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ECONOMIC + FISCAL IMPACTS OF SELECTED PLANYC POLICIES

FINAL REPORT

GHG 2012 – PLANYC GHG MITIGATION STUDY + ECONOMIC ASSESSMENT

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AECOM
605 3rd Avenue
New York, NY 10158
www.aecom.com

1. Executive Summary

As an important national and global economic, cultural, tourism and population center, New York City faces a number of challenges related to its long term growth and development. In addition to dealing with a growing population, aging infrastructure, and evolving economy, the city is also committed to the environmental health and wellbeing of the region as an important component of maintaining the city's quality of life and competitive advantage in this global economy.

In an effort to address these issues, the New York City Mayor's Office of Long Term Planning and Sustainability (OLTPS) created PlaNYC, a broad agenda which proactively addresses these issues and plans to "build a greener, greater New York." Initiated in 2007, PlaNYC charts a path to accommodate long-term population and economic growth, while reducing the city's carbon footprint and enhancing quality of life. As a comprehensive strategy, one of PlaNYC's central goals is the reduction of greenhouse gas emissions by 30 percent below 2005 levels by 2030, referred to as the *30x30 goal*.

Of the many initiatives developed under PlaNYC's 30x30 goal, five discrete policies were selected to further understand the economic and fiscal impacts of implementation. The five policies that were identified for analysis are all energy policies that either require or induce commercial businesses and/or households to invest in a series of physical improvements that will result in a reduction in energy usage. These policies include:

1. **Greener, Greater Buildings Plan (GGBP)** – A suite regulations intended to improve the energy efficiency of large buildings.
2. **30x17 Goal for Municipal Operations** – Investments in municipal operations to achieve 30 percent carbon reduction by 2017.
3. **Mayor's Challenge** – Coordinated engagement with hospitals and universities to achieve 30 percent carbon reduction by 2017.
4. **Clean Heat Program** – Regulation eliminating the dirtiest types of building heating fuels.
5. **Rooftop PV Solar Permit Streamlining** – Interagency effort to reduce the time and associated costs of rooftop solar PV project permitting.

In evaluating the policies, three stages of investment and return are considered, explaining why various policies have difference scale of impact:

1. **Capital Outlay** - These costs are considered "one time only" impacts that do not recur on an annual basis, as they are only related to the initial capital outlay. The initial capital investment primarily affects the construction and professional services, and typically results in a short-term boon to the economy.
2. **Opportunity Cost of Local Spending** – The portion of the capital outlay that is paid for by local companies and households. This payment results in an increase in business production costs and a reduction in other household spending. Because this category represents an increase in production costs or reduction of household spending, the economic impacts associated with this phase are typically negative. The larger the local percentage of capital investment, the more negatively the policy impacts economic growth.
3. **Long-Term Operational Shifts and Regional Competitiveness** – This category represents all energy and operational savings that businesses and households accrue as a result of the capital investments. The earlier the investments are made, the earlier participants benefit from savings, and the greater the long term impacts of a policy area. This third phase determines, in large part, the long term economic impacts associated with a given policy.

Together these three stages of investment and return determine the extent to which policies impact the New York City economy. In the Task 2 analysis work, each individual policy was reviewed independently. For the purposes of this executive summary, the results of the five policies are aggregated to show the overall expected impact. Individual highlights are noted as well.

The overarching finding of the analysis is the important role that the policies play in making New York City a more economically thriving and competitive region. While sustainability policies are often criticized for weakening an economy due to their cost of implementation, the analysis demonstrates that this is not the case. In the short term, some of the policies create a dip in economic activity, however, viewed as longer-term strategies, each of the policies results in significant gains in employment, personal income, and GRP.

When evaluated together, by 2030, the five policies result in:

- A net increase of almost **4,400 new jobs,**
- **$760 million in personal income** growth,
- An additional **$750 million to New York City's GRP**, and

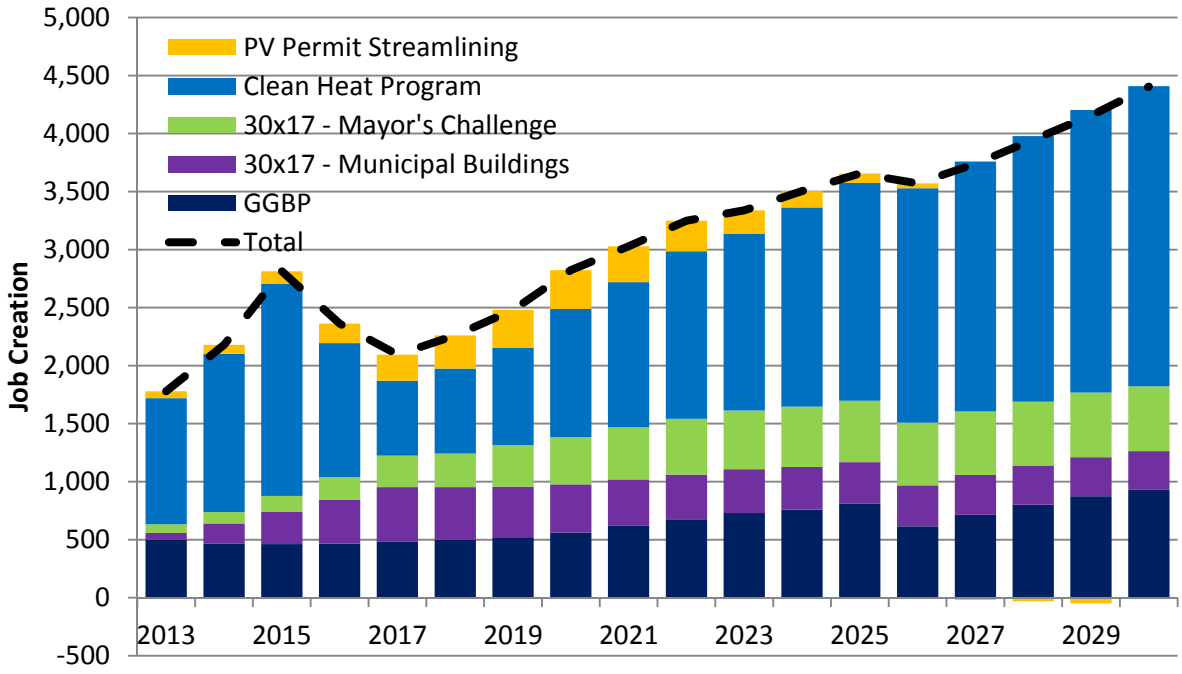
- A **$38 million** increase in **New York City's tax revenue**.

