



**NEW YORK CITY
MAYOR'S CARBON
CHALLENGE
PROGRESS REPORT
APRIL 2013**

A GREENER, GREATER NEW YORK



The City of New York
Mayor Michael R. Bloomberg

The City of New York would like to thank the following for their valuable assistance in producing this report: Barnard College, Berkeley College, Broadway Green Alliance, The City University of New York, Columbia University, Continuum Health Partners, The Cooper Union, Fashion Institute of Technology of the State University of New York, Fordham University, Lutheran Medical Center, Maimonides Medical Center, Memorial Sloan-Kettering Cancer Center, Montefiore Medical Center, Mount Sinai Hospital, New York City Health and Hospitals Corporation, New York Hospital Queens, The New School, New York School of Interior Design, New York State Energy Research and Development Authority, New York University, New York University Langone Medical Center, NewYork-Presbyterian Hospital, North Shore-Long Island Jewish Health System, Pace University, Polytechnic Institute of New York University, Pratt Institute, The Rockefeller University, School of Visual Arts, St. John's University, and Weill Cornell Medical College.

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Cover Photo: Downtown Manhattan

Credit: John H. Lee



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Executive Summary

Tackling global climate change is one of the most significant challenges we face today. Hurricanes Sandy and Irene provided dramatic snapshots of the growing risks to New York City. To address these risks, New York City must both increase its resiliency to withstand future events and take bold action to mitigate the greenhouse gas (GHG) emissions that contribute to climate change.

In 2007, Mayor Michael R. Bloomberg released PlaNYC, a comprehensive set of strategies for a sustainable future that includes the goal to reduce citywide GHG emissions 30 percent by the year 2030. Because 75 percent of New York City's emissions come from its buildings, and 80 percent of the buildings that exist today will still be here in 2050, increasing the energy efficiency of existing buildings represents the greatest opportunity to meet this goal. Improving efficiency also lowers building operating costs, creates good jobs, and reduces our dependence on fossil fuels.

Mayor Bloomberg asked the city's universities and hospitals to match City government's goal to reduce its own GHG emissions at an accelerated pace of 30 percent in ten years. Since then, 17 of New York City's leading universities and the 11 largest hospital systems have accepted the Mayor's Carbon Challenge to meet that goal, measured as a 30 percent reduction in carbon dioxide equivalent per square foot. Together, they make up 120 million square feet and roughly 3.5 percent of citywide emissions, based on 2005 emissions levels. If each participant achieves the 30 percent goal, they will eliminate more than 600,000 metric tons of carbon dioxide equivalent and reduce citywide emissions by about one percent, assuming no change in baseline square feet.

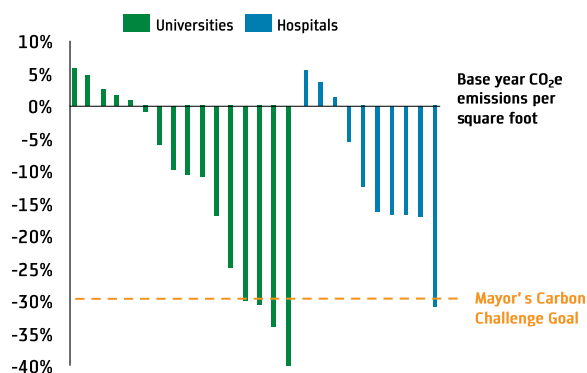
Since the launch of the Challenge, participating universities and hospitals have significantly cut their energy use and emissions, revealing effective strategies and providing insight on how to use voluntary action to meet policy goals. The Challenge has fostered collective action by creating a platform to share ideas and engaging new communities in the effort to address climate change.

Outcomes

Universities and hospitals have achieved tremendous results.

- Five participants achieved the 30 percent goal: Barnard College (Barnard), the Fashion Institute of Technology (FIT), New York University (NYU), The Rockefeller University (Rockefeller), and New York Hospital Queens (NYHQ).

Change in Challenge Participants' Emissions per Square Foot



Source: NYC Mayor's Office

- The reductions from these five early achievers alone is equal to nearly 1 percent of the citywide reduction in emissions to date.
- In five years, the universities have reduced their emissions intensity by a total of 12.8 percent. Six universities cut their emissions by 15 percent or more.
- In three years, the hospitals cut their emissions intensity by 6.1 percent. Five hospitals cut emissions by 15 percent or more.

Reductions from Energy Efficiency

Since joining the Challenge, universities and hospitals experienced significant growth, serving more people and adding energy-intensive equipment. Still, they offset this growth and further reduced their energy use intensity (EUI) per square foot through energy efficiency measures. Altogether, universities reduced their EUI by about seven percent, while hospitals reduced their EUI by two percent. Barnard, FIT, NYHQ, NYU, and Rockefeller, the five participants that met the Challenge goal, cut energy use even further, reducing their total EUI by 21.7 percent (although some of these reductions are due to a milder winter in 2011).

To achieve these reductions, the Challenge participants pursued a mix of large-scale capital investment projects, such as the installation of large co-generation plants, heating system upgrades, and steam chiller replacements, as well as smaller projects that often had payback periods of two years or less. These projects included improved operations and maintenance,

lighting upgrades, retro-commissioning of building equipment, and public education campaigns aimed at behavioral change.

Reductions from Cleaner Energy Sources

Universities and hospitals also achieved emissions reductions by phasing out carbon intensive sources of energy and switching to cleaner sources.

Universities and hospitals phased out 67 percent of No. 6 fuel oil, the heaviest of available fuel oils. These efforts removed more than 210,000 metric tons of carbon dioxide equivalent from the air last year. Electricity and gas now make up more than 85 percent of the participants' energy use.

Barnard, FIT, NYHQ, NYU, and Rockefeller phased out 87 percent of their No. 6 fuel oil. Electricity and natural gas now account for more than 90 percent of their energy use.

Cost-Savings

Challenge participants experienced financial savings as a result of their energy projects, based on a recovery of investment costs over time. The five early achievers accrued the following savings:

- NYU – \$11-14 million per year
- NYHQ – at least \$2.5 million per year
- Rockefeller – at least \$1 million per year
- FIT – at least \$1 million per year
- Barnard – roughly \$1 million per year

There Are Many Ways to Reach 30 Percent

Barnard, FIT, NYHQ, NYU, and Rockefeller began the Challenge with very different energy and emissions profiles. Some started the Challenge as high energy users, while others began with much lower energy use intensities. Several depended on just two or three energy sources while others depended on a wider mix. Still, each managed to achieve the goal in just a few years by using a tailored set of projects to address their individual profiles. Their success shows that there is no single pathway to reach a 30 percent reduction in emissions. With the right mix of strategies, it is possible for a wide range of institutions to achieve the goal.

New Sectors

Building on the success of the universities and hospitals, the City, partnership with the New York State Energy Research and Development Authority (NYSERDA), is expanding the program to include new sectors.

Commercial Offices

In April 2013, ten companies with significant commercial office space in New York City accepted the Challenge: AIG, BlackRock, Bloomberg L.P., Credit Suisse, Deutsche Bank, Goldman Sachs, Google, JetBlue, JP Morgan Chase, and PVH.



Commercial buildings account for 21 percent of New York City's emissions, and interior office space accounts for between 40 to 60 percent of energy use in a typical commercial office building. The building owners, not the tenants, are most often responsible for implementing energy efficiency upgrades to the base building systems of their buildings. This group will explore ways to increase energy efficiency in interior office spaces from innovative strategies such as lighting upgrades and daylighting, plug load reductions, IT efficiency, and space layout optimization.

Residential Co-Ops and Condos

In the summer of 2013, the City will launch a new Mayor's Carbon Challenge to residential co-ops and condos, expanding the program to include some of the largest residential buildings in the city. The residential sector accounts for 37 percent of New York City's emissions, and the 10,000 co-ops and condos here represent more than 17 percent of the city's total residential square footage. A fragmented decision-making process has been a barrier to energy efficiency in the past, but the ownership structure of co-ops and condos also means that investments in energy efficiency will generate cost-savings that result in direct paybacks to unit owners.

Broadway Theatres

In 2008, the Mayor launched a partnership with Broadway theatres to introduce a number of sustainability initiatives. New York City is now working with the Broadway Green Alliance to begin measuring energy use in 40 individual Broadway theatres and create an appropriate emissions reduction goal for theatres.

Looking Forward

With the expansion of the Challenge, new participants will build on the documented success of the universities and hospitals. This diverse set of participants will continue to demonstrate that determined, individual organizations can motivate each other to cut their GHG emissions and contribute toward citywide emissions reductions. With each new participant that crosses the finish line, New York City will become a stronger and more sustainable city.

