranteed level of performance. A major barrier to implementing energy performance contracts is that they need to be structured as long-term contracts because the ESCO needs to ensure savings exceed payments.

- **Direct Loans:** At its simplest, debt financing takes the form of a loan to a borrower from a lending institution. A borrower can usually negotiate terms for repayment of principal and interest so that savings from increased energy efficiency provide, at least, a breakeven cash flow. Banks or energy efficiency financing organizations often make loans for energy-efficiency investments.

- **Bonds:** Bonds are long-term debt obligations in which an investor loans money to an entity which borrows the funds for a defined period of time at a variable or fixed interest rate. For example, Qualified Energy Conservation Bonds (QECBs) enable state and local government issuers to borrow money at attractive rates to fund energy conservation projects.

- **Power Purchase Agreements:** A power purchase agreement (PPA) is a financial arrangement in which a third-party owner operates and maintains a renewable energy system and a host customer agrees to site the system on its property and purchases the system's electric output from the provider. This results in stable and sometimes lower cost electricity for the host, while the provider acquires valuable financial benefits such as tax credits and income generation from the sale of electricity to the host customer. For more information about renewable energy systems, please refer to Chapter 8.

Make Use of Financial Incentives and Rebates

The federal government, local governments, utilities, and state authorities offer financial incentives and rebates for customers to cover or offset the costs of energy efficiency upgrades. In New York, the New York State Energy Research and Development Authority (NYSERDA) and local utilities such as Con Edison and National Grid offer financial incentive and rebate programs that are financed through a small charge on New

NYCEEC

One financing option available in New York City is the New York City Energy Efficiency Corporation (NYCEEC), an independent, not-for-profit financial services firm created by the City in 2011 and dedicated to clean energy finance. NYCEEC provides financing for energy efficiency improvements, heating oil conversions, and renewable energy investments in all building types throughout the five boroughs of New York City. Loan proceeds can be used for both hard and soft costs, including assessment and audit costs, design and engineering, equipment purchases, construction, installation, implementation, commissioning, establishment of monitoring and data protocols, and other related activities.

Yorkers' energy bills, called the Systems Benefit Charge. Additionally, utilities offer incentives for participation in demand response programs by paying customers to temporarily reduce electricity consumption during peak load periods. The money from participating in these programs can often be invested in energy efficiency projects.

Many Challenge participants have integrated financial incentives and rebates into project design and capital planning phases before they go through vetting and approval. This helps improve the payback for energy efficiency projects, making the projects more financially feasible. One way to ensure that incentives and rebates are included in projects is to create a formal set of design standards that aligns equipment purchases with locally available rebate and incentive programs. For more information about design standards, please refer to Chapter 9.

Online Resources

Incentive programs vary between states and municipalities and can also change significantly over time. A useful resource for investigating available financing, incentive and rebate opportunities is the Database of State Incentives for Renewables & Efficiency (DSIRE), which covers incentives at both the state and federal levels. The database is available online at: www.dsireusa.org.

Consider Using an Outside Consultant

Many Challenge participants have employed a third party consultant to help navigate available utility, state, and federal incentive and rebate programs. Oftentimes, these incentive and rebate programs include money to hire a consultant to recommend specific incentives based on an institution's planned capital work, calculate financial metrics for energy efficiency and clean energy projects, and help fill out relevant incentive and rebate program applications.

Establish an Internal Revolving Fund

An internal or green revolving fund is a budget that exists outside the normal budgeting process that is dedicated specifically to energy efficiency and clean energy improvements. The fund is consistently replenished with energy savings

NewYork-Presbyterian/Queens

- First hospital to meet the 30 percent GHG reduction goal in the Challenge.
- Upgraded chiller plant is saving hospital $176,000 a year and has cut GHG emissions by 7 percent.
- Established a web-based monitoring system to track and analyze the performance of building systems in real time.

Located in Flushing, Queens, NewYork-Presbyterian/Queens (NYP/Q) is a member of the NewYork-Presbyterian Healthcare System and affiliate of Weill Cornell Medicine. In 2012, NYP/Q was the first hospital to achieve the 30 percent GHG reduction goal. After meeting the Challenge goal, NYP/Q has continued to significantly cut its GHG emissions, achieving almost a 37 percent reduction as of 2014. A major component of NYP/Q's emissions reduction strategy is its sustained investment in capital upgrades and continuous monitoring of their energy consumption.

In 2011, NYP/Q commissioned a performance study of its central chiller plant through NYSERDA's FlexTech program. Through this study, the Engineering Department decided to replace one of the three 1,100-ton gas fired absorption chillers with a 1,200-ton high efficiency electric chiller. NYP/Q received financial incentives from NYSERDA's Existing Facilities Program. The selected unit also qualified for NYSERDA's Super-Efficient Electric Chiller Bonus. In a comparison of standard performance and high efficiency chillers, it was determined that the selected high efficiency unit used 17 percent less electricity and cost $33,000 less per year to operate than a standard performance chiller. The energy rebate and the total operational savings of $176,000 a year provided the entire project with a simple pay back just over ten years. The chiller helped NYP/Q cut GHG emissions by 7 percent.

To optimize energy use and ensure the continued efficiency of investments, NYP/Q enlisted an energy advisory firm to help monitor the energy consumption of major equipment from the chillers and boilers. Through a monitoring system, provided by the advisory firm, NYP/Q has gained the capability to analyze the energy consumption of the boiler and chiller plants and determine if they are running efficiently. This technology will allow NYP/Q to monitor and analyze the boiler and chiller plants through real time, web-based metering and monitoring.

This monitoring system allows the NYP/Q engineering staff to compare the actual usage of their district energy plants compared to their design efficiency benchmarks. The yielded results will help NYP/Q audit their district energy plants to confirm they are running at optimal efficiency. Overall the ability to monitor and optimize the energy use of district energy plants allows for a significant reduction in GHG emissions and operating costs. Maintaining equipment at optimal efficiency can also increase the life of equipment, reducing or deferring capital expenditure.