Individually, the key outcomes of the five policies include:

1. **Greener, Greater Buildings Plan (GGBP)** – Increasing energy costs drive up the value of energy efficiency savings associated with GGBP compliance, increasing employment, personal income and GRP at significant levels, with employment increasing by almost 1000 jobs by 2030.
2. **30x17 Goal for Municipal Operations** – By the policy's full implementation in 2017, the 30x17 is expected to result in 450 additional jobs, compared to just 100 additional jobs at the current level of investment.
3. **Mayor's Challenge** – The Mayor's Challenge is expected to result in significant long term operational cost savings, as buildings convert to more energy efficient practices and enjoy accruing benefits. As primary participants include hospitals and universities, the health and education sectors are disproportionately positively affected.
4. **Clean Heat Program** – Increasing conversion to natural gas results in larger initial capital investment as well as larger long term operational savings. A moderate conversion schedule, taking advantage of New York City's natural gas resources is expected to generate over 2,500 new jobs by 2030.
5. **Rooftop PV Solar Permit Streamlining –** The permit streamlining program would shift PV installation to an earlier date, allowing participants to begin enjoying energy savings much earlier. These earlier savings result in an additional $12.7 million being added to New York City's GRP in 2030.

Of the five policies, the Clean Heat Program, GGBP and the 30x17 Mayor's Challenge are expected to have the largest impact on employment growth by 2030. Figure 2 illustrates the individual contribution of each policy to total job creation, and highlights the range among policies.

Figure 1 Total Employment of Five 30x30 Policies (2013-2030)



Source: AECOM

2. Introduction

New York City is an important economic, cultural, tourism and population center nationally and globally. As a large metropolitan area, it faces a number of challenges related to its long term growth and development. These challenges include a growing population, aging infrastructure, a changing climate, and an evolving economy, all of which need to be addressed in order to maintain the city's quality of life and competitive advantage in this global economy.

In order to address these issues, the New York City Mayor's Office of Long Term Planning and Sustainability (OLTPS) created PlaNYC, a broad agenda created to proactively address these issues and "build a greener, greater New York."

2.1 An Overview of PlaNYC

Initiated in 2007, PlaNYC charts a path to accommodate long-term population and economic growth, while reducing the city's carbon footprint and enhancing quality of life. PlaNYC is a comprehensive strategy with 10 discrete sections, 132 initiatives, and 400 specific milestones, addressing topic areas such as Housing and Neighborhoods, Parks and Public Space, Brownfields, Waterways, Water Supply, Transportation, Energy, Air Quality, Solid Waste and Climate Change. As part of PlaNYC, the Mayor's office has worked and coordinated the efforts of over 25 City agencies to integrate work around sustainability goals and practices.

One of the central goals for PlaNYC is the reduction of greenhouse gas emissions by 30 percent below 2005 levels by 2030, referred to as the 30x30 goal. A City study in 2007 found that New York City was responsible for approximately one percent of the nation's greenhouse gas emissions. Progress towards achieving this goal is already being made. By December 2013, over 97 percent of the 127 initiatives in PlaNYC were launched, and almost two-thirds of its 2009 milestones were nearly achieved. In the same time period, New York City had achieved a 16 percent reduction over 2005 emissions. The continued success of the plan will depend on innovative, ambitious policies; luckily the City has a rich history of such policies to build on.

In addition, the City is exploring series of strategies that would achieve an 80 percent reduction in greenhouse gas emissions by 2050 (80x50).

2.2 PlaNYC Economic and Fiscal Impact

The importance of PlaNYC on reducing greenhouse gas emissions is evident. However, PlaNYC initiatives also have broader impacts on the regional economy in New York City. In order to understand how key PlaNYC 30x30 policies will affect the New York City economy, OLTPS retained AECOM to evaluate the economic and fiscal impacts of five PlaNYC initiatives that are central to achieving the 30x30 goal.

The five policies that were identified for analysis are all energy policies that either require or induce commercial businesses and/or households to invest in a series of physical improvements that will result in a reduction in energy usage. These policies include:

- Greener, Greater Buildings Plan (GGBP) – A suite of building regulations intended to cost-effectively improve the energy efficiency of large buildings.
- Clean Heat Program – A set of regulations intended to eliminate the dirtiest types of heating fuel in buildings in New York City, which pose the greatest risk to public health.
- 30x17 Goal for Municipal Operations - Investments and ongoing efforts on the municipal government level to achieve a more aggressive greenhouse gas reduction goal than the city as a whole.
- 30x17 Mayor's Challenge - Coordinated engagement with hospitals and universities to achieve a more aggressive greenhouse gas reduction goal than the city as a whole.
- Rooftop PV Solar Permit Streamlining - Interagency effort to reduce the time and associated costs it takes to usher rooftop solar PV projects through the permitting progress.

2.3 Scope of Work

The scope of work included the following tasks:

- Interviewed a number of key policy managers and stakeholders from City and State organizations.
- Conducted extensive desktop research for policies, including policy structure, expected policy benefits, relevant case studies, and industry standards and assumptions.
- Developed customized models to analyze the capital investment, the opportunity costs and the long term operational cost shifts of each policy.