Background

New York City's Climate Strategy

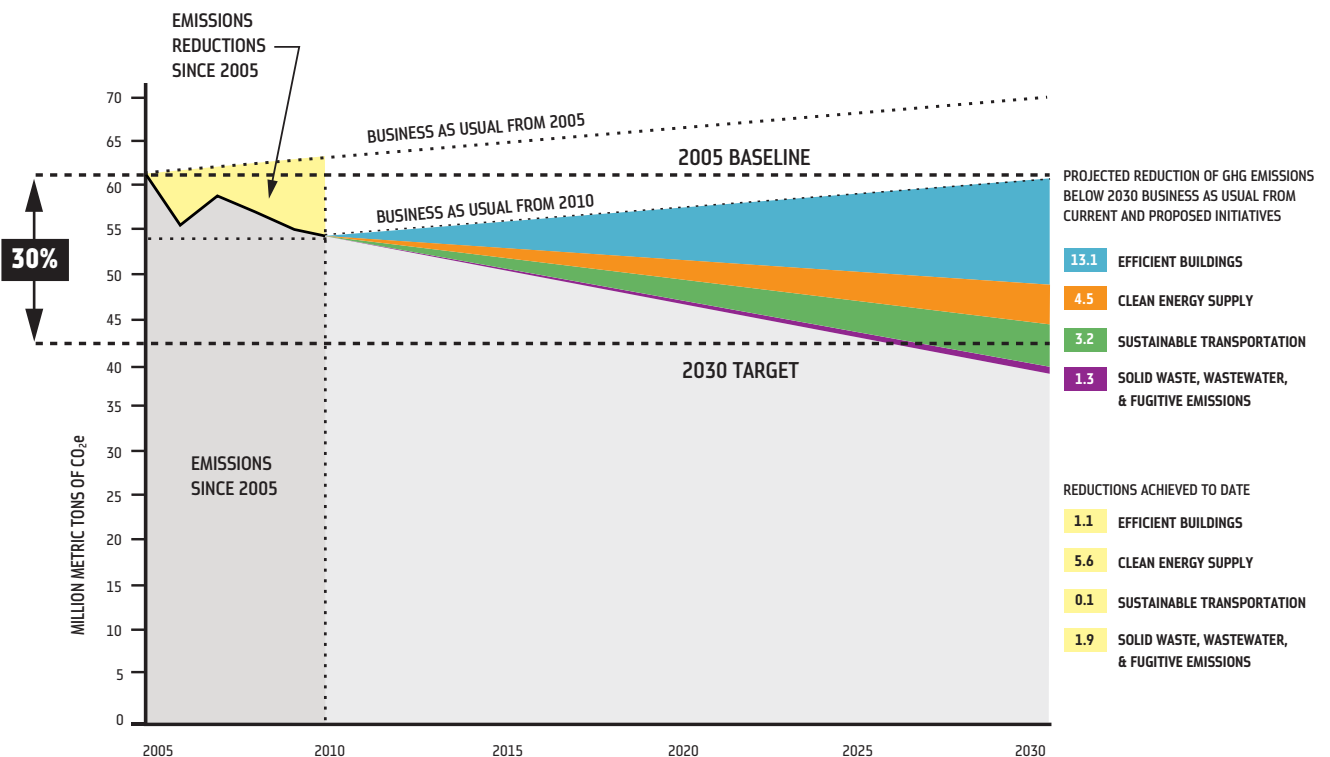
Human activities such as industrial processes, fossil fuel combustion, and changes in land use contribute to climate change by emitting GHG emissions into the atmosphere that cause destabilizing changes in global weather patterns. In New York City, the risks from climate change include sea level rise, more frequent and extreme weather events, rising temperatures, storm surge, and increased likelihood of droughts and floods. To help mitigate these risks, we must take action to reduce these harmful greenhouse gas (GHG) emissions.

Fortunately, New York City has long been a leader in the effort to tackle climate change. New York City emits far less carbon per capita than many large cities in the United States and abroad, primarily due to the high population density of its built environment and the

city's extensive public transportation system. Still, New York City alone accounts for about 0.5 percent of the world's emissions, and has a responsibility to take bold action.

On Earth Day in 2007, Mayor Bloomberg launched PlaNYC, a comprehensive set of strategies for sustainable growth in New York City, with an ambitious target to reduce citywide GHG emissions by 30 percent by the year 2030. Because almost 75 percent of New York City's GHG emissions come from its buildings, and 80 percent of existing buildings will still be here in 2050, the best strategy to achieve these reductions is to increase the energy efficiency of the city's existing buildings. To achieve the ambitious PlaNYC goal, certain building sectors must move at an accelerated pace to increase their energy efficiency and cut emissions. Leading by example, City government pledged to reduce emissions from its municipal buildings and operations by 30 percent in just ten years (30x17).

Fig. 1: Projected Impacts of our Greenhouse Gas Reduction Strategy



Source: NYC Mayor's Office and M. J. Beck Consulting, LLC

Fig. 2: 2011 Citywide CO₂e Emissions by Sector

Total = 53.4 million metric tons

Buildings = 74%

■ Residential
■ Commercial
■ Industrial
■ Institutional

Transportation = 21%

■ On-road transportation
■ Transit

Wastewater, fugitive = 1%

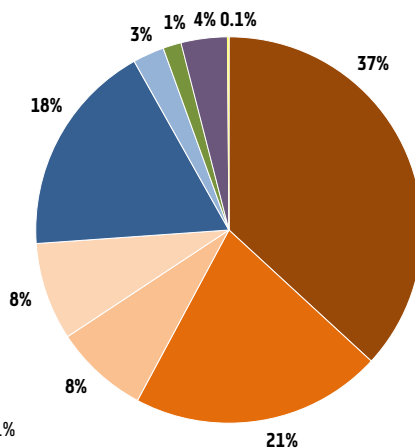
■ Wastewater, fugitive

Solid waste = 4%

■ Solid waste

Streetlights and traffic signals = 0.1%

■ Streetlights and traffic signals



Source: NYC Mayor's Office

Mayor's Carbon Challenge

Following this pledge, Mayor Bloomberg issued the Mayor's Carbon Challenge (Challenge) to members of the institutional and private sectors to match City government's goal. The Challenge is a way to motivate voluntary action and help overcome structural barriers to reduce emissions from the city's largest sectors. Since then, 17 of the leading universities and the 11 largest hospital systems—representing more than 50 individual hospitals—have accepted the Challenge. Together, they make up more than 120 million square feet of space and account for 3.5 percent of the City's total emissions, based on 2005 emissions levels. In addition, the City has joined a partnership with the Broadway Green Alliance (BGA) to launch a number of sustainability initiatives in more than 40 Broadway theatres.

Universities

Mayor Bloomberg launched the Challenge to universities in 2007, recognizing strong leadership within academic institutions to address climate change and their significant contribution to citywide emissions. For the universities, the Challenge is an opportunity to align their academic research and environmental stewardship efforts with the broader citywide sustainability goals in PlaNYC.

The first nine universities accepted the Challenge in 2007, joined later by eight additional universities in 2008. Together, these 17 schools make up roughly 70 million square feet of space in the city and account for 1.5 percent of total citywide emissions, based on 2005 emissions levels.

Hospitals

Mayor Bloomberg launched the Challenge to hospitals two years later as a way to engage one of the most vitally important but

Mayor's Carbon Challenge Universities

- Barnard College
- Berkeley College
- The City University of New York
- Columbia University
- The Cooper Union
- Fashion Institute of Technology of the State University of New York
- Fordham University
- The New School
- New York School of Interior Design
- New York University
- Pace University
- Polytechnic Institute of New York University
- Pratt Institute
- The Rockefeller University
- School of Visual Arts
- St. John's University
- Weill Cornell Medical College

Mayor's Carbon Challenge Hospitals

- Continuum Health Partners
- Lutheran Medical Center
- Maimonides Medical Center
- Memorial Sloan-Kettering Cancer Center
- Montefiore Medical Center
- Mount Sinai Hospital
- New York City Health and Hospitals Corporation
- New York Hospital Queens
- NewYork-Presbyterian Hospital
- North Shore-Long Island Jewish Health System
- NYU Langone Medical Center

energy-intensive sectors of the economy. Hospitals viewed the Challenge as a way to reduce their air pollution and emissions, which is an important component of their missions to improve public health.

The 11 largest hospital systems in New York City accepted the Challenge in 2009, which represent more than 50 individual hospitals and dozens of clinics, outpatient centers, and medical offices. Together, these facilities make up nearly 50 million square feet of space in the city and account for roughly two percent of total citywide emissions, again based on 2005 emissions levels.



Credit: NYC Mayor's Office

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 in ten years 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 used for the Challenge 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. In this report, "GHG emissions" and "carbon emissions" are used interchangeably to refer to CO₂e. Under the Challenge methodology, emissions are calculated by applying a "carbon coefficient" to each participant's annual energy consumption by fuel type. The Challenge uses New York City-specific coefficients for electricity and steam, which are calculated by the New

York City Mayor's Office of Long-Term Planning and Sustainability (Mayor's Office). These coefficients are based on aggregate power plant data and are in compliance with the 2010 Local Government Operations Protocol (LGOP). All emissions coefficients for natural gas, propane, and No. 2, 4, and 6 fuel oils were developed by the U.S. Environmental Protection Agency (EPA).

For the purposes of the Challenge, the coefficients used to determine the carbon emissions associated with electricity and steam are fixed at 2005 levels, which is because these coefficients can change dramatically over time. For example, since 2005, the retirement of coal-fired power plants, increased use of natural gas, and construction of more energy-efficient combined cycle power units have decreased the carbon intensity of New York City's electricity supply by more than 30 percent. Annually changing the electricity coefficient to reflect this reduction would provide an advantage to Challenge participants that depend primarily on electricity. Fixing the electricity and steam carbon coefficients at 2005 levels therefore measures only the direct efforts of the participants, and not exogenous changes to the energy supply.

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.

Emissions Intensity: The level of a participant's GHG emissions per square foot (CO₂e/sq ft). This is used to measure the 30 percent emissions reduction goal.

Emissions Intensity

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.

This report usually describes emissions intensity in terms of metric tons of carbon dioxide equivalent per square foot (Mtons CO₂e/sq ft), but will sometimes refer to emissions intensity as pounds of carbon dioxide equivalent per square foot (lbs CO₂e/sq ft). These two measures are interchangeable: 1 metric ton of CO₂e = 2,204.6 pounds of CO₂e. Metric tons of CO₂e/sq ft will generally be used to represent the aggregate carbon intensity among institutions, while pounds of CO₂e/sq ft will be used to represent the carbon intensity of an individual institution at a smaller scale.

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.