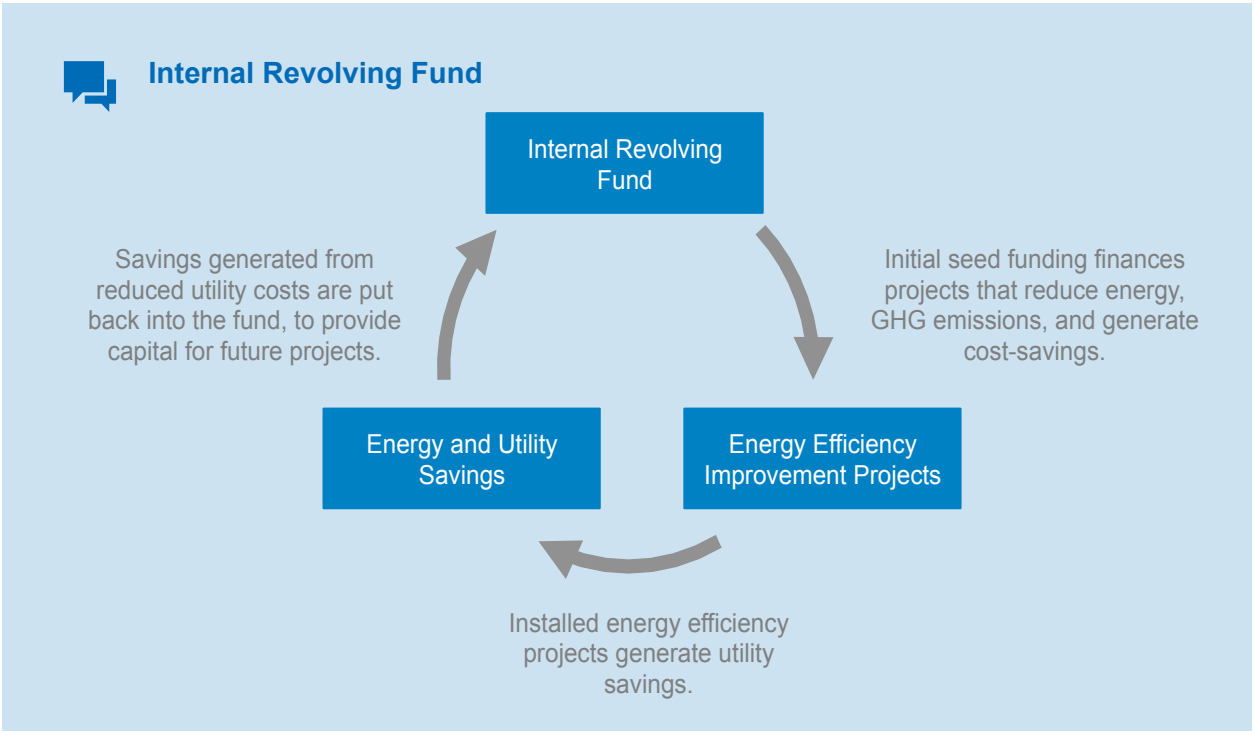
Building upon the success of their GHG reduction initiatives, NYP/Q has continued to demonstrate its leadership in energy efficiency by committing to a 50 percent GHG reduction goal by 2025.

from projects previously financed through the fund. To start an internal revolving fund, an initial investment is made for one or more energy efficiency projects. As savings accrue from avoided energy costs, the party responsible for overseeing the operations of the fund earmarks some or all of the savings for repayment to the revolving fund, thus replenishing the initial investment. As energy savings compound, so do the returns to the fund, while any surplus savings in excess of costs are profits that allow the fund to grow. For the projects that are reinvested that have a mix of capital improvement and energy conservation, only the premium cost associated with maximizing efficiency should be covered by the fund.

A green revolving fund requires dedicated management responsible for overseeing the operations of the fund. Challenge participants have utilized their energy management team, which includes facilities managers, finances officers, and members of the senior administration. Management should also encourage cross-disciplinary collaboration when accessing the fund to make the best use of project funding for increased returns. For more information about establishing an energy management structure, see Chapter 2.

Successful implementation of an internal revolving fund includes the following key management needs:

- **Selecting projects:** Potential projects must be identified, evaluated, and selected based on a determined set of criteria.
- **Developing a savings tracking methodology:** Monitoring and tracking savings from capital and operating budgets is necessary to determine funding levels to be returned to the green revolving fund.
- **Determining an appropriate accounting system:** An initial funding source is necessary for seed capital and there must be a system that transfers funding within the institution between accounts.



Chapter 8

Invest in Innovative Technologies

Investing in innovative technologies such as cogeneration, solar PV, solar thermal, and geothermal heat pumps is a highly visible way for universities and hospitals to demonstrate their commitment to reducing energy and GHG emissions and generate broader support for their energy programs. Advancing innovative technologies and strategies can also pave the path to deeper reductions in GHG emissions. Several innovative technologies are described in more detail here, but do not represent an exhaustive list of options.

Combined Heat and Power (CHP or Cogeneration)

Combined heat and power (CHP), also known as cogeneration, is the simultaneous production of two or more useful forms of energy from a single device. A CHP system will take fuel—most commonly natural gas—and generate electricity for a building or campus. The CHP system then captures the excess heat from this process, which is typically otherwise wasted, and uses it to provide space or hot water heating to the building or campus. By installing a CHP system designed to meet the thermal and/or electrical base loads of a facility, CHP systems can greatly increase the facility's operational efficiency and dramatically reduce energy costs and GHG emissions.

CHP systems operate with up to 75 percent fuel efficiency, compared to just 15 to 55 percent for standalone electricity generators.[6] As a result, CHP systems can significantly reduce GHG emissions, particularly if the switch is from a more GHG-intensive fuel, such as heavy heating oil, to a relatively less GHG-intensive one, such as natural gas. A CHP system can also allow your building to continue producing electricity or campus during an emergency or a blackout and lowers the demand on New York City's strained electrical grid. Universities and hospitals are great candidates for CHP systems because their operations need power to run their building systems continuously.

CHP systems vary in size—the capacity for CHP systems installed by some Challenge participants range from 250 kilowatts (kW) to 13.8 megawatts (MW). Large CHP systems have the potential to displace the need for significant amounts of grid-purchased electricity and necessary heating for a campus or multiple buildings and can realize greater efficiencies at scale. Smaller CHP systems can cover the heating and base load electricity for certain buildings. To provide an adequate thermal load during the summer months, some facilities use absorption chillers which use heat to make chilled water for air conditioning.

CHP systems can be implemented cost-effectively, particular when combined with financial incentives. Incentives from NYSERDA can cover up to 30 percent of the total project cost through its Combined Heat and Power Performance Program.[7]

Reforming the Energy Vision

Reforming the Energy Vision (REV) is a clean energy modernization initiative for New York State launched in 2015. REV is in the process of deployment, but it will involve a multi-layered approach of regulatory changes to promote renewable energy and distributed energy generation. REV programs like the NY Prize, NY-Sun and the NY Green Bank, will make a large impact in the expansion of incentives and rebate options for those participants pursuing renewable energy. More information can be found online at: www.dps.ny.gov/REV.

Montefiore Medical Center

- First New York City hospital to install a cogeneration (CHP) system.
- CHP plant utilizes a gas turbine to generate electricity with excess heat used to produce steam for heating.
- CHP system ensured that during the Northeastern Blackout of 2003, Montefiore's Moses Campus remained open without major interruption services.