- Modeled economic impact of the key 30x30 policies, through refined REMI models, evaluating a number of economic indicators including changes employment, gross regional product (GRP), and personal income.
- Developed high level fiscal impact estimates based on changes in industry wages within the New York City economy.
- Developed a high level analysis of the economic impact potential for 80x50 strategies identified in the Task 1 report.

2.4 Report Organization

This report is organized into 10 sections. The overall approach and methodology for the analysis follows this section in Section 2. Sections 3 through 8 present a detailed analysis for each of the key 30x30 policies. Section 9 addresses the fiscal impact of the five policies. An analysis of major components of 80x50 strategies is included as part of Task 1.

2.5 Summary of Findings

The following section briefly summarizes the cumulative economic impact of the five policies explored in greater detail within this report. The policies have varying levels of impact on job creation, personal income and GRP growth within the New York City economy.

One of the overarching findings of the analysis is the important role that the policies play in making New York City a more economically competitive region. While sustainability policies are often criticized for weakening an economy due to their cost of implementation, the analysis demonstrates that this is not the case. In the short term, some of the policies create a dip in economic activity, however, viewed as longer-term strategies, each of the policies results in significant gains in employment, personal income, and GRP.

It is also important to note that the five policies reviewed represent current technical feasibility, economic viability and political acceptability. These factors, as well as a number of externalities, will certainly change over the course of PlaNYC policy implementation, affecting each policy's economic impact.

For the purposes of the results summary, the *moderate scenario* of the Clean Heat Program without the additional health benefits has been evaluated.[1] Results would change if a more conservative or aggressive scenario were implemented.

Overall Findings

Together, by 2030, the five policies[2] result in a net increase of almost 2000 new jobs, $295 million in personal income growth, and an additional $310 million to New York City's GRP.

Table 1 Combined Economic Impact of Five 30x30 Policies (2015-2030)

	2015	2020	2025	2030
Employment (Net new jobs)	2,142	2,972	3,604	4,573
Personal Income (2012$M)	275.3	405.8	681.8	860.1
GRP (2012$M)	144.0	289.0	477.4	648.6

Source: AECOM

In general, the moderate scenario of the Clean Heat Program, with its large capital investment within the next ten years, is responsible for a significant percentage of the expected growth within all three economic impact categories (employment, personal income, GRP). The Greener, Greater Buildings Plan (GGBP) and the 30x17 and Mayoral Challenge policies also contribute heavily to economic growth within New York City.

[1] Three different scenarios were modeled for the Clean Heat Program. The *moderate scenario* reflects 50 percent building conversion by 2020.

[2] For the summary of results, the *moderate scenario* of the Clean Heat Program was selected. Implementing a more conservative or more aggressive conversion program will result in greater or lesser economic impacts.

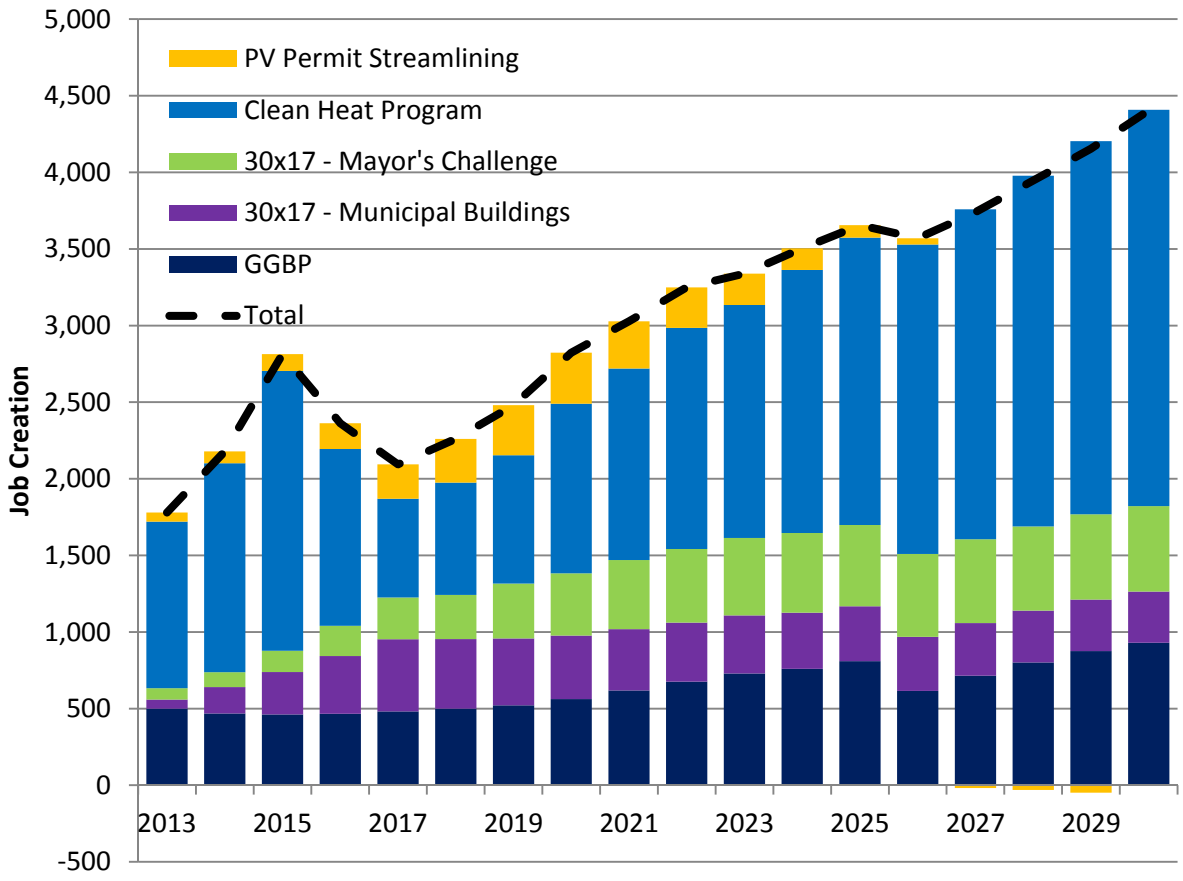
Findings by Category of Impact

The following section reviews job creation, personal income growth and GRP by impact category.