Base Year: The year from which Challenge participants' GHG emissions reductions are measured. Universities were allowed to choose a base year of either 2005 or 2006. However, some universities were only able to obtain complete energy use data for later years. In these cases, universities were permitted to use the earliest base year for which they had complete data.

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.

All hospitals use a base year of 2005 or 2006 except one that uses a base year of 2007 because it is missing energy data for previous years.¹

Start Year: The year that a participant began the Challenge. The universities' start year is 2007. The hospitals' start year is 2009.

End Year: The last year of the Challenge and the year by which the 30 percent emissions reduction goal must be achieved. This is ten years from a Challenge participant's start date. The universities' end year is 2017 and the hospitals' end year is 2019.

Outcomes

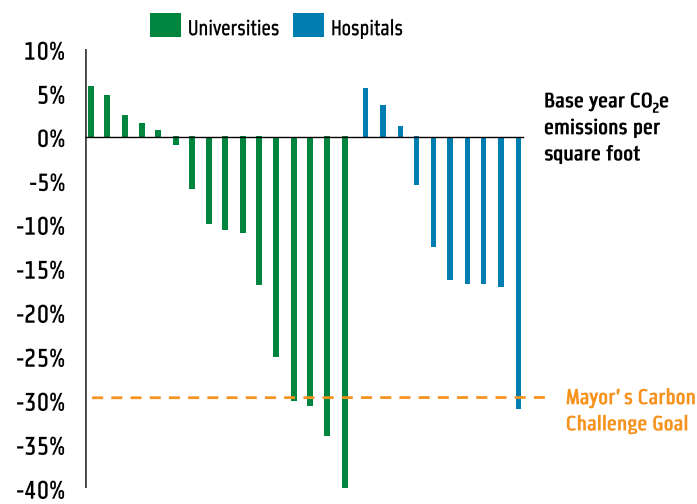
GHG Emission Reductions

The Challenge works by motivating voluntary action, creating a platform for the exchange of ideas, and providing the tools needed to achieve reductions in the energy use and emissions. Several years into the program, the universities and hospitals have made significant progress to reduce their energy use, cut GHG emissions, and address the sustainability of their operations.

Universities

In their base years, participating universities made up almost 68 million square feet of space in New York City and emitted more than 900,000 Mtons CO₂e/sq ft from their facilities—more than 1.5 percent of total citywide emissions (Fig. 4). By 2011, universities had grown by more than 3 million square feet, but had reduced their emissions to about 830,000 Mtons CO₂e/sq ft (using 2005 emissions coefficients for electricity and steam). All together, this represents a 12.8 percent reduction in emissions intensity since the universities' base years, putting the group nearly halfway to their goal to achieve a 30 percent reduction by 2017.

Fig. 3: Change in Challenge Participants' Emissions per Square Foot



Source: NYC Mayor's Office

Hospitals

In their base years, participating hospitals made up more than 46 million square feet of space in the City and emitted 1.1 million Mtons CO₂e/sq ft from their facilities—or about two percent of total citywide emissions (Fig. 5). By 2011, these hospitals grew by nearly 3.5 million square feet but managed to hold emissions relatively constant (again using 2005 electricity and steam emissions coefficients). This represents a 6.1 percent reduction in emissions intensity since their base years, also putting hospitals on target to meet their 30 percent reduction goal by 2019.

Reductions in Energy Use

Between 2005 and 2011, universities and hospitals both increased the number of students and patients they serve and added new, more energy-intensive research labs and equipment. Universities and hospitals were collectively able to offset this growth and further reduced their energy use intensity (EUI) as a result of both large and small investments in energy efficiency and upgrades to their buildings, equipment, and operations.

Since their base years, universities have reduced their EUI by 6.9 percent, although some of this reduction can be attributed to a

Fig. 4: University Challenge Square Feet and Emissions Reductions

UNIVERSITY CHALLENGE PROGRESS			
	Square Feet (sq ft)	Emissions (Mton CO ₂ e)	Emissions Intensity (Mton CO ₂ e/sq ft)
Base Year	67,690,254	913,883	0.013
Today	70,870,480	834,176	0.011
Change in carbon intensity = 12.8%			

Fig. 5: Hospital Challenge Square Feet and Emissions Reductions

HOSPITAL CHALLENGE PROGRESS			
	Square Feet (sq ft)	Emissions (Mton CO ₂ e)	Emissions Intensity (Mton CO ₂ e/sq ft)
Base Year	46,318,310	1,117,350	0.253
Today	49,742,702	1,126,675	0.235
Change in carbon intensity = 6.1%			

milder winter in 2011. In their base years, hospitals' aggregate EUI was nearly twice that of the universities, which is reflective of the fact that hospitals operate 24 hours per day, seven days a week and power extremely energy-intensive medical research equipment such as CT scanners and MRI machines. By 2011, the hospitals' aggregate energy use grew slightly, but their EUI remained relatively constant because of the growth in the hospitals' square footage.

Not only did universities and hospitals save energy, they also saved millions of dollars from lower energy costs. Many energy projects had payback periods of two years or less, such as retrofits of outdated building equipment, upgrades to more efficient lighting, retro-commissioning of building systems, and installation of lighting occupancy sensors.

Changes in Energy Sources

Universities and hospitals also underwent significant changes to their energy profiles as they switched to cleaner energy sources.

Electricity. Electricity accounted for roughly half of the energy use for both universities and hospitals in their base years. Participants largely held their electricity use flat, but the share of electricity increased to nearly 60 percent of the mix as other sources declined.

Steam. The use of steam decreased significantly for both universities and hospitals, primarily due to several large-scale chiller plant replacement projects. As a result, steam use and the associated emissions for both the universities and hospitals decreased by more than 30 percent.

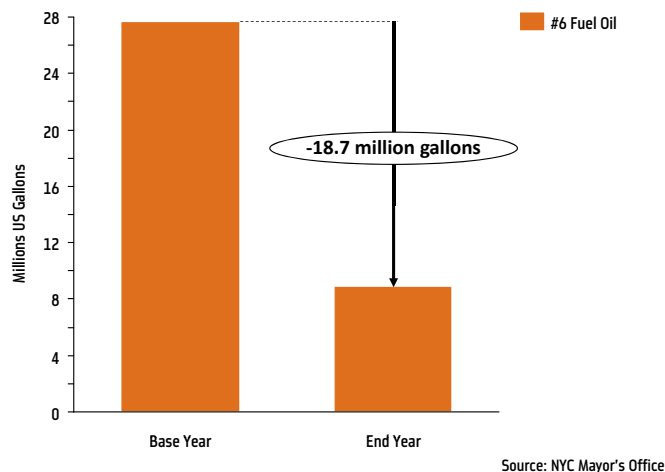
Fuel Oil. Major carbon reductions came from efforts to phase out No. 6 fuel oil and switch to cleaner-burning fuels. Not only is No. 6 fuel oil carbon intensive, it also emits fine particulate matter (PM_{2.5}) that can aggravate respiratory diseases. Recognizing this public health issue, the New York City Department of Environmental Protection issued regulations in 2012 to phase out all No. 6 fuel oil by July 2015. Acting on a faster time frame, the university and hospital participants reduced their No. 6 fuel oil use by 18.7 million gallons—a 67 percent decrease overall. As a result, universities and hospitals removed more than 210,000 metric tons of carbon dioxide equivalent from the air last year.

Natural Gas. As universities and hospitals phased out their heavy fuel oil, they largely replaced it with cleaner-burning natural gas. As a result, both the universities and hospitals increased their annual use of natural gas by roughly 50 percent, which became more than 30 percent of their overall energy mix.

Additional Benefits

Beyond the impact that the Challenge participants' efforts have had on citywide reductions, the Challenge has provided additional benefits that are less quantifiable but equally important. For one, the visibility of the Challenge has engaged senior level management within the participating institutions to take meaningful action to reduce energy use and emissions. This high-level commitment

Fig. 6: Mayor's Carbon Challenge Total Heating Oil Use



is often necessary to prioritize investments in energy efficiency and can also serve as motivation that diffuses throughout an organization from the top down. The Challenge program also helped overcome professional silos between financial departments, sustainability offices, and facilities staff, allowing large institutions to overcome structural barriers and make progress toward a common goal.

The Challenge also provides a platform for sustainability professionals and facilities managers across institutions to measure their progress and learn from others' experiences. Even within large institutions with dedicated facilities staff, there can be limited technical understanding of energy management. The Challenge helps to expedite this learning curve by providing tools such as a carbon emissions calculator to measure emissions and a climate action plan template to help participants develop their emissions reduction strategy. In addition, the Challenge has created a community of dedicated professionals that help each other navigate the complex array of energy-saving opportunities and financial incentives. Regular meetings in which participants can share their results have also created a healthy dose of friendly competition that helps motivate the whole group.

The Challenge has also engaged new communities in the important but often invisible work of energy efficiency. Universities and hospitals have launched various campaigns to actively involve their students, patients, faculty, staff, and others in their energy reduction efforts. These campaigns are often built upon existing programs such as waste reduction and recycling efforts and are incorporated into the institution's overall green efforts. The reach of the Challenge therefore extends far beyond the participating institutions as students, patients, and staff are inspired to take action in their own lives, playing an important role for New York City's broader environmental goals.

Highlights

Since the launch of the Challenge, the participating universities and hospitals have undertaken dozens of innovative projects to increase energy efficiency and reduce emissions. The following are a sample of just a few of the projects that have led to significant results.