Ranked among the top hospitals nationally and regionally, Montefiore Medical Center (Montefiore) excels not only in breaking new ground in research and training the next generation of healthcare leaders, but also in its forward-thinking approach to investing in energy efficiency, through its staff resources and expertise in operating a cogeneration (CHP) plant.

In the mid-1990s, Montefiore installed the first CHP facility within the New York City healthcare field. Prior to the installation of a CHP system on its Moses Campus, Montefiore did not have the benefit of being on a municipal district steam system; relying instead on boilers to produce steam to heat its buildings. Additionally, Montefiore had a utility service area with above-ground electrical distribution, which carried a higher risk of losing power during storms. Given these conditions, Montefiore determined that the best solution both environmentally and in terms of patient care was to invest in CHP.

Montefiore's 9.5 megawatt CHP plant uses a gas turbine to generate electricity and utilizes the heat from the turbine to produce steam. The CHP currently produces electricity and heat for all buildings on the Moses campus, totaling 1.5 million square feet. With an overall thermal efficiency of 74.5 percent, the CHP system reduces fuel and energy costs, while reducing GHG emissions by an estimated 16,675 tons per year. In addition to these benefits, CHP has the benefit of allowing a hospital to remain open in the event that there is a loss of power. For example, in the Northeastern Blackout of 2003, Montefiore's Moses Campus remained open without major interruption to any services, and continued to provide systems, such as air conditioning, to all patients. As the natural gas system is not reliant on local power for distribution, Montefiore was able to continue to operate with its own power production.

A high level of engineering expertise is needed to operate Montefiore's CHP plant, which produces high-pressure steam. Montefiore currently has four full time managers and more than a dozen High-Pressure Steam certified boiler operators. These operators are responsible for monitoring the plant electrical and steam systems at all times, including familiarity with large industrial equipment controls systems. Through a close relationship with SUNY Maritime College, Montefiore has been able to hire and train operators who are intricately familiar with similar systems on oceangoing vessels. As a leader in CHP development and deployment, Montefiore has helped pave the way for other hospitals to install and maintain similar systems.

Building upon the progress made towards the Challenge goal, Montefiore has continued to demonstrate its leadership in energy efficiency by committing to a 50 percent GHG reduction goal by 2025.

Solar Photovoltaic

Solar electric systems, also known as solar photovoltaic (PV) systems or solar panels, convert sunlight into electricity. Installing solar PV can help save energy costs by reducing the need to purchase electricity from a utility. Moreover, any excess electricity produced that a building does not use can be sold to the utility in a process called net-metering. Solar panels can be expensive to install, but financial incentives from NYSERDA, NY-Sun, the federal government, and others can cover 60 percent or more of the costs. Additionally, solar panels provide a visible and noticeable way to demonstrate an organization's commitment to sustainability.

One way to install a solar PV system on a campus is through a power purchase agreement (PPA) with a renewable energy power provider, who will install and own a PV system located on campus. A PPA obligates the institution to purchase power from the PV system for a number of years at rates established by the contract. The primary advantage of this arrangement is that the institution is not responsible for the installation, operation, maintenance, or cost of the PV system. This arrangement may also allow the energy supplier to take advantage of tax credits, which may not be available directly to the institution.

Online Interactive Solar Map Tool

A free interactive map tool, called the NYC Solar Map, is available in NYC to estimate the solar potential, savings, and payback period of buildings, taking into account financial incentive programs in NYC. The NYC Solar Map tool is available online at: www.nycsolarmap.com.

Solar Hot Water Heaters

Solar hot water heaters are installed on the roofs of buildings and capture heat from the sun to heat water. When the water is hot enough and ready to use, pipes transport the water back to a hot water tank. If the solar hot water system cannot keep up with the heat demand, a simple, automatic control system enables the conventional water heater to provide supplemental hot water. These systems do not usually cover 100 percent of domestic hot water heating requirements, but are typically connected to existing hot water systems to provide auxiliary heating that can meet anywhere between 25 to 80 percent of a building's hot water needs.[8] Solar hot water heaters can also be installed in conjunction with solar photovoltaic (PV) systems to provide the benefits of both.

NYSERDA offers a cash incentive of up to $150,000 per site per meter for solar thermal systems that displace electrically heated hot water, which typically covers 30 to 50 percent of the installation cost.[9] Additionally, system owners may also qualify for New York State and federal tax credits. Once installed, these systems can save between 50 and 80 percent of domestic hot water costs per building.[10]

To be most effective, solar hot water projects generally require short piping runs, large and unobstructed roof spaces, and easily accessible space for storage tanks. These conditions tend to preclude tall, narrow buildings. In general, buildings between one and 12 stories with unobstructed, south-facing roof space provide the best potential for solar hot water systems. The cost effectiveness of these systems depends on the type of fuel being displaced; for example, displacing more expensive sources of energy, such as

electricity, will provide greater benefits compared to energy sources with relatively lower costs, such as natural gas.

NYSERDA Renewable Generation Incentives

More information about NYSERDA's incentives for geothermal, combined heat and power, solar PV, and solar thermal can be found at: www.nyserda.ny.gov/Cleantech-and-Innovation/Power-Generation.

Geothermal Heat Pumps

Geothermal heat pump systems, also known as ground source heat pumps, tap into the constant temperature of the earth beneath a building to provide efficient heating and cooling, which can reduce reliance on boilers, cooling towers, and other conventional HVAC equipment. These systems operate by exchanging heat energy between a building and the ground, which provides energy efficient heating in the winter and cooling in the summer. Geothermal heat pumps can be installed in all New York City boroughs, but feasibility depends on the building location and the specifics of the heating and cooling systems.

Geothermal Systems and their Application in New York City

In February 2015, the Mayor's Office of Sustainability released a report titled Geothermal Systems and their Application in New York City. The report sets forth the challenges to installing geothermal systems in the City, including the significant capital investment typically required. Also reviewed are the countervailing benefits that such systems can provide, including energy cost savings, reduced GHG emissions, increased reliability and reduced exposure to market energy price fluctuations. The report can be found at: nyc.gov/html/planyc/downloads/pdf/publications/2015_Geothermal.pdf.

Chapter 9

Review Design Standards

Setting an organizational energy policy and reviewing design standards can help ensure the inclusion of energy efficiency into planned capital upgrades, renovations, and new construction. Taking steps to formalize design standards through an institution-specific design manual helps to coordinate all parties involved in the planning and construction of projects.

Establish an Organizational Energy Policy

Before establishing a specific set of design standards, institutions often establish an energy policy with the purpose of creating a framework for acceptable practices for how to approach energy use in new construction, major renovations, and capital upgrades. These strategies are usually general in nature, serving as a blueprint for the project team to integrate energy and sustainability goals at appropriate phases during project implementation. Examples of strategies include:

- Reuse energy wherever economically possible.
- Size system capacities to the anticipated demand after thorough consideration of total connected load for the institution.
- Select properly sized equipment for optimal operating efficiencies.
- Configure systems and controls to minimize energy consumption.