Employment

As clearly shown in Figure 2, the five policies do not evenly contribute to employment growth over the next twenty years. The Clean Heat Program is responsible for over half of the total growth in employment by 2030. GGBP, the 30x17 and Mayoral Challenge policies also, contribute to new employment in the region. This is primarily due to the large capital investments and long term operational cost savings associated with each of the programs. PV Permit Streamlining has much smaller employment impacts compared to the other programs.

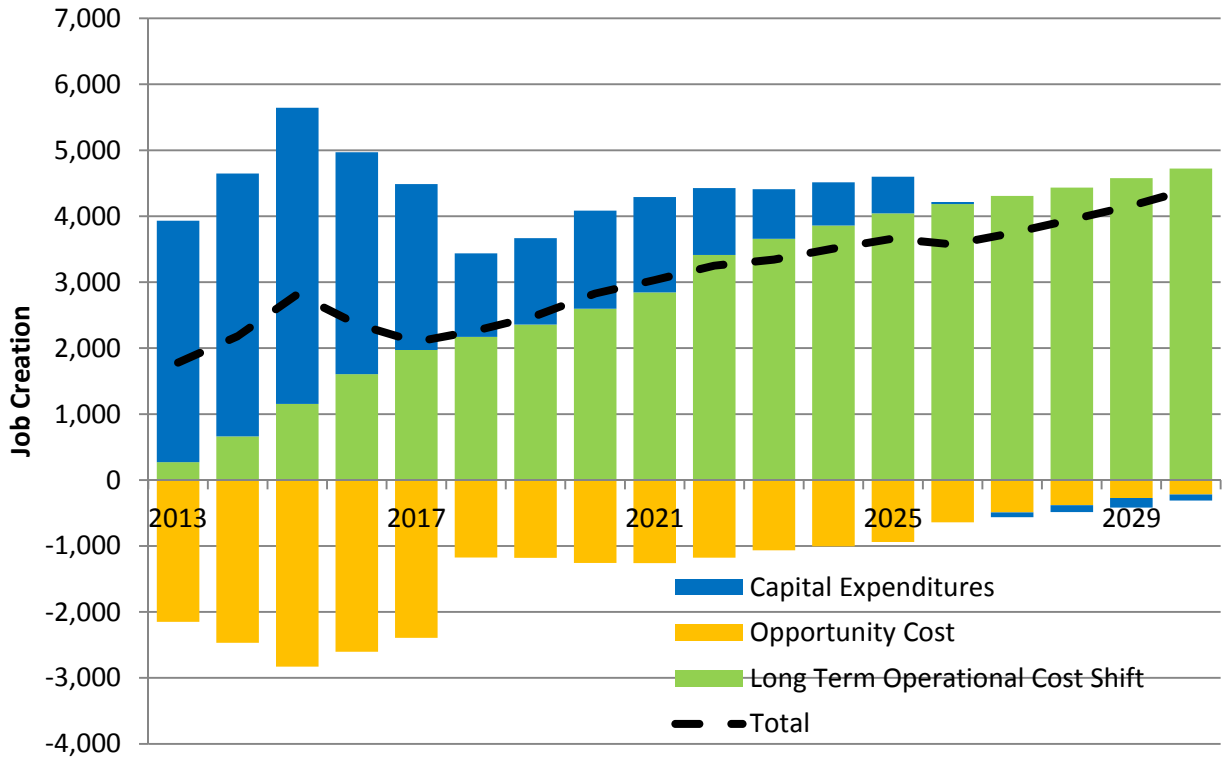
Figure 2 Total Employment of Five 30x30 Policies (2013-2030)



Source: AECOM

As will be described in greater detail in Section 2, the timing of the spending and saving associated with each policy, directly correlates to job creation. Therefore the timing and intensity of job creation is heavily influenced by policy design and implementation. Figure 3 shows that while the initial capital outlay associated with policy investment is an important driver of job growth in the early years, over the long term, the changes in operational spending and savings exert a much larger influence over job growth and retention. While the opportunity costs of invested capital tend to negatively affect job creation, these impacts recede over time as policies are implemented and participants see the benefits of their investments.