Berkeley College

Key Project: Lighting Retrofit Project

Berkeley College began a lighting retrofit project in 2007 to replace 675 lighting fixtures in one of the college's three buildings in New York City. Berkeley found it could replace four higher watt bulbs with two low-watt bulbs and a reflector kit and still produce the same amount of light throughout the building, which would reduce electricity usage by 31,370 watts and cut lighting costs by more than half. In combination with a rebate from NYSEERDA, the energy savings of the project generated a payback period of less than one year, proving that spending a little on energy efficiency can realize great savings. Berkeley College now plans to replicate the success of this lighting project in a second



Berkeley College might be small, but that has not stopped the college from realizing big energy savings, helping the college reduce its emissions by 17 percent since 2007.

Columbia University



Columbia University owns and operates more than 13 million square feet of space in NYC. Planned projects across these properties will reduce emissions by up to 45,000 metric tons.

Key Project: Residential Fuel Conversions

Columbia University is working with Con Edison to convert heating fuel in 75 residential buildings from heavy fuel oil to natural gas, which will both reduce the university's emissions and improve local air quality for the entire neighborhood. So far, Columbia has converted heating fuel in 22 of its buildings. The university expects to complete conversions in an additional 27 buildings in 2013, with the remainder to be converted by June 2014. As a result of these fuel conversions, Columbia projects that it will reduce its emissions by 7,236 metric tons of carbon dioxide equivalent—or roughly five percent of its baseline emissions in 2005.

St. John's University

Key Project: Behavioral Change

St. John's University has made student engagement integral to its emissions reduction strategy. Every year, St. John's participates in competitions such as RecycleMania and Campus Conservation Nationals to engage students in sustainability measures. St. John's won Campus Conservation Nationals for the New York region in 2012, reducing energy use in 9 dorms by 37,071 kWh—an average of 10 percent per dorm. Now, St. John's has challenged other NYC universities to compete in 2013. Student "Wattstoppers" are using data gathered from energy use dashboards and meters for standard appliances to win the competition again this year.

Students are key to St. John's University's success so far, helping to achieve a 12 percent reduction in emissions since 2007 through their behavioral changes.



Montefiore Medical Center

Montefiore Medical Center is improving public health by reducing emissions in the Bronx, which has asthma rates that are 70% higher than the other boroughs.



Key Project: Combined Heat and Power Plant

Montefiore is a pioneer of combined heat and power (CHP) generation within the healthcare community. The medical center installed its first CHP system in 1994 and a second in 2003, which together generate 11 MW of power and produce steam for heating, cooling, and hot water. The plant provides reliable power that allows the hospital to continue operating even during blackouts and other emergencies. With a system-wide efficiency of 70 percent, the CHP system cuts emissions by 17,000 tons per year and uses 26 percent less fuel than electricity from the grid. Now, Montefiore is planning an additional CHP plant to cut emissions beyond the 17 percent reduction already achieved.

Memorial Sloan-Kettering Cancer Center

Key Project: Central Chilled Water Plant Oversight

Memorial Sloan-Kettering Cancer Center (MSKCC) launched the Central Chilled Water Plant Oversight program in 2007 to find simple, cost-saving ways to optimize performance of its chiller plants. MSKCC installed a utility grade measurement system to collect data on its chilled water production for continuous energy oversight and analysis. Based on the data, MSKCC reset its condenser water supply schedule to optimize efficiency and changed piping configurations to maximize free cooling. Implementing these changes in four chiller plants reduced the hospital's steam use by nearly 30,000 mlbs and cut electricity use by 2.4 million kWh, reducing costs by more than \$800,000 last year.



Memorial Sloan-Kettering Cancer Center saved a total of \$2.6 million from its energy projects in 2012—funds that the hospital can reinvest in its cancer patients and research.

NYU Langone Medical Center



NYU Langone Medical Center's Energy Committee manages and evaluates the performance of dozens of energy projects at a time, helping the hospital reduce its emissions by 17%.

Key Project: Enhanced Energy Management

NYU Langone Medical Center has created an institutional framework to help make energy management a top priority across the organization. In 2008, NYU Langone appointed an energy manager to oversee project development and created a committee to track energy performance. Each month, the energy committee reviews the status of projects, examines energy usage to pinpoint opportunities for improvement, and recognizes successful initiatives and staff achievements. The committee currently oversees 33 active projects and has committed \$7.4 million in capital investments since 2008, which have helped NYU Langone achieve a 17 percent reduction in emissions since 2005.

Early Achievers

Since Mayor Bloomberg launched the Challenge to universities and hospitals, four universities and one hospital reached the goal, cutting their emissions by 30 percent or more in half the time allotted for the Challenge. The four universities are Barnard College (Barnard), the Fashion Institute of Technology of the State University of New York (FIT), New York University (NYU), and The Rockefeller University (Rockefeller), each of which exceeded the 30 percent goal in less than five years since joining the Challenge. The hospital is New York Hospital Queens (NYHQ), which achieved the goal in just two years since joining the Challenge. All together, these five institutions' GHG reductions are equal to nearly one percent of the total reduction in citywide emissions since 2005.

Overview of Reductions

At the beginning of the Challenge, Barnard, FIT, NYHQ, NYU, and Rockefeller operated nearly 18 million square feet of space and emitted more than 300,000 Mtons CO₂e/sq ft (Fig. 8). In their most recent inventories, these five institutions grew by about 500,000 square feet but cut their emissions by more than 86,000 Mtons CO₂e/sq ft (Fig. 7). The reduction in emissions from these five institutions alone is equal to 0.85 percent of New York City's total emissions reduction last year, or the equivalent of removing about 18,000 passenger vehicles from the road.⁵

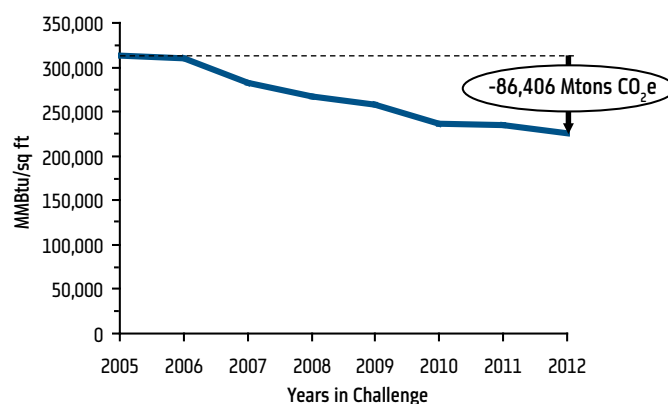
Reductions from Energy Efficiency

Dramatic reductions in energy use occurred as a result of major investments in energy efficiency. Even as Barnard, FIT, NYHQ, NYU, and Rockefeller added capacity, they reduced energy use by more than 20 percent, although this is partly due to a mild winter in 2011.

All together, the institutions cut their energy consumption from 5.5 million MMBtu to 4.4 million MMBtu and reduced their EUI from 0.311 MMBtu/sq ft to 0.243 MMBtu/sq ft. This 21.7 percent reduction in EUI accounts for more than two-thirds of their total reduction in emissions.

Barnard, FIT, NYHQ, NYU, and Rockefeller reduced energy use through a combination of both large-scale investments in energy efficiency and low-cost energy conservation measures. Large energy projects included the installation of a 13.8 megawatt (MW) cogeneration plant at NYU, which allowed NYU to both reduce total energy use and switch to cleaner-burning natural gas, as well

Fig. 7: Early Achievers' Absolute CO₂e Emissions Reductions



Source: NYC Mayor's Office

Mayor's Carbon Challenge Early Achievers

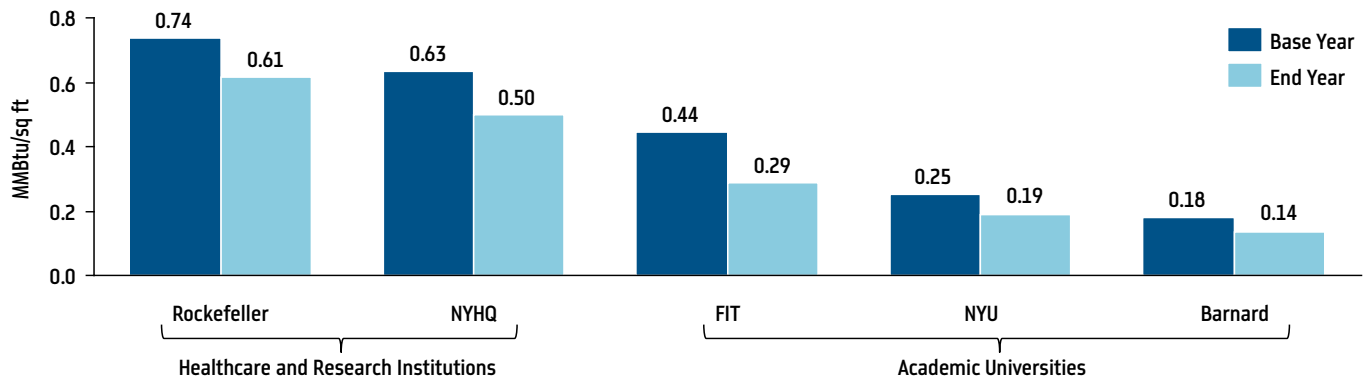
- New York University: 30.03%
- The Rockefeller University: 30.64%
- Barnard College: 34.09%
- Fashion Institute of Technology: 40.78%
- New York Hospital Queens: 30.92%

as chiller plant replacements at FIT and NYHQ. However, smaller, lower-cost energy projects, which can have a payback time of two years or less, also contributed significantly to the reductions. These projects include lighting upgrades, window replacements, retro-commissioning of building equipment, lighting and heating controls, improved operations and maintenance, schedule changes to maximize efficiency, procurement of energy efficient appliances, enhanced insulation, and public education campaigns aimed at behavioral change.