Create a Specific Set of Design Standards

Design standards are an internal document that institutions create to guide project managers and design consultants through many phases of project development. Design standards identify a minimum level of design and energy specification requirements for all new construction and renovation projects to help ensure that energy efficiency is integrated into all project development. Design standards are usually included in all Requests for Proposals (RFPs) issued for new projects and are referenced in contracts for design consultants, construction managers, and commissioning agents. Typically, the energy management team is responsible for developing and updating the energy specifications outlined, which should be updated at scheduled intervals to incorporate new knowledge and more stringent energy efficiency guidelines.

A formalized set of design standards allows organizations to:

- **Safeguard energy efficiency from being eliminated because of cost:** Design standards serve as a central reference point for all individuals involved in the project implementation process, including the construction team, project managers, design consultants, and the Energy Director. This helps to prevent lapses in communication between parties about energy specifications.
- **Create a standard for equipment installation:** Design standards streamline the installation of building systems, providing guidance that can be used for site-specific training and allows for O&M procedures to be streamlined.
- **Plan for energy efficiency investments:** Design standards can help provide more reliable projections for incremental costs associated with energy efficiency, which can be integrated into budgeting processes.

Design standards can include design and energy specifications for all new construction and major renovations, such as room configuration modifications, new HVAC systems, envelope modifications, and new lighting. In addition, the design standards can include energy specifications for the equipment used in partial renovations or fit-outs of existing facilities

where the systems such as controls, plumbing, and HVAC components are replaced, even when the base building systems and building envelope remain unaffected.

Creating a unique set of design standards can be a time-intensive process and requires significant staff dedication and financial resources. To help simplify the development process for design standards, Challenge participants have used some of the following strategies:

- **Start with standards for simpler projects:** Institutions that do not have a set of design standards in place can start the process by creating efficiency standards for simple projects first, such as lighting upgrades.

- **Align standards with financial incentive programs:** Universities and hospitals can create design standards by strategically aligning all of their equipment purchases with financial incentive and rebate programs, available through organizations such as NYSERDA or utilities like Con Edison and National Grid.

- **Reference existing guidelines:** Many institutions have developed design standards by referencing existing guidelines for energy specifications such as LEED®, ENERGY STAR®, Passive House, or have committed to being a percentage better than a local energy code like the 2014 NYC Energy Code or a national standard like ASHRAE 90.1 Standards and Guidelines for major building systems.

- **Model the design standards of other hospitals and universities:** Many institutions have also adapted others design standards as a model for their own.

Aligning Building Practices with LEED® Standards

One of the most common sets of existing design standards is the U.S. Green Building Council's (USGBC) Leadership in Energy & Environmental Design (LEED®) standards. The City of New York and many Challenge participants have aligned their design standards with these certifications, committing to achieve a minimum threshold within the rating system for new construction and major renovation practices. Aligning building practices with LEED® standards broadens the scope of work beyond energy efficiency, considering strategies for sustainable site development, water savings, materials selection, indoor environmental quality and integrated whole-building design practices. For more information on LEED® standards can be found at: www.usgbc.org/leed.

Commissioning as Part of the Design Process

Proper commissioning is vital to realizing the best energy performance from a set of design standards. Many Challenge participants retain a third-party commissioning agent or an in-house manager to help facilitate the design and commissioning process. The agent should be prepared to work with all members of the energy management team, including facilities staff, on the implementation of commissioning and provide training as part of the handover process. For more information on the commissioning process, see Chapter 4.

Chapter 10

Educate the Community

Educating the institutional community, including staff, students, faculty, and visitors about the university or hospital's commitment to sustainability encourages the community to contribute ideas and engage in actions to help meet the institution's sustainability and GHG reduction goals. Educational programs can help increase awareness of an institution's energy and sustainability initiatives and the community's role in carrying them out.

Establish a Distinct Sustainability Brand

Creating a sustainability brand that establishes a consistent message about energy efficiency and sustainability can help internally educate the institutional community about their role in sustainability and externally communicate the organization's commitments to a broader audience. A sustainability brand can potentially include a name, slogan, and logo that unite the different components of the institution's commitment to reducing its environmental impact, including energy efficiency, waste reduction, sustainable transportation, water efficiency, and socially responsible procurement.

Creating a recognizable brand helps facilitate communication between the institutional community and the staff responsible for overseeing the organization's environmental initiatives. Opening this line of communication can help establish and sustain awareness of the institution's sustainability commitments, creating awareness of progress to date and current projects or initiatives. The brand should also set the stage for other programs that teach and promote sustainable actions. The brand can do this by framing complex issues like climate change into relatable terms that can be easily understood and explain the role that individuals can play in mitigating the effects of these larger issues. In particular, a sustainability brand can educate and motivate the community to take an interest in energy initiatives so that they can contribute to the institution's GHG reduction goal by being aware of their role in the energy management process and help individuals take steps to reduce their personal energy consumption.

Many Challenge participants have created brands that highlight how energy efficiency and sustainability fits into the organization's broader mission and purpose, and appeal to all audiences to maximize uptake and appeal. To maximize community exposure and promote brand recognition, participants have included the sustainability brand's name, logo, and or slogan on all communications materials related to energy efficiency and sustainability, including internal and external reports, websites, feedback programs, social media outlets, or other knowledge sharing networks.

GreeNYC

GreeNYC is New York City's public education program dedicated to educating, engaging, and mobilizing New Yorkers to take simple, but meaningful, steps to reduce their energy use, generate less waste, and live more sustainable lifestyles. GreeNYC's mascot, Birdie, provides tips to help New Yorkers reduce energy use and choose a more sustainable lifestyle. See more at: www.nyc.gov/greenyc.

Employ Behavior Change Campaigns

Creating behavior change campaigns are an integral component in educating the institutional community about how they can contribute to the organization's energy efficiency or sustainability goals by changing simple day-to-day behaviors. Changes in behaviors of the campus community in terms of how individuals use lighting, heating, cooling, office, and laboratory equipment can potentially result in substantial energy savings with relatively low up-front investment. Successful behavior change campaigns are built upon best practices for conserving energy which are customized to the particular audience, whether it be a classroom, office, lab, residence

NewYork-Presbyterian Hospital

- Ten time ENERGY STAR Partner of the Year — Climate Communications Awards for NYPgreen, a unified sustainability program.
- NYPgreen's messaging campaign managed by Sustainability Officer, utilizing social media and hospital communication outlets to communicate energy efficiency and sustainability initiatives.