Figure 3 Total Employment of Five 30x30 Policies by Impact Category

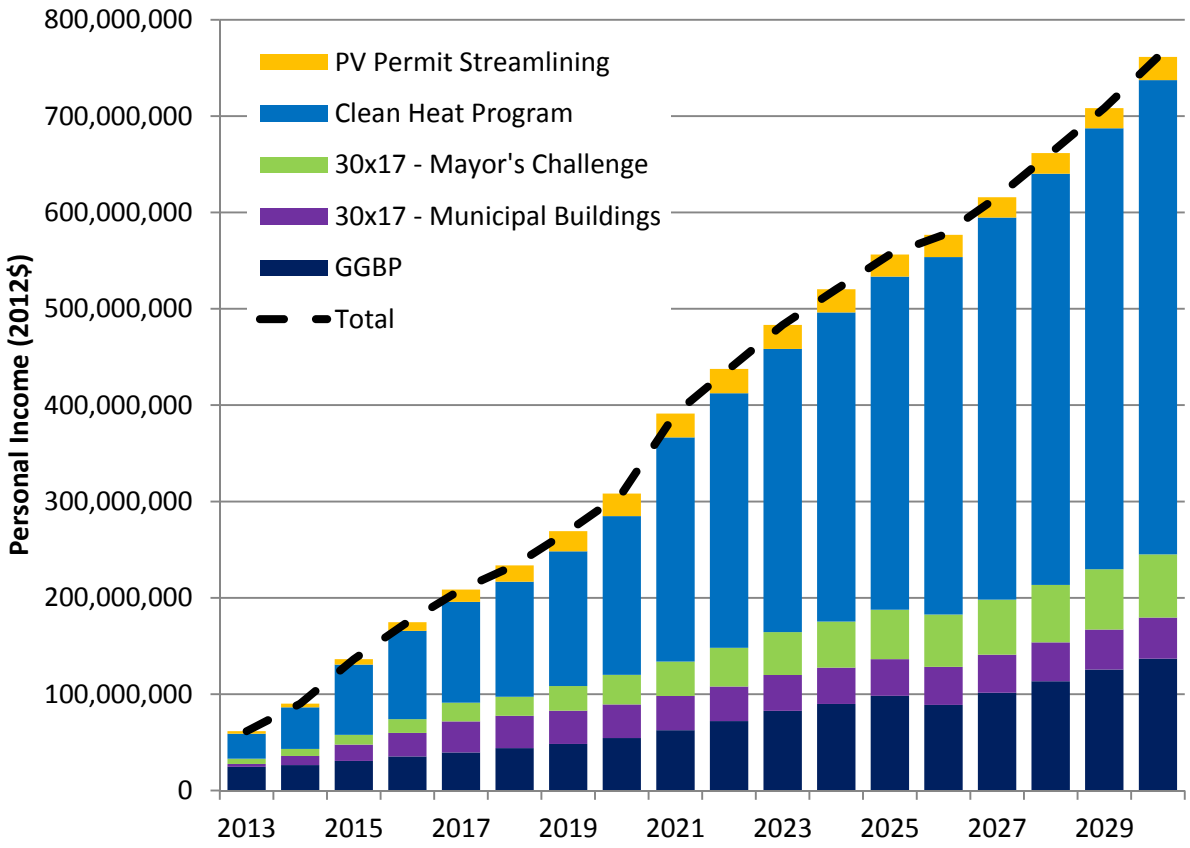


Source: AECOM

Personal Income

The city's personal income has similar significant positive growth over the course of the policies' implementation. Shown in Figure 4, the Clean Heat Program is a significant driver of the personal income growth, accounting for nearly 70 percent of all personal income growth by 2030. The scale of the capital outlay of the Clean Heat Program – both by the private sector and by Con Edison (ConEd) as well as the long term operational savings expected by buildings converting to natural gas are the primary drivers of the growth.

Figure 4 Total Personal Income of Five 30x30 Policies (2013-2030)

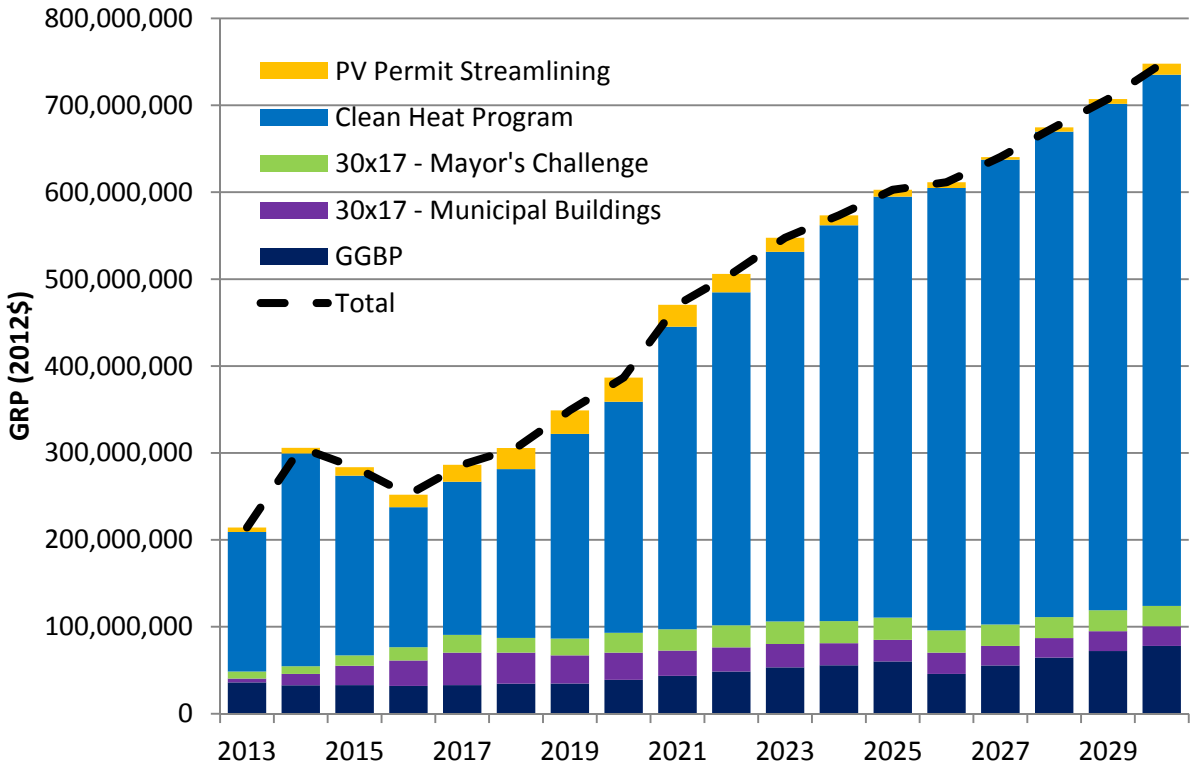


Source: AECOM

Gross Regional Product

Implementation of the five policies is expected to result in an estimated $290 million in net new GRP. As with the other economic indicators, the Clean Heat Program is expected to be a significant contributor, accounting for over 75 percent of new GRP by 2030. GGBP's investments account for almost 12 percent of GRP growth.