Reductions from Fuel Switching

Switching heavy fuel oil to cleaner energy sources such as electricity and natural gas also accounted for a significant portion of Barnard, FIT, NYHQ, NYU, and Rockefeller's emissions reductions. In their base years, these five institutions burned nearly 10 million gallons of No. 2, No. 4, and No. 6 fuel oil, emitting nearly 110,000

Fig. 8: Early Achievers' Base and End Year Comparison of Energy Use Intensity



Source: NYC Mayor's Office

Mtons CO₂e/sq ft as a result. Since then, these institutions undertook aggressive efforts to phase out their use of fuel oil, reducing their use by 89 percent and the resulting emissions by 98,000 Mtons CO₂e/sq ft. Converting from No. 6 fuel oil to cleaner-burning heating fuels will soon be required of all buildings in New York City as a result of the City's clean heat regulations.

Changes in Energy Sources

Barnard, FIT, NYHQ, NYU, and Rockefeller all saw dramatic changes to their energy and emissions profiles, as the combination of electricity and natural gas grew from two-thirds of the mix to nearly 90 percent of their energy profiles. Meanwhile, the combination of fuel oil and steam decreased to just 10 percent of the mix.

Electricity. All together, Barnard, FIT, NYHQ, NYU, and Rockefeller decreased the intensity of their electricity use per square foot by 13.8 percent, which is due in part, but not in total, to NYU's cogeneration plant. Overall, these five institutions reduced their yearly electricity use by nearly 30 million kilowatt-hours (kWh), from 248 million kWh (2.4 million MMBtu) to just 220 million kWh (2.1 million MMBtu). This decreased the emissions associated with their electricity use by about 13,000 Mtons CO₂e/sq ft—the equivalent of eliminating the electricity used in 2,000 homes every year.⁵

Steam. The early achievers also decreased their steam use by almost half, which was primarily driven by a large steam chiller replacement project at FIT that replaced an inefficient system. This project eliminated more than 200,000 MMBtu from steam at FIT alone—a 60 percent reduction in their steam use since their base year. All together, the share of steam decreased from about 9.5 percent of the mix to just 6.5 percent.

Fuel Oil. One of the most dramatic changes in energy use came from reductions in the use of heavy fuel oil. Rockefeller and NYU both burned No. 6 fuel oil at the beginning of the Challenge but had nearly eliminated it by the time they reached the 30 percent goal. Together, they phased out 87 percent of their No. 6 fuel oil, decreased from 20 percent of the early achievers' total fuel mix to less than 3 percent.

Natural Gas. As the early achievers began phasing out their fuel oil, they largely replaced it with cleaner-burning natural gas. As a result, the participants increased their use of natural gas by nearly 60 percent, which rose from roughly 20 percent of their energy profiles to more than 40 percent. By 2012, natural gas and electricity together accounted for about 90 percent of the total mix.

Differences in Energy Use

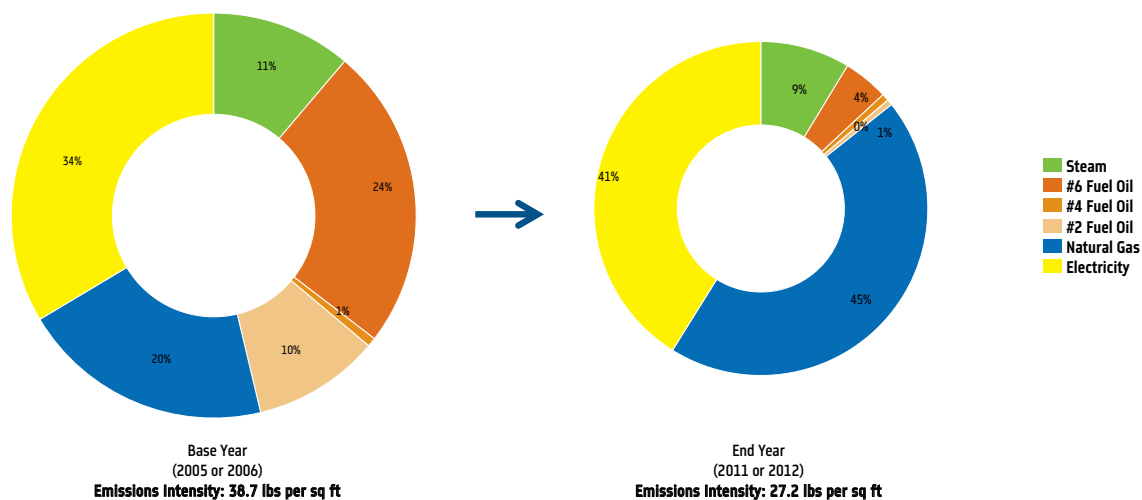
Two of the institutions, Rockefeller and NYHQ, began the Challenge as relatively high energy users. This is not surprising because as a research university and a hospital, both institutions must operate energy-intensive research labs and life-saving equipment. Meanwhile, Barnard and NYU began the Challenge as relatively low energy users, while FIT began in the middle range. This was due in part because they have fewer research labs and equipment, and partly because of the energy efficiency work they had completed before beginning the Challenge.

It is not necessarily more difficult for energy-intensive institutions to reduce emissions. There may be standard strategies not yet employed that can achieve significant reductions quickly and cost-effectively. In fact, low energy users may actually have a more difficult time realizing significant reductions if they have already achieved the so-called “low-hanging fruit,” leaving them with only more difficult and costly energy efficiency measures to choose from.

Differences in Energy Sources

The five early achievers also began the Challenge with a wide range of energy sources. All of the institutions except FIT burned at least some fuel oil in their base years, although Barnard and NYHQ primarily burned No. 2 fuel oil while Rockefeller and NYU mainly burned No. 6 fuel oil. For these institutions, eliminating almost 90 percent of fuel oil across the board drove significant carbon reductions at all four of these institutions. FIT, on the other hand, did not burn fuel oil but began the Challenge as a heavy steam user, which made up two-thirds of its energy use in its base year. By the time FIT met the Challenge goal, it had reduced nearly 60 percent of its steam use, which drove the majority of its emissions reductions.

Fig. 9: Early Achievers' Base and End Year Comparison of Carbon Emissions by Fuel Type



Source: NYC Mayor's Office

Electricity accounted for anywhere between one-third and one half of the five early achievers' energy profiles in their base years. NYU led the way in the institutions' electricity reductions, with a decrease in electricity use of about 27 percent, largely due to its cogeneration plant but also due to aggressive energy efficiency efforts such as occupancy sensors in its dorms and enhanced training in operations and maintenance. Meanwhile, electricity decreased or stayed relatively constant at the other institutions, while the share of electricity in the overall mix increased as other sources decreased.

All five participants started off using some natural gas and have increased this use since their base years, although some increased natural gas usage much more dramatically than others. For example, Rockefeller began with natural gas at just six percent of its energy mix, but since then has quadrupled its use, which now accounts for nearly half of the university's energy consumption. Natural gas accounted for just 0.1 percent of FIT's energy use in its base year but has since increased by tenfold.

Cost Savings

In order to reach the 30 percent goal, Barnard, FIT, NYHQ, NYU, and Rockefeller pursued a range of strategies that were tailored to fit their individual needs. This included a mix of large-scale capital investment projects and smaller projects with quicker pay-back times. However, the common outcome among the five early achievers was saving millions of dollars by reducing energy consumption and cutting emissions—savings that can be reinvested directly into these institutions' students, patients, and research.

- NYU is saving between \$11-14 million per year in energy costs from the combination of its new 13.8 MW cogeneration plant and aggressive campuswide energy efficiency measures.
- NYHQ is saving at least \$2.5 million per year in energy costs from phasing out its fuel oil and investing in energy efficiency measures such as a large chiller plant replacement.

- Rockefeller is saving more than \$1 million in energy costs from measures that include phasing out its fuel oil and reducing its lighting and air conditioning needs, particularly in its labs.
- FIT is also saving more than \$1 million in energy costs by replacing a large, outdated steam chiller, weatherizing its buildings, purchasing energy efficient appliances, and other measures.
- Barnard is saving at least \$1 million in energy costs from reducing its fuel oil, adjusting temperature settings, installing occupancy sensors, and improving building operation.

Highlights

There are some common trends in how Barnard, FIT, NYHQ, NYU, and Rockefeller achieved their reductions. For example, all of the early achievers reduced or held their electricity use constant, even as they added students, patients, and research capacity, and all institutions that used fuel oil at the start of the Challenge also undertook aggressive efforts to phase it out.

However, the progress of the five early achievers is even more remarkable because of the wide variety in their energy and emissions profiles. Each institution achieved early reductions through unique strategies, demonstrating that there are many ways to reach a 30 percent reduction. The key factor of success for each institution was a strategic plan tailored to individual needs and dedicated staff that moved quickly to implement the strategy across their campuses. The sustainability and facilities staff vary by composition and size across the institutions, but each provided direction and accountability while consistently measuring the results. Using tools provided by the Mayor's Office, these participants were able to track energy use, emissions reductions, and financial savings from projects, which resulted in a virtuous cycle that helped to obtain additional capital needed for new projects.

Barnard College

-34.1%

Barnard College accepted the Challenge in 2007. In five years, Barnard cut emissions by more than 34 percent from 2005 levels.