NewYork-Presbyterian (NYP) is one of the nation's largest hospitals with six main campuses that encompass 35 buildings and 10.5 million square feet. The EPA has honored the hospital with ten ENERGY STAR® Partner of the Year—Climate Communications Awards for NYPgreen, a unified sustainability program that promotes awareness the organization's hospital-wide work with regards to energy and water conservation, recycling, waste management, and many other sustainability initiatives.

Started in 2008, NYPgreen is a branded sustainability program that serves as the internal and external facing communication strategy for everything sustainability-related at NYP. The program seeks to communicate the organization's commitment to and progress towards its energy efficiency and sustainability goals. Additionally, the program educates the institutional communities' role in meeting these goals To maximize community exposure and promote brand recognition, the NYPgreen logo appears on all communications materials related to energy efficiency and sustainability, including internal and external reports, websites, and social media outlets.

The program's messaging campaign is managed by a full time Sustainability Officer. The Officer utilizes various internal communication routes, as well as social media, to distribute information. Campaigns like "Green Tip Tuesday," offer advice to employees on ways to reduce energy and implement sustainability in everyday actions; and "Turn It Off Tuesday", encourages the reduction in the use of unnecessary lighting at each hospital.

The NYPgreen program is also used as a vehicle to communicate the information and progress about specific energy management initiatives. In 2009, NYP created a Sustainability Council with a focused Energy Efficiency Committee. Totaling 15 representatives, the committee is made up of Site Directors, Plant and Electrical Managers, and Supervisors from each hospital. Through this energy management structure, NYP has established several initiatives aimed at reducing hospital-wide energy use, including a four-year plan to optimize the operation and energy use of all NYP facilities. Another program launched through the EEC is "Gallery Walks." Led by the Sustainability Council, "Gallery Walks" are quarterly walk-throughs of hospital facilities to help generate ideas to reduce waste, find energy efficiency opportunities, and improve care.

For their work in energy efficiency, NYP received the 2015 ENERGY STAR® Partner of the Year — Sustained Excellence Award for reducing GHG emissions through superior energy efficiency. This award is given to a select group of organizations that have exhibited outstanding leadership year after year in the GHG emissions reductions by setting and achieving aggressive goals and employing innovative energy efficiency approaches. It is the only hospital in the nation to have earned the award ten years in a row.

hall, or kitchen. The campaign could encourage individuals to choose goals most relevant to their own lives and break those goals into small, doable everyday actions. The campaign can also address barriers to change, as well as making the behaviors easy, convenient, relevant, and socially desirable. The reach of a behavior change campaign can extend beyond the institution, by inspiring faculty, students, staff and visitors to take action in their own lives, which can play an important role in the environmental goals of the local community, city, or state. Many Challenge participants have established successful behavior change campaigns by promoting energy efficient behavior through:

- **Prompts:** Prompts are messages that are reminders to take certain actions at strategic times or locations. Prompts often have a clear and memorable message with a relatively easy and specific behavior that can be changed. For instance, institutions can place stickers on lighting controls without occupancy sensors, reminding users to turn lights off when not in use.

- **Commitments:** Commitments are public pledges made to take certain actions. Commitments can include real and attractive incentives for people to embrace the campaign, such as public recognition, an award or certification, or simple forms of appreciation such as free LED light bulbs or reusable bags.

- **Feedback mechanisms:** Mechanisms that inform the institutional community about the impacts of their changed behaviors can help solidify these actions. Dependent upon the behavior change campaign, feedback mechanisms can take many forms. Standard feedback mechanisms include reports or announcements that measure the results of behavior change campaigns. For energy-related behavior change campaigns, institutions can install dashboards that display the energy consumption of an institution's buildings to show the impacts of collective action to reduce energy consumption.

Behavior change campaigns that Challenge participants have created or participated in include, but are not limited to:

- **Campus Conservation Nationals:** Campus Conservation Nationals (CCN) is the largest electricity and water reduction competition for colleges and universities in the world. Launched in 2010, CCN gives motivates hundreds of thousands of students across North America to work together to reduce energy consumption and mitigate the impacts of climate change. Colleges and universities can participate by committing to an individual competition, in which buildings on their own campus compete against each other, or a group completion in which they compete against schools in their region, state, or peer group.

- **Shut the Sash:** "Shut the Sash" campaigns or competitions encourage lab-users to lower fume hoods when not in use to reduce ventilation and air conditioning needs. Fume hoods expel air through ventilation systems, so when unintentionally left open, significant waste of energy waste is incurred since the air has to be cooled, heated and/or filtered. When a sash is closed, a valve attached to the hood decreases the flow of air to the hood, and slows down fans to more energy efficient modes.

Fashion Institute of Technology

- First Challenge participant to achieve the 30 percent emissions reduction goal in 2010.
- Established a standing Sustainability Council of faculty, students and staff to advise the President.
- Hosts annual series of events and conferences to educate the community on sustainability.

The Fashion Institute of Technology (FIT) is a leading art and design school part of the State University of New York system that serves over 10,000 students. Under the leadership of President Dr. Joyce F. Brown, FIT has taken bold steps to integrate sustainability into all facets of the university community. This work by President Brown and the FIT community demonstrates how proactive leadership and community education can inspire innovative sustainability actions at all levels of an institution.

After FIT committed to the Challenge in 2007, the university administration formed the Sustainability Council, made up of students and faculty, as a standing advisory council to the President that would act as ambassadors for building a culture of sustainability on campus. The commitment from the senior administration helped provide motivation from the top down and the formation of the Sustainability Council ensured that there was engagement from the FIT community in meeting the institution's GHG reduction goal.

The Sustainability Council organizes and hosts a series of events and programs to educate and inspire the FIT community, including the Sustainable Business and Design Conference, No Impact Week, the Sustainable Global Sourcing Forum, and the yearly Summer Institute. All of these events are aimed at bringing in industry experts to inform and involve the FIT community about sustainability and energy efficiency. The Sustainability Conference is also used as an opportunity to present a yearly update to the community on FIT's energy projects and performance in the Challenge. FIT has also communicated its progress in meeting the Challenge goal by distributing information about energy projects through monthly newsletters and announcements from the President.

The high-level commitment from the executive administration has helped prioritize investments in energy efficiency and helped create a Facilities Department that has been dedicated to finding and implementing energy efficiency projects. Supported by a blend of internal funding and external capital from the Department of Citywide Administrative Services (DCAS), FIT has made a number of investments to reduce the carbon intensity of its buildings. In 2013, FIT replaced over 16,000 T12 florescent lighting fixtures with T8 replacements, saving over half a million dollars a year. Additionally, three 1,000 ton steam turbines and compressors were replaced with new energy efficient equipment and a new cooling tower was replaced to better match cooling demand and increase operating efficiency.

This collaboration of leadership from the President and Sustainability Council, and innovative ideas from the student body feeding back into how FIT does business, has proven its effectiveness in the achievement of FIT being the first Challenge participant to achieve the 30 percent GHG reduction goal in 2010. FIT has built upon this achievement by committing to a 50 percent GHG reduction goal by 2025.