Figure 5 Total GRP of Five 30x30 Policies (2013-2030)



Source: AECOM

3. Overall Approach and Methodology

This section presents a summary of the approach and methodology used to estimate the economic and fiscal impacts of the five selected PlaNYC energy policies.

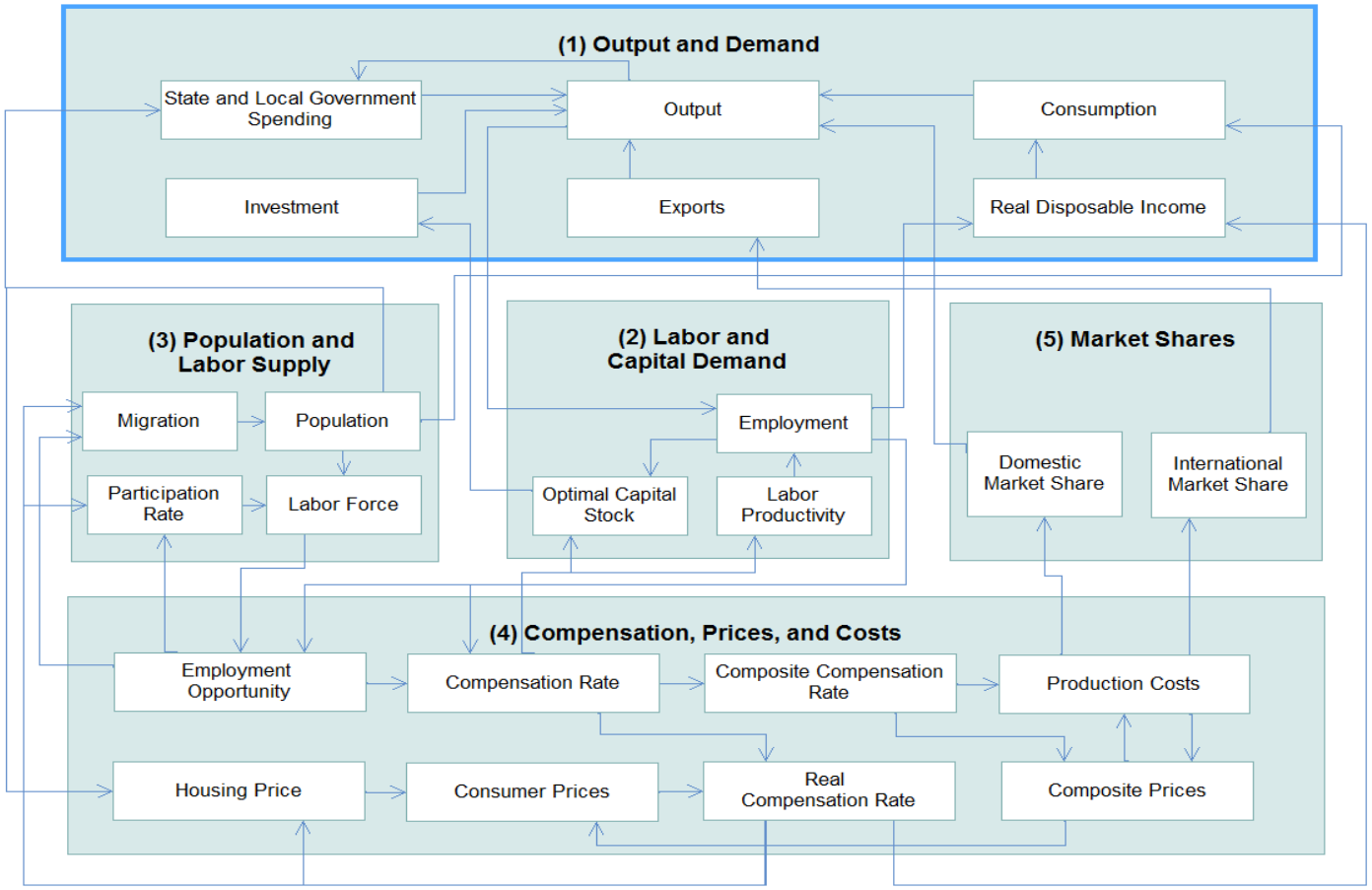
3.1 Description of the REMI Model

Energy improvements create economic benefits in a number of ways. Many traditional economic impact analyses focuses on the employment and additional dollars flowing through the economy based upon the construction and operations of a given improvement. However, the major economic benefits of the PlaNYC energy policies examined within this report are likely to accrue over the long term due to efficiencies resulting from lower energy costs. These efficiencies allow New York firms to be more competitive. In order to capture the comprehensive economic benefits of the five PlaNYC energy policies, AECOM used Policy Insight, a dynamic economic impact modeling system created by Regional Economic Models, Inc. (REMI).

REMI was established in 1980 to respond to the demand for regional forecasting and simulation models. The REMI Insight model is a forecasting and policy analysis model that helps users analyze the impact of public policy initiatives on the economy and population of local regions. The model includes key econometric estimates and integrates inter-industry transactions, long run equilibrium features, and new economic geography.

The Insight model includes: substitution among factors of production in response to changes in relative factor costs; migration responses to changes in expected income and employment opportunity, access to regional and national consumer commodities, and exposure to positive and negative amenities; labor participation rate responses to changes in real wage and employment conditions; wage rate responses to labor market changes; consumer consumption responses to changes in real disposable income and commodity prices; and local, regional, and market shares responses to changes in regional production costs and in agglomeration economics. The output of this model includes such key economic indicators as employment by industry, output and value added by industry, personal income, population, and many more (see Figure 6 for detail on REMI model blocks).