To meet the 30 percent goal, Barnard:

- Completed extensive façade and roof repairs and replaced windows with low thermal emissivity glass to improve building envelope and reduce heat loss
- Replaced steam traps in buildings to reduce steam leakage
- Retro-commissioned existing building equipment
- Installed efficient lighting, timers, and occupancy sensors
- Set up web-based building management systems to control equipment energy use
- Reduced building operating temperatures during the winter and increased temperatures during the summer
- Installed pipe insulation to prevent heat loss
- Reduced usage of No. 2 fuel oil
- Built to Leadership in Energy and Environmental Design (LEED®) standards for all new construction

Total Savings: At least \$1 million per year

"As a leading New York academic institution, Barnard pledged to reduce its greenhouse gas emissions by 30% within 10 years. To meet this challenge, we committed to not only reduce the amount of energy the campus consumes, but also to reduce waste and encourage environmentally-friendly habits among the Barnard community." – Daniel Davis, Associate Director of Facilities Services

Key Project: Retro-commissioning

Retro-commissioning is a systematic process to optimize the energy performance of existing buildings by identifying and implementing operational and maintenance improvements to building equipment and systems. Through retro-commissioning, Barnard made a series of upgrades to its mechanical plant, including its boilers and ventilation systems, and changed operational measures to make them more efficient.

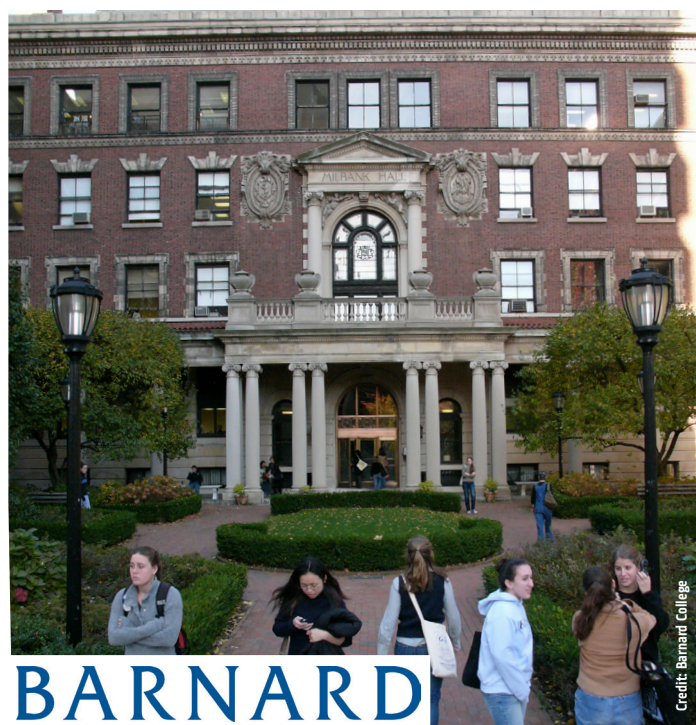
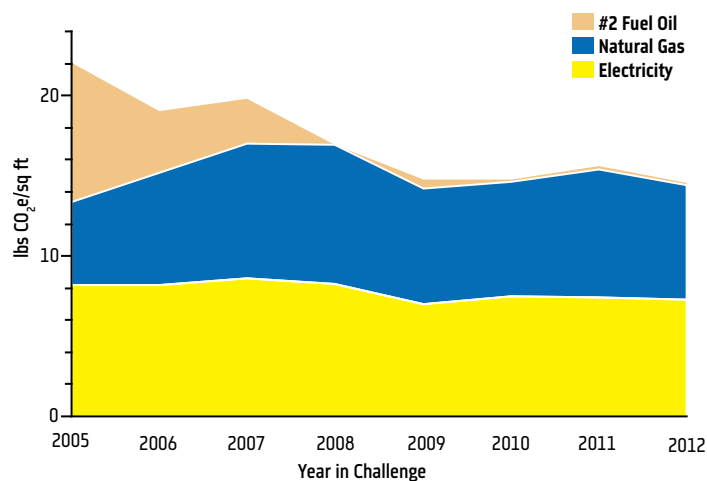


Fig. 10: Barnard CO₂e Intensity by Fuel Type



Source: NYC Mayor's Office

Fashion Institute of Technology

-40.8%

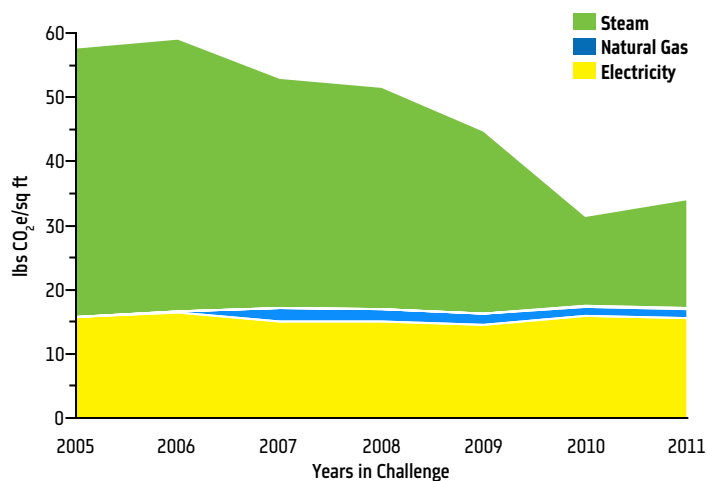
The Fashion Institute of Technology accepted the Challenge in 2007. In four years, FIT cut emissions by more than 40 percent from 2005 levels.

To meet the 30 percent goal, FIT:

- Replaced an outdated chiller plant and cooling tower
- Installed lighting retrofits and occupancy sensors
- Replaced windows with low thermal emissivity glass
- Installed high-efficiency refrigerators, washers, and dryers
- Retrofitted 50,000 square feet of lab space
- Painted over 10,000 square feet of roofs with reflective paint
- Installed a green roof on the Shirley Goodman Resource Center

Total Savings: At least \$1 million per year

Fig. 11: FIT CO₂e Intensity by Fuel Type



Source: NYC Mayor's Office

"The Fashion Institute of Technology is very pleased to be a participant in the Mayor's Carbon Challenge for New York colleges and universities. The tools and information provided by the Mayor's Office of Long Term Planning and Sustainability allowed the College to document a 39% reduction in carbon emissions as of 2011, making FIT one of the first colleges to successfully meet the Mayor's Challenge." — Dr. Joyce Brown, President



Key Project: Chiller Plant Replacement

In 2007, FIT installed a new chiller plant to efficiently meet FIT's cooling demands. The plant is composed of a new 500 ton electric chiller with a variable speed drive that provides efficient, modulated cooling, and three steam turbines, each with 1,000 tons of cooling capacity. Additionally, the plant was retrofitted with a new steam turbine driver, refurbished refrigerant compressors, re-tubed evaporators and condensers, and a more ozone-friendly refrigerant. FIT also replaced its cooling tower with a new 6-cell cooling tower (shown above), equipped with automated controls and variable speed fans. FIT estimates that that project will remove about 11 million pounds of CO₂e per year and save the university almost \$600,000 annually in reduced steam costs.

New York Hospital Queens

-30.9%

In 2009, New York Hospital Queens accepted the Challenge. In two years, the hospital cut emissions by 31 percent from 2005 levels.



Key Project: Chiller Plant Replacement

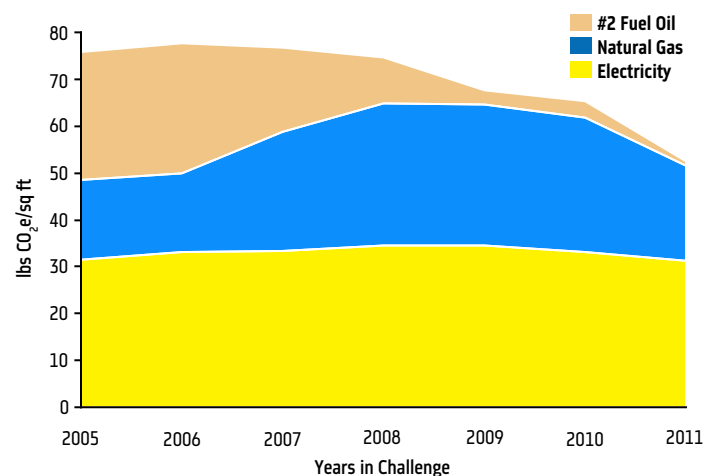
NYHQ's former central chiller plant consisted of three 1,100-ton gas fired absorption chillers serving the hospital's multiple cooling needs. With the help of financial incentives from the New York State Energy Research and Development Authority (NYSERDA)'s Existing Facilities program, NYHQ replaced one chiller with a 1,200-ton high efficiency electric chiller (shown above), which will use 17 percent less electricity than standard performance chillers. It reduces NYHQ's annual carbon emissions by seven percent, or 1,655 Mtons CO₂e from the atmosphere. This saves the hospital more than \$175,000 per year in reduced energy costs.

To meet the 30 percent goal, NYHQ:

- Replaced a gas-fired absorption chiller with a high efficiency electric chiller with a variable frequency drive
- Replaced a No. 2 fuel oil boiler with two new high pressure natural gas boilers
- Retro-commissioned a large, 30-year old air handling unit
- Installed photocell controls to increase natural lighting and occupancy sensors to turn off lighting in unoccupied rooms
- Used a centralized Building Management System to shut off unused ventilation systems during non-business hours
- Built all new construction to higher energy efficiency standards
- Launched an aggressive education campaign to encourage more energy efficient practices on the part of doctors, patients, and staff

Total Savings: At least \$2.5 million per year

Fig. 12: NYHQ CO₂e Intensity by Fuel Type



Source: NYC Mayor's Office

"The Mayor's Carbon Challenge has helped us cut emissions, reduce our energy use and save money in the process." – Kevin Mannle, Associate Vice President for Facilities Management

New York University -30.0%

NYU accepted the Challenge in 2007 and in five years, reduced emissions by 30 percent from 2006 levels. Now, NYU has set out to cut its emissions in half by the end of the Challenge.