- **Daylight Hour:** Daylight Hour is a global social media campaign launched in 2014 by the Building Energy Exchange, a New York City based non-profit that provides resources to improve energy efficiency in the built environment. To demonstrate the availability of daylight, the Building Energy Exchange organized Daylight Hour—a single hour on the third Friday in June when buildings all over the world turn off the lights in day-lit spaces.

Create Organizational "Green Champions"

Meeting the institution's energy efficiency and sustainability goals usually requires engagement across the entire organization. All levels of the organization need to recognize the effort for energy efficiency and sustainability as a priority, be engaged, and possess the resources needed to support and align with these goals. Many Challenge participants have utilized organizational "Green Champions" as a way to create internal advocates that can help promote and educate the campus community about the institution's energy efficiency and sustainability goals.

Green Champions should be volunteer members of the campus community who serve as the primary point of contact for their peers about energy efficiency and sustainability initiatives. Participants in a Green Champions program can help the energy management team communicate the results of the Climate Action Plan or act as a point person for behavior change campaigns. They should typically have personal interest in sustainability and energy efficiency and have the capacity to act and influence others in the organization. To help foster peer-to-peer exchange, Green Champions should work closely together in a network to share ideas and practices. Two examples of Green Champions program include:

- **Green Office Champions:** Green office champions are faculty or staff champions that encourage their peers to make their office or workplace more sustainable and energy efficient. Green Office Champions help build momentum and monitor progress around behavior change campaigns and can lead specific programs like Green Office Certification programs aimed at certifying the sustainability of office spaces.

- **Eco-Reps:** Eco-Reps are student-leaders who foster environmental responsibility on campus. They work to educate their fellow classmates about energy efficiency and sustainability issues by distributing information, as well as creating, coordinating, and hosting activities throughout campus and within residence halls. Eco-Reps are often responsible for engaging and employing behavior change campaigns. Eco-Reps also interact with other leaders on campus, and work to develop programs and events that challenge their peers to adopt more sustainable behaviors.

Appendices

Appendix A Rules of the NYC Carbon Challenge

Carbon Emissions Inventory and Reporting Methodology

For each calendar year, Challenge participants aggregate their annual energy use by fuel type and amount for all owned, operated, and leased properties that are covered by the Challenge and input these amounts into the Carbon Emissions Inventory Calculator. It is optional, but recommended, that Challenge participants report on fuel usage of their vehicle fleet and solid waste generation from all owned, operated, and leased properties that are covered by the Challenge. For all properties, universities and hospitals report total electricity, natural gas, heating oil No. 2, 4 and 6, steam and propane for other fuels used for backup generation. Offsite renewable energy purchased by a Challenge participant, such as through a power-purchase agreement, can count towards reductions in emissions intensity if the electricity generated feeds directly into New York City's electric grid (New York Independent System Operator Zone J). Challenge participants must have direct ownership of the offsite renewable energy and may not sell any RECs or environmental attributes generated by the renewable energy on the open market.

The Carbon Emissions Inventory Calculator automatically applies New York City's carbon coefficients, held constant at 2005 levels, to each fuel type to calculate the participant's total emissions. The calculator then divides this value by the gross square footage to calculate each participant's emissions intensity (CO2e/sq. ft.).

All carbon coefficients for the Challenge are in compliance with the 2012 United States Community Protocol for Accounting and Reporting Greenhouse Gas Emissions (USCP). The Challenge uses New York City-specific coefficients for electricity and steam, which are developed by the Mayor's Office of Sustainability based on aggregate power plant data. All emissions coefficients for natural gas, and No. 2, 4, and 6 fuel oils were developed by the U.S. EPA.

For the purposes of the Challenge, the carbon coefficients for electricity and steam are fixed at 2005 estimates. Changes in primary energy sources used to generate the City's electricity and steam supply cause these coefficients to vary significantly between years. If the electricity coefficient changes annually to reflect changes in carbon intensity of the power plants that feed the electrical grid, it would provide a significant advantage to Challenge participants who depend primarily on electricity. Fixing the carbon coefficients for electricity and steam at 2005 figures therefore levels the playing field and measures only the direct emissions reduction efforts taken by participants, and not exogenous changes to the energy supply.

Participants are required to track their emissions intensity for each year of the Challenge, beginning in the base year and ending ten years after their start year. Most universities and hospitals in the Challenge use a base year of 2005 or 2006. Universities began the Challenge in 2007 or 2008 and have until 2017 to complete it; hospitals began in 2009 and will complete the Challenge in 2019. Participants that have committed to a 50 percent reduction goal will have until 2025 to complete the Challenge.

Challenge Metrics

The university and hospital participants have pledged to reduce the emissions intensity of their buildings, measured as carbon dioxide equivalent per square foot, by 30 percent or more from a set base year. The participants track energy use by fuel type, associated GHG emissions, emissions intensity per square foot, and energy use intensity per square foot. Metrics include:

- **Energy Use:** The total amount of energy used in a participant's buildings and facilities. Energy use is measured as million British thermal units (MMBtu), which is a standardized measure of total energy use to compare across different energy sources. The Challenge measures energy use in terms of "source energy," or energy use that takes into account production, transmission, and delivery losses of an upstream energy source. "Source energy" is not weather-normalized for the Challenge.

- **GHG Emissions:** The total level of emissions that result from a participant's energy use. GHG emissions are measured as carbon dioxide equivalent (CO2e), which is a level of carbon dioxide (CO2) that would have the same climate impact as a given concentration and type of GHG gas. Under the Challenge methodology, emissions are calculated by applying a "carbon coefficient" to each participant's annual energy consumption by fuel type.

- **Total Floor Area:** The total square footage of a participant's owned and leased space. Total floor area is measured in terms of gross square feet (sq. ft.), which includes the total number of square feet measured between the exterior surfaces of the enclosing fixed walls, including spaces such as vent shafts, stairs, basements, etc.

- **Energy Use Intensity (EUI):** The level of a participant's source energy use per square foot, measured as MMBtu per square foot (MMBtu/sq. ft.). "Source energy" takes into account all production, transmission, and delivery losses of the energy source. For purposes of the Challenge, EUI is not weather-normalized.

- **Emissions Intensity:** The level of a participant's GHG emissions per square foot (CO2e/sq. ft.). This is used to measure the 30 percent or more GHG reduction goal. This handbook describes emissions intensity in terms of metric tons of carbon dioxide equivalent per square foot (CO2e/sq. ft.),. 1 metric ton of CO2 e = 2,204.6 pounds of CO2e.