Figure 6 REMI Model Structure



Source: REMI

3.2 Framework for Analysis

- An important part of economic impact assessment is establishing the framework for analysis. The key assumptions related to the economic impact analysis are: Geographic Area - The geographic area is a key component of any economic impact analysis. The analysis of the PlaNYC policies examines the economic impacts on one region – the City of New York, which includes the five boroughs.
- The time frame of analysis is from 2011, when most policies began, through 2030, when most policies are complete. Most results in this report are shown in five year increments, depending on the expected time frame and phasing of the policy.
- Base Case – The base case scenario is always important to consider in any economic impact framework. The base case for the analysis assumes that the PlaNYC policies and regulations being evaluated do not exist.

3.3 Components of Economic Impact

The total economic impact of the proposed PlaNYC 30x30 strategies is a result of many factors. While each of the five policies examined affects different industry sectors, they are all somewhat similar in the core components that drive their impact on the New York City economy. The components of the economic impacts considered are described in this section.

Capital Outlay: "One-Time Only" Construction Impacts

All of the policies either require or induce some type of initial investment or capital outlay. Examples for each policy are as follows:

- Greener, Greater Buildings Plan – Building owner audit and electricity and lighting system upgrades for buildings over 50,000 square feet.
- 30x17 Municipal Buildings – Government spending on energy efficiency upgrades to government buildings.
- 30x17 Mayor's Challenge – Participating institutional organization spending on energy efficiency upgrades.
- Clean Heat Program – Building upgrades and improvements to fuel-burning heating systems. Additionally results in new natural gas infrastructure investment.

- PV Permit Streamlining – Residential, commercial and investor installation of rooftop solar PV systems.

The initial capital investment primarily affects the construction and professional services sectors and is modeled in REMI as exogenous final demand. The REMI model allocates the spending based upon assumptions related to the capacity of the industries in New York City to meet the demand and leakage of costs on components of the total cost.

These costs are considered "one time only" impacts that do not recur on an annual basis, as they are only related to the initial capital outlay. However, since most of these policies are implemented over a number of years, the construction period is fairly lengthy.

Opportunity Cost of Local Spending

Unlike major transportation projects with federal funding, most of the PlaNYC 30x30 initiatives examined as part of this analysis are partially paid for by local dollars. In order to accurately measure the true economic impact of these policies, it is important to account for the opportunity cost of any local spending.

- For residential households, the spending reflects a reallocation away from other consumer expenditures.
- For commercial businesses and property owners, the capital outlay results in a temporary decrease in their production efficiency – this is modeled in REMI as an increase in production cost, or as a decrease in income, dividends, or rent.

However, not all of the capital investment is likely paid for by local dollars. Due to the complex nature of building ownership in New York City, including the presence of many multinational firms and property owners with shareholders all over the world, only a percentage of the capital investment required represents a true opportunity cost for alternative spending in New York City. For each policy, the percentage of capital expenditure was estimated which reflects an opportunity cost for otherwise locally spent dollars, based upon the following factors:

- Overall program design and targeted buildings;
- Residential versus commercial buildings;
- Ownership versus rental tenancy;

- Tenant characteristics;
- Likely lease structure;
- Local / non-local ownership; and
- Involvement of real estate investment trusts (REITS) or other real estate investment vehicles.

Long Term Operational Shift and Regional Competitiveness

All five policies result in a change in ongoing operational costs related to energy. For most of the policies, there is a resulting decrease in energy costs which translates to a reduction in production costs for industries and an increase in spending in other consumption categories for households.

The lower production cost has an important impact on the economy, resulting in a fundamental economic shift towards greater regional competitiveness. With lowered production costs, the industries become more competitive, allowing them to expand their market share to meet demand within and outside the region. Expanding market shares result in greater industry output and, therefore, employment required to produce the output.

The one policy that is an exception is the Clean Heat Program, as in the short term industries experience an increase in energy costs due to the use of more expensive fuel types.

Other Benefits

There are a number of benefits associated with the reduction in greenhouse gas emissions, including reduced risk to human health and welfare and decreased impacts on the climate. While these can certainly translate to economic impacts, the benefits will accrue to a larger or different geographic area than New York City, which is the region of analysis for this study. Therefore, for the most part, the analysis of these benefits is not included.

The Clean Heat Program is again the exception, since the use of cleaner fuel types and natural gas will result in a number of localized health benefits and fewer premature deaths. Since these benefits are measurable and localized within the region of analysis, they are included in the analysis. More detail is provided in Section 8, but the health benefits generally have the following economic impacts:

- A decrease in demand for services from hospitals and the healthcare industry;
- An increase in labor productivity resulting from the days of work not missed due to health problems; and

- An increase in the number of lives saved, modeled using the REMI amenity variable.

REMI Non-Pecuniary Amenity Variable

The REMI model includes a non-pecuniary amenity variable that captures the increased attractiveness of the region due to quality of life. Households may be motivated to migrate into regions whose amenity value increases, as this enhances the comparative attractiveness of those regions. From another standpoint, regions whose amenity values improve can pay workers comparatively lower salaries than regions with stagnant amenity values. This captures an economic concept called the "compensating differential." As a consequence, a policy that effectively reduces these non-pecuniary costs stimulates in-migration to the region or reduces out-migration, and the model will capture this dynamic over the course of the forecast period.

3.4 Major Assumptions

The analysis is predicated on the following major assumptions:

- The 30x30 policies are in various stages of development and implementation. The analysis is based on current understanding of the policies as currently envisioned. Any changes in specific implementation or policy components would likely change the estimates.
- There were varying amounts of data specific to the 30x30 policies available. For those policies with limited data, industry factors or standards were used to estimate inputs and impacts. Impacts are projected through 2030. The analysis is based upon a long term economic baseline that does not assume any major incidents or natural disasters that could significantly disrupt the economy.
- All estimates are in 2012 constant dollars and do not include inflation.
- All numbers and inputs come from City departments unless otherwise indicated.