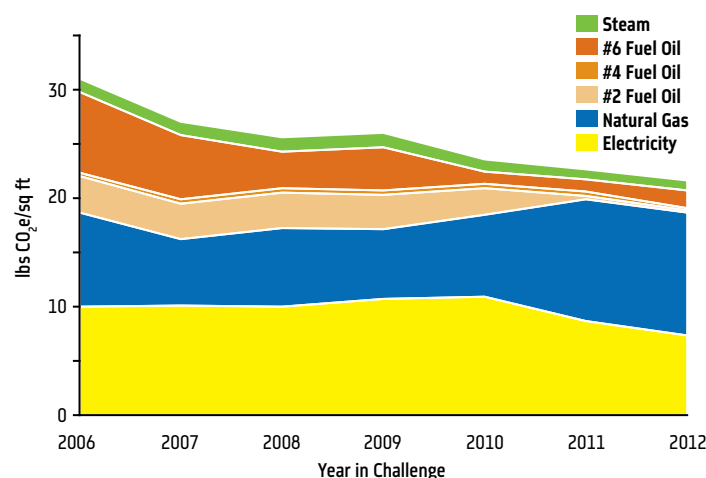
Credit: New York University

To meet the 30 percent goal, NYU:

- Constructed a 13.8 MW cogeneration facility
- Retrofitted and upgraded outdated equipment
- Installed occupancy sensors for lighting, heating and cooling
- Expanded the use of building management systems
- Trained equipment operators in energy efficiency
- Minimized use of heavy fuel oils for heating
- Installed ENERGY STAR boilers, printers, and computers
- Integrated energy efficiency into the construction process and built to LEED® standards for new construction
- Engaged students, faculty and staff to use less energy

Total Savings: \$11-14 million per year

Fig. 13: NYU CO₂e Intensity by Fuel Type



Source: NYC Mayor's Office

"Seldom have I seen an initiative unite and motivate our campus more than our green efforts. From declines in electrical consumption to increases in recycling, from our new co-gen plant's reductions in greenhouse emissions to expansion of bicycle riding, the commitment to meeting the challenges of climate change is not only an institutional priority at NYU, but a widespread and very personal one as well." — John Sexton, President

Key Project: Combined Heat and Power Plant Installment

NYU completed a cutting-edge, high-efficiency combined heat and power (CHP) plant in 2011 at a cost of \$125 million, which was the largest capital investment in NYU's history. The plant provides heating, cooling, and electricity to 40 buildings, providing half the campus with more efficient energy and helping to prevent brownouts by taking pressure off the city's strained electrical grid. The plant reduces NYU's GHG emissions by more than 20 percent, cuts air pollutants by 68 percent, and doubles the power output of the previous system. The CHP system is expected to save \$5-8 million per year in reduced energy costs, freeing up resources for additional energy-saving retrofits and academic purposes. Over time, NYU's investment will be returned through cost savings, with support from financial incentives from NYSERDA.

The Rockefeller University

-30.6%

The Rockefeller University accepted the Challenge in 2007. In less than five years, the University cut emissions by 30.6 percent from 2005 levels.



“After joining the Mayor’s Carbon Challenge, The Rockefeller University’s administration made energy a major priority, making significant upgrades to the University’s buildings and infrastructure. As a result, in less than five years The Rockefeller University met the Mayor’s Carbon Challenge goal. The Rockefeller University now operates more efficiently and sustainably—which is good for students, the University, and the planet!” – Alex Kogan, Associate Vice President of Plant Operations & Housing

Key Project: Energy Efficient Laboratories

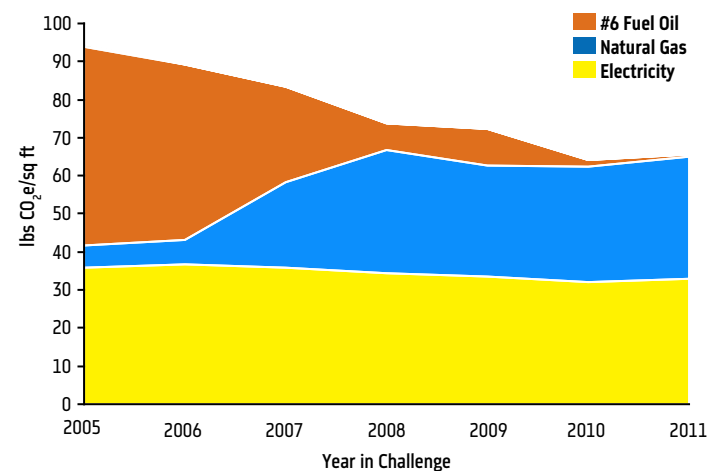
Laboratory air systems are required to use 100% outside air and are typically designed for the worst case load scenarios. This level of air turnover is extremely expensive, but is only required about 1% of the year. To increase the efficiency of air flows in its labs, Rockefeller University installed variable air volume (VAV) controls to vary the quantity of air delivered based on occupation levels and cooling requirements and installed sash monitoring controls on fume hoods to reduce hood exhaust flows. With these measures, Rockefeller University reduced the volume of air on average by about 15%.

To meet the 30 percent goal, Rockefeller University:

- Formed a Green Task Force of faculty, staff, and administrators to discuss green issues, potential projects, and initiatives
- Installed variable air volume (VAV) controls to vary air delivery to laboratories for occupancy levels and cooling requirements
- Installed more energy efficient lighting, reducing up to 50% of lighting loads in several buildings
- Converted No. 6 fuel oil to natural gas for heating systems
- Rebalanced air flows throughout the campus
- Adjusted temperature settings to be warmer in the summer and cooler in the winter
- Reduced heating during nights and weekends
- Launched a “Shut the Sash” campaign to lower laboratory fume hoods when not in use, reducing air conditioning needs
- Built to LEED® standards for new construction
- Engaged students in sustainability efforts through recycling programs

Total Savings: Over \$1 million in reduced energy costs per year

Fig. 14: Rockefeller CO₂e Intensity by Fuel Type



Source: NYC Mayor’s Office

New Sectors

Expansion of the Challenge

Building on the success of the existing program, the City is now partnering with NYSERDA to expand the Challenge to additional sectors, including New York City's largest commercial offices and residential cooperatives and condominiums. The City is also in the process of enhancing the Challenge partnership with Broadway theatres.

Commercial Offices

In April 2013, the City, in partnership with NYSERDA, launched the Challenge to commercial offices to engage some of the largest global corporations in energy efficiency, with a focus on reducing the energy used in their interior offices and leased spaces. Commercial buildings account for 21 percent of citywide emissions, and interior office space makes up between 40 to 60 percent of the energy use in a typical office building. However, most energy efficiency efforts have historically been geared toward upgrades that the building owners can make in their base building systems, and often exclude upgrades that office tenants can make in the interior office space.

The new Challenge to commercial offices motivates companies with significant office space in New York City to reduce emissions and energy use in these spaces. This new Challenge will include two groups: commercial office tenants and commercial building owner-occupiers. Because these two groups have fundamental differences in the energy use that they have direct operational control over, they will measure their emissions in different ways. Commercial tenants will measure per capita emissions resulting from the energy use in their interior office space, which includes lighting, plug loads, data centers, and supplemental heating and ventilation systems, while building owner-occupiers measure their emissions per square foot from their whole buildings, including the base building systems.

Ten global corporations with significant office space in New York City have accepted the Challenge, committing to reduce emissions per capita or per square foot by 30 percent or more in ten years. Together, these ten corporations make up more than 20 million square feet of space in New York City and employ more than 70,000 New Yorkers.

Mayor's Carbon Challenge Commercial Offices

- American International Group
- BlackRock
- Bloomberg L.P.
- Credit Suisse
- Deutsche Bank
- Google
- Goldman Sachs
- JetBlue
- JP Morgan Chase
- PVH

Residential Co-Ops and Condos

In the spring of 2013, the City will launch the Challenge to residential co-ops and condos, targeting energy use and emissions from the City's largest residential cooperatives and condominiums. New York City's 2010 Local Law 84 benchmarking data shows that GHG emissions from large residential buildings represent nearly 60 percent of emissions from all buildings greater than 50,000 square feet. Because the ownership structure of co-ops and condos incentivizes the deployment of energy efficiency measures, these buildings are particularly strong candidates for the Challenge.

Broadway Theatres

In 2008, the City joined a partnership with the Broadway Green Alliance (BGA) to launch a number of sustainability initiatives in more than 40 Broadway theatres. These initiatives include replacing all marquee and roof lighting with energy efficient light-emitting diode (LED) lights, recycling supplies and reusing props, replacing bottled water with tap water, appointing a "Green Captain" on every Broadway production, and more. The City is now working with the BGA and the Natural Resources Defense Council (NRDC) to measure the energy used in participating Broadway theatres, and create the proper set of metrics for an emissions reduction goal.



The Broadway Green Alliance has partnered with the Mayor's Carbon Challenge to encourage sustainable practices in Broadway theatres.

Credit: NYC Mayor's Office

Mayor's Carbon Challenge Broadway Theatres

- Al Hirschfeld Theatre
- Ambassador Theatre
- American Airlines Theatre
- August Wilson Theatre
- Belasco Theatre
- Bernard B. Jacobs Theatre
- Booth Theatre
- Broadhurst Theatre
- The Broadway Theatre
- Brooks Atkinson Theatre
- Circle in the Square Theatre
- Cort Theatre
- Ethel Barrymore Theatre
- Eugene O'Neill Theatre
- Foxwoods Theatre
- Gerald Schoenfeld Theatre
- Gershwin Theatre
- Helen Hayes Theatre
- Imperial Theatre
- John Golden Theatre
- Longacre Theatre
- Lunt-Fontanne Theatre
- Lyceum Theatre
- Majestic Theatre
- Marquis Theatre
- Minskoff Theatre
- Music Box Theatre
- Nederlander Theatre
- Neil Simon Theatre
- New Amsterdam Theatre
- Palace Theatre
- Richard Rodgers Theatre
- Samuel J. Friedman Theatre
- Shubert Theatre
- Stephen Sondheim Theatre
- St. James Theatre
- Studio 54
- Vivian Beaumont Theatre
- Walter Kerr Theatre
- Winter Garden Theatre

Conclusion

The success of the Mayor's Carbon Challenge to Universities and Hospitals demonstrates that motivating voluntary action on the part of private institutions can lead to substantial progress on public policy goals. Taken together, the efforts of the universities and Hospitals have had a measureable impact on citywide emissions, making the Challenge a tremendously cost-effective way for New York City to make progress toward its PlaNYC goal to reduce citywide emissions by 30% by 2030.