  The participants base their Challenge reduction goal on emissions intensity because this standardizes emissions levels for facilities of different sizes. An absolute emissions reduction was not feasible because the university and hospital participants expected to significantly increase their size as they add more students, patients, staff, and research capacity, which is both central to these institutions' missions and vital to New York City's broader economy. Measuring emissions intensity will still translate to real emissions reductions even as the universities and hospitals continue to grow, particularly as they renovate older buildings and facilities to make them more energy efficient.

- **Emissions Scopes:** The Challenge participants are asked to report emissions from the energy used in their buildings,

but it is important to understand that this does not cover the full profile of their emissions. According to the World Resources Institute's Greenhouse Gas Protocol, the full profile of an institution's emissions include three main categories: "Scope 1" emissions, which are direct emissions physically produced on the institution's property (for example, by fossil fuels used in boilers); "Scope 2" emissions, which are indirect emissions that result from offsite energy generation in a location separate from the institution's property (for example, district steam or electricity); and "Scope 3" emissions, which are indirect emissions that are not produced on-site or from offsite energy generation but are nonetheless attributable to the institution's activities (for example, emissions from air travel or solid waste disposal). The Challenge does not include Scope 3 emissions, both because they are not always located within the city and because there is a lack of agreement on proper accounting methodologies for calculating these emissions. However, GHG accounting protocols are evolving to include methodologies for calculating and reporting Scope 3 emissions. As these protocols become more established, future inventories may include emissions from Scope 3 sources.

- **Reporting GHG from Waste:** The minimum reporting requirement for waste is the total annual tonnage of municipal solid waste (mixed/unsorted MSW), based on carter bills or an annual waste report. Completing a physical waste audit is optional, but will provide waste characterization percentages that will make the emissions calculations more accurate and most likely more favorable. The minimum waste characterization of the mixed/unsorted MSW include Mixed Recyclables (waste that could be recycled), Mixed Organics (waste that could be composted), and Sorted MSW (all remaining waste). Hiring waste audit professionals to complete a physical audit is recommended, but not required.

  Due to a lack of current available research, at this time the Mayor's Office is not including regulated medical waste (red bag waste, sharps, trace chemical waste), hazardous waste (RCRA pharmaceutical waste, chemical waste, universal waste), bulk waste, e-waste/technoscrap, or waste from construction and demolition.

- **Reporting GHG from Fleets:** The minimum reporting requirement for fleets are the total annual gallons of fuel consumed, aggregated by fuel type (gasoline, diesel, biodiesel). The electricity used to fuel hybrid, plug-ins, and electric vehicles are assumed be reported in an institution's electricity bill, which would be reported in the 'Energy' section of the GHG inventory. Fleets are vehicles owned and operated by the institution which includes maintenance vehicles, intercampus bus/shuttles, and security vehicles, but does not include personal commuting or employer-owned vehicles that are leased to individuals.

Climate Action Plan

Each Challenge participant is required to develop an emissions reduction strategy in the form of a Climate Action Plan (CAP) and update it bi-annually. If the Challenge participant has previously submitted a CAP, they will be required to update the plan to report their strategy to achieve the 50 percent Challenge goal. The Mayor's Office provides Challenge participants with a template to

complete the CAP. All CAPs are received and kept confidentially by the Mayor's Office. Participants are free to publically disclose the CAP.

The NYC Mayor's Office provides a CAP Template that includes the minimum information that a participant must submit for the CAP. Challenge participants are encouraged to submit additional information.

The Climate Action Plan includes:

- Background information about the Challenge participant's owned buildings and facilities, rental properties, and tenant spaces.
- Decision making processes for drafting and updating the Climate Action Plan.
- An overview of results from the Challenge participant's most recent Carbon Emissions Inventory and outcomes of Local Law 87 Energy Efficiency Reports.
- A description of the strategy and projects completed to date.
- Operations and Maintenance procedures aimed at improving energy efficiency.
- A description of the proposed strategy to achieve the remaining reductions needed to meet the Challenge goal.

Appendix B Energy Efficiency Programs

Energy Efficiency Programs	Managing Organization	Description
Building Operator Certification (BOC) Level I – Building System Maintenance	Northeast Energy Efficiency Council (NEEC), CUNY Building Performance Lab	BOC training is a nationally recognized certification that emphasizes the recognition of no-cost/ low-cost solutions to improve energy performance. The training includes information on developing a preventive maintenance program that improves the building environment and prolongs equipment life. www.theboc.info
Building Operator Certification (BOC) Level II – Equipment Troubleshooting and Maintenance		
Energy Conservation Course	Local 94 Operating Engineers	The ultimate goal of the Energy Conservation Course is to produce effective energy principles, which can be applied to different facilities. The course teaches energy calculations, metering and monitoring, lighting, automation systems, steam, HVAC systems, audits and energy bills. www.local94.com/affiliated-funds/training-fund/course-descriptions
Comprehensive 5-day Training Program for CEM Certification	Association of Energy Engineers (AEE)	5-day training seminar provides a learning and problem-solving forum for those who want a broader understanding of the latest energy cost reduction techniques and strategies. It is also a preparatory course for energy professionals preparing to sit for AEE's Certified Energy Manager (CEM) examination. www.aeecenter.org/certification/CEM
Certified Energy Manager (CEM) Certification		The designation CEM recognizes individuals who have demonstrated high levels of experience, competence, proficiency, and ethical fitness in the energy management profession. The CEM exam identifies persons with principles and practices of energy management related disciplines and laws governing and affecting energy managers. www.aeecenter.org/i4a/pages
Basics of Energy Management Self-Study Seminar		The self-study course serves as preparation for the CEM seminars and covers topics, such as: the need for energy management; the numerical, calculation skills needed to solve energy management problems; facility electrical systems and electric rates; and how to perform basic economic analyses of energy projects. www.aeeprograms.com/store
Government Operator of High Performance Buildings (GOHP)	Association of Energy Engineers (AEE)/ Association for Facilities Engineering (AFE)	The GOHP training is designed to provide energy management, sustainability and operations and maintenance training for government personnel and contractors operating Government High Performance Buildings. www.aeecenter.org/i4a/pages/
Energy Efficient Building Operations Specialist (EEBOPS)	Building Performance Institute (BPI), AEA, 32BJ	The EEBOPS program trains management and maintenance staff to eliminate energy and water waste. It includes in-class and hands-on time with building equipment. The topics covered include: whole building systems approach; energy efficient lighting & appliances; fuel bill analysis; health and safety issues; water saving technologies; heating systems and controls; domestic hot water systems; indoor air quality; ventilation; and energy savings upgrades. www.aea.us.org/wp-content/uploads