The Challenge has brought about high-level commitment to reduce emissions within the partner institutions, reduced the learning curve of facilities staff on issues of energy management, and engaged new communities in the effort to tackle climate change. As a result, the participants have collectively saved millions of dollars in reduced energy costs. Keys to this success include developing tools to help participants plan their strategy and track reductions, creating a platform for the open exchange of ideas, and providing the opportunity for institutions and private sector organizations to partner with the City on sustainability initiatives and be recognized for those efforts.

The organizational and financial benefits that have resulted from the Mayor's Carbon Challenge will continue to pay dividends for years to come. For Barnard, FIT, NYHQ, NYU, and Rockefeller, the five early achievers that have already reached the 30% goal, this means that their work is not over. Each of these institutions has pledged to continue investing in their energy efficiency, and several are even considering a commitment to reach a 50% emissions reduction stretch-goal by the end of the Challenge.

Building on this successful model, the City of New York, together with NYSEDA, will now expand the partnership with Broadway theaters, launch two new Challenges to commercial offices and residential co-ops and condos, and explore options to expand the Challenge model to other initiatives including water use and solid waste. Some lessons learned along the way from the Mayor's Carbon Challenge will provide insights for these and other voluntary engagement programs.

For one, the lack of a standard GHG accounting methodology and a set of accepted sustainability metrics is a major difficulty. Although the Challenge methodology is in full compliance with the Local Government Operations Protocol (LGOP), issues remain that lack clear answers, such as how to account for the changing carbon intensity of the City's electricity supply or the marginal impact of onsite generation on peak load carbon intensity. In these cases, the Mayor's Office made executive decisions that attempt to balance simplicity of reporting with accuracy of information. In the future, more should be done to coordinate between the various GHG reporting methodologies across government agencies and outside programs.

In addition, there are difficulties associated with managing a ten-year program, which continues to exist even after staff leave. The Challenge program seeks to overcome these difficulties by helping to provide a foundation for participants to institutionalize their energy management and providing simple tools for participants with varying degrees of expertise so they can track their emissions and plan their strategies without needing substantial guidance. Again, creating these tools requires a careful balance between both simplicity and accuracy in reporting.

In the five years since Mayor Bloomberg launched the first Challenge, the program demonstrated that private institutions can achieve sharp emissions reductions in a short period of time that have a measureable impact on citywide emissions. But on an even broader scale, the success of the Challenge program to universities and hospitals proves that voluntary engagement programs can play a role in fostering the stakeholder buy-in and behavioral changes necessary to tackle climate change. With an expansion of the Challenge underway, we will continue to engage new and vitally important sectors of New York City in this effort. As large commercial offices, residential co-ops and condos, and Broadway theatres begin their work, they will join the universities and hospitals as case studies that can be scaled up in New York City and beyond.

APPENDICES

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B	Acronym Definitions	25
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Appendix A

Methodology

All Challenge participants track their carbon emissions according to a common methodology, whereby participants aggregate their respective energy consumption data by fuel type and enter it into a Carbon Emissions Inventory calculator provided by the Mayor's Office. Participants currently track only building energy use. Methodologies to calculate emissions for vehicle fleets and solid waste are under development, but will be optional under the Challenge. Emissions from these sources are only expected to account for two to three percent of participants' total emissions.

The Carbon Emissions Inventory calculator applies a "carbon coefficient" to the Challenge participants' annual fuel consumption to determine the associated level of GHG emissions, which is measured in terms of CO₂e. Total emissions are then divided by the participant's gross square footage to determine their carbon intensity (CO₂e/sq ft). Participants are required to track their carbon intensity for each year of the Challenge, beginning in the base year and ending ten years later. Most Challenge Universities and Hospitals use a base year of 2005 or 2006, which is the first year they begin measuring energy use and the year from which their emissions reductions are measured. 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.

All carbon coefficients for the Challenge are in compliance with the 2010 LGOP. The Challenge uses New York City-specific coefficients

for electricity and steam, which are developed by the Mayor's Office based on aggregate power plant data. All emissions coefficients for natural gas, propane, and No. 2, 4, and 6 fuel oils were developed by the 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. Since 2005, the retirement of coal-fired power plants, increased use of natural gas, and construction of more energy-efficient combined cycle power units have decreased the carbon intensity of New York City's electricity supply by over 30 percent. If the electricity coefficient annually changes to reflect these changes in carbon intensity at the source, 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.

In 2011, the Mayor's Office decided to hold the electricity and steam coefficients constant, basing them on the best estimates for 2005 emissions levels. The City has updated these estimates since 2011, but for purposes of the Challenge, both coefficients are maintained at these figures. This is not expected to significantly change the emissions levels for participants.

STANDARD UNITS FOR THE MAYOR'S CARBON CHALLENGE			
Measure	Units	Abbreviation	Description
Greenhouse Gas Emissions	Carbon dioxide equivalent	CO ₂ e	The level of carbon dioxide (CO ₂) that would have the same climate impact as a given concentration and type of greenhouse gas.
Energy Use	Million British thermal units	MMBtu	A standardized measure of total energy used to compare energy use across different fuel types. For purposes of the Challenge, energy use is measure in terms of source energy, or energy use that takes into account weather fluctuations or transmission, delivery, and production losses of an energy source.
Floor Area	Gross Square Feet	sq ft	Includes the total number of square feet measured between the exterior surfaces of the enclosing fixed walls. This includes spaces such as vent shafts, stairs, basements, etc.
Carbon Intensity	Metric tons of carbon dioxide equivalent per gross square foot	MTCO ₂ e/sq ft	A measure of the intensity of carbon emitted per square foot, which standardizes emissions levels for buildings of different sizes.
Energy Use Intensity	Million metric British thermal units per gross square foot	MMBtu/sq ft	A measure of the intensity of energy used per square foot, which standardizes energy use for buildings of different sizes.

MAYOR'S CARBON CHALLENGE COEFFICIENTS							
	Electricity (kWh)	Natural Gas (Therms)	#2 Fuel Oil (US Gallons)	#4 Fuel Oil (US Gallons)	#6 Fuel Oil (US Gallons)	Propane (US Gallons)	Steam (Mlbs)
MT CO ₂ e per unit energy	0.0004227	0.0053156	0.0102640	0.0110167	0.0113276	0.0124138	0.0894146
MMBtu per unit energy	0.0095346	0.1000000	0.1380000	0.1460000	0.1500000	0.0910000	1.3301500

Appendix B

Acronym Definitions

Entities:

- BGA – Broadway Green Alliance
- EPA – United States Environmental Protection Agency
- FIT – Fashion Institute of Technology of the State University of New York
- NRDC – Natural Resource Defense Council
- NYHQ – New York Hospital Queens
- NYSERDA - New York State Energy Research and Development Authority
- NYU – New York University
- WRI – World Resources Institute

The following acronyms are used throughout this report:

- CT – Computed Tomography
- CO₂ – carbon dioxide
- CO₂e – carbon dioxide equivalent

- CO₂e/sq ft – carbon dioxide equivalent per square foot (carbon intensity)
- EUI – energy use intensity
- FY – fiscal year
- GHG – greenhouse gas
- kWh – kilowatt-hours
- lbs – pounds
- LED – light-emitting diode
- LEED® – Leadership in Energy and Environmental Design
- LGOP – Local Government Operations Protocol
- MMBtu – million British thermal units
- MRI - Magnetic Resonance Imaging
- MW – megawatt
- PM2.5 - fine particulate matter
- sq ft – gross square foot

Appendix C

Endnotes

1. Berkeley College, Cooper Union, Pace University, Polytechnic Institute of NYU, School of Visual Arts, St. John's University, and Montefiore Medical Center use a base year of 2007.
2. Barnard College, New York University, and The Rockefeller University submitted energy data for Fiscal Year 2012 (FY 2012) to demonstrate their 30 percent emissions reductions; this data is substituted for their 2011 energy data. The Polytechnic Institute of New York University and Cooper Union submitted data through 2010, thus 2010 energy data is substituted for their 2011 energy data. The New School has not yet submitted an inventory due to problems locating accurate energy data and therefore has been excluded from these data sets.
3. Continuum Health Partners has not yet submitted a complete inventory due to problems locating accurate energy data, and therefore has been excluded from these data sets.
4. Challenge participants were originally given the option of submitting inventories based on either a calendar year or a fiscal year. In 2012, all Challenge participants were asked to begin reporting on a calendar year in order to standardize submissions, but participants that could demonstrate a 30 percent reduction for Fiscal Year 2012 (FY 2012) were allowed to report on a fiscal year for their most recent inventory. Those reporting their FY 2012 energy use are Barnard, NYU, and Rockefeller.
5. All equivalencies are calculated by the EPA Greenhouse Gas Equivalencies Calculator which can be found online at: <http://www.epa.gov/cleanenergy/energy-resources/calculator.html>.

The data presented is for Fiscal Years 2005 through 2011.

For more information, please visit:
www.nyc.gov/carbonchallenges



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