Building Systems Maintenance Certificate (SMC)	Building Owners and Managers Institute (BOMI)	The SMC program provides in-depth information on key building principles, including efficient energy management and water treatment. It also helps attendees gain a better understanding of HVAC, plumbing, and other building systems. www.bomi.org/Students/Educational-Offerings
Systems Maintenance Technician (SMT)		SMT program is ideal for those who maintain major building systems such as heating, refrigeration, electrical, and plumbing. In this program, people can learn about the technologies and trends in the maintenance field in order to maximize the efficiency and safety of building systems. www.bomi.org/SMT
Systems Maintenance Administrator (SMA)		SMA education is for those who are in charge of a team of technicians who run the day-to-day operation of a building. The training focuses on how to streamline the operations of buildings in order to manage energy-efficient, environmentally sound, and cost-effective building systems. www.bomi.org/SMA
GPRO: Fundamentals of Building Green	Urban Green Council, Solar One, AEA, CUNY LaGuardia CC	GPRO: Fundamentals of Green teaches the basics of sustainability and provides an overview of the essential strategies and work practices that make buildings more efficient. GPRO covers the "green gap" between standard trade skills and the new awareness required to successfully implement sustainable building practices. www.gpro.org/courses/fundamentals
GPRO: Operations & Maintenance Essentials (O&M)		Led by industry experts, GPRO O&M provides building professionals with the critical tools to transition from conventional to sustainable operations. GPRO O&M is ideal for property managers and building staff in multi-family residential & high-rise commercial buildings including: Building superintendents, Operators, Facility and property managers, Operating engineers, Stationary engineers. www.gpro.org/courses/ome
Basic Boiler Operator	National Association of Power Engineers (NAPE)	The Basic Boiler Operator test is made up of questions covering all aspects of boiler operation including: boiler operation & maintenance, fuels, combustion, thermodynamic fundamentals, steam and hot water distribution, water treatment, national codes and standards, and emergency procedures. www.powerengineers.com
Advanced Boiler Operator		The Advanced Boiler Operator exam is similar in content of the Basic Boiler Operator exam, but the level of difficulty increases as the equipment worked on is much more sophisticated. More emphasis will be placed on: combustion, pollution control, safety, operating procedures. www.powerengineers.com

Appendix C Online Resources

How to Get Started

- NYC Carbon Challenge: www.nyc.gov/carbonchallenges
- NYC Green Buildings & Energy Efficiency: www.nyc.gov/gbee

Energy Management

- Environmental Defense Fund Framework for Strategic Energy Management: www.edfclimatecorps.org/sites/edfclimatecorps.org/files/content/thevirtuouscycleofstrategicenergymanagement.pdf
- BetterBricks Organizational Approaches to Energy Management: www.betterbricks.com/sites/default/files/Office/approach_final_8.22.11.pdf
- EnergyStar Guidelines for Energy Management: www.energystar.gov/sites/default/files/buildings/tools/Guidelines%20for%20Energy%20Management%206_2013.pdf
- Energy Star Guide on Building an Energy Management Team: www.energystar.gov/sites/default/files/buildings/tools/Teaming_Up_To_Save_Energy_508_0.pdf

Operations and Maintenance

- NYC Long-Term Plan to Reduce Energy Consumption of Municipal Buildings and Operations: www.nyc.gov/html/om/pdf/2008/pr264-08_plan.pdf
- US Department of Energy (DOE) Operations and Maintenance Best Practices: www1.eere.energy.gov/femp/pdfs/omguide_complete.pdf
- Portland Energy Conservation, Inc. (PECI) Fifteen O&M Best Practices: www.energystar.gov/ia/business/15best.pdf

Commissioning and Retro-Commissioning

- Environmental Protection Agency (EPA) Building Commissioning Guidelines: www.epa.gov/oaintrnt/documents/ae-guidelines_appendixb.pdf
- EPA Retro-commissioning Guide for Building Owners: www.peci.org/sites/default/files/epaguide_0.pdf

Financing

- Sustainable Endowments Institute Introduction to Green Revolving Funds: www.greenbillion.org/wp-content/uploads/2013/01/GRF_Implementation_Guide.pdf

Organizational Structure and Change

- American Council for Energy-Efficient Economy (ACEE) Dismantling Barriers to Organizational Energy Efficiency: www.aceee.org/files/proceedings/2012/data/papers/0193-000332.pdf

Climate Action Planning

- American Association for Sustainability in Higher Education Guide of University Climate Action Planning: www.aashe.org/files/resources/cool-campus-climate-planning-guide.pdf
- American Public Power Association (APPA) Practical Guide to Reducing Carbon Footprint: www.presidentsclimatecommitment.org/html/documents/FINAL09APPASustainabilityGuide.pdf
- National Wildlife Federation (NWF) Guide to Climate Action Planning: www.nwf.org/pdf/Reports/climateactionplanning.pdf

Sources and End Notes

1. Measured as annual building-based emissions of carbon dioxide equivalent per square foot.

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Glossary

ASHRAE |	American Society of Heating, Refrigerating and Air-Conditioning Engineers
ASP |	NYSERDA Advanced Submetering Program
BMS |	Building Management System
BRTF |	Building Resiliency Task Force
Btu |	British thermal unit
CAP |	Climate action plan
CFL |	Compact fluorescent light
CHP |	Combined heat and power, also known as cogeneration
CO2e |	Carbon dioxide equivalent
Con Edison |	Consolidated Edison, Inc.
DDC |	Direct digital control
DHW |	Domestic hot water
EAP |	Energy management systems
ECM |	Energy conservation measure
EER |	Energy efficiency report
EMS |	Energy management system
ESA |	Energy services agreement
ESCO |	Energy services company
EUI |	Energy use intensity
GGBP |	Greener, Greater Buildings Plan
GHG |	Greenhouse gas
HCR |	New York State Homes and Community Renewal
HEAP |	Home Energy Assistance Program
HHS |	U.S. Department of Health and Human Services
HVAC |	Heating, ventilation, and air conditioning
kW or kWh |	Kilowatt or Kilowatt Hour

LED |	Light-emitting diode
LEED |LCC |	Leadership in Energy & Environmental DesignLife-cycle cost
MMBtu |	Million British thermal units
MW |	Megawatt
NOI |	Net operating income
NYC DEP |	NYC Department of Environmental Protection
NYC DOB |	NYC Department of Buildings
NYCEEC |	New York City Energy Efficiency Corporation
NYCPCC |	New York City Panel on Climate Change
NYSERDA |	New York Energy Research and Development Authority
O&M |	Operations and maintenance
PV |	Photovoltaic solar panels
SBC |	System benefits charge
ULS |	Ultra-low sulfer
USCAP |	U.S. Community Protocol for Accounting and Reporting Greenhouse Gas Emissions
US DOE |	U.S. Department of Energy
US DOE EERE |	U.S. Department of Energy Office of Energy Efficiency and Renewable Energy
US EPA |	U.S. Environmental Protection Agency
USGBC |	U.S. Green Building Council
VAV |	Variable air volume
VSD |	Variable speed drive

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