4. Greener, Greater Buildings Plan

4.1 Policy Overview

The Greener, Greater Buildings Plan (GGBP) was signed into law in late 2009 with the goal of improving energy efficiency in buildings larger than 50,000 square feet in New York City. These larger buildings account for only two percent of the number of buildings in the city, but represent 50 percent of total building square footage and generate nearly 45 percent of the city's greenhouse gas emissions.

To encourage greater energy efficiency, the GGBP includes four regulatory components supplemented by job training and opportunities, and a financing entity called the New York State Energy Efficiency Corporation (NYSEEC). The regulatory pieces include:

- Local Law 84: Requires annual benchmarking of energy and water consumption
- Local Law 85: Establishes New York City's local energy conservation code
- Local Law 87: Requires an energy audit and building retrocommissioning once every 10 years
- Local Law 88: Requires the lighting in nonresidential space be up to code and large commercial tenants to be provided with submeters by 2025.

The components of the GGBP requiring the most significant investments by the private sector, and directly leading to the most significant savings are Local Laws 87 and 88.

Local Law 87

Local Law 87 requires a Level II ASHRAE energy audit and building retrocommissioning to be performed once every 10 years. Details related to energy audits and building retrocommissioning are as follows:

- Energy audits provide cost-effective energy-saving strategies, with detailed costs and savings estimate for energy consumption throughout a building.
- Retrocommissioning examines more specifically central building systems, such as heating, cooling, and ventilation systems, ensuring that equipment is working as intended and fine-tuning equipment to optimize performance.
- A retrocommissioning contractor also typically provides guidance to building operations and maintenance staff on the proper maintenance of central systems.
- Given the similar timing of the audit and retrocommissioning requirements (once every 10 years), and the overlap between audit and retrocommissioning (central systems that are

retrocomissioned typically comprise a significant portion of building energy), property owners are likely to conduct auditing and retrocommissioning simultaneously or in close succession.

Local Law 88

LL 88 has two key components, the submetering of tenant spaces lighting upgrades to bring the lighting up to the New York City Energy Conservation Code (NYCECC) standards. Additional details are as follows:

- Submetering is required of tenant spaces larger than 10,000 square feet, and tenants must be provided with monthly electricity consumption data.
- Submetering, like energy audits, doesn't explicitly create energy savings but it does provide tenants and property owners the information they need to make informed operating decisions. In particular, submetering is a major step forward to providing tenants with the information they need to reduce electricity consumption. Many buildings depend on a single meter to monitor electricity consumption, and as such, bill non-residential tenants a standard percentage of total building energy use regardless of the tenant's actual consumption. Individual tenants would likely reduce their energy consumption if energy use information were made available to them regularly.
- If owners go one step further and not only submeter space and provide usage data, but also bill tenants accordingly, tenants themselves will be able to benefit from any energy savings they are able to achieve through the smart use of energy efficient appliances, and encouraging energy efficient behavior at the tenant level, rather than spreading those savings across all tenants within a building.
- The lighting component of the GGBP requires all non-residential spaces to be brought up to the lighting portion of the energy efficiency code by 2025. Overall, lighting upgrades must meet current new standards for maximum lighting power allowances, lighting controls, tandem wiring, exit signs, and exterior lighting. There are two paths to compliance with the code: prescriptive or performance-based. Compliance with the prescriptive path is demonstrated by specific lighting controls and equipment. Compliance with the performance-based path is demonstrated by achieving a specific maximum installed lighting power intensity per square foot. This maximum varies by property type, for commercial office spaces it is 1.1 W/sq. ft. That is to say, there can be no more than 1.1 watts worth of lighting power installed per square foot within a tenant space.

Overview of Buildings Impacted

The GGBP applies to all parcels with one or more buildings larger than 50,000 square feet, and all parcels with two or more buildings with combined square footage exceeding 100,000 square feet. An example of the latter category would be a parcel with five 40,000 square foot buildings for a combined square footage of 200,000 square feet. Each individual building does not exceed 50,000 square feet but the parcel as a whole exceeds 100,000 square feet, and thus is required to comply with the GGBP.

The vast majority of commercial, industrial, institutional, government and multi-family buildings subject to the above requirements must comply with the audit and retrocommissioning components of the GGBP, with a few exceptions:

- Buildings without central systems that have separate heating and cooling elements in each individual unit or space;
- Landmarked buildings and houses of worship;
- Buildings with various combinations of LEED certifications and points; and
- Buildings built within 10 years of the date of compliance.

Estimate of Square Footage

The current estimate of square footage for buildings that must comply with the GGBP is 2.1 billion square feet. This estimate is based on the New York City's 2012 Covered Buildings list, identifying buildings that must comply with the benchmarking requirement of Local Law 84 and an analysis of the Primary Land Use Tax Lot Output (PLUTO) database (referred to as the GGBP/PLUTO database). Since many buildings in New York City are mixed use, it is important to understand not only the general land use of a building, which is often based on the zoning of a specific parcel, but the variety of uses within buildings.

An analysis of the GGBP/PLUTO database was able to provide such detail. As shown below in Table 2, the commercial square footage affected by the GGBP is distributed throughout a broad range of primary building use types.

Table 2 Greener, Greater Building Plan Square Footage by Use

Primary Building Use	Millions of Square Feet
Commercial	410
Industrial	110
Retail	80
Public / Institutional	240
Residential	1,270
Total	**2,110**

Source: PLUTO, OLTPS, AECOM.

4.2 Categories of Economic Impact

As outlined in the methodology section, there are three major components that drive the economic impact of the GGBP policy on the New York City economy.

Capital Expenditures

Audit & Retrocommissioning

Typical costs for audit and retrocommissioning are estimated at $0.30 per square foot for non-residential space and $0.25 for residential space, or $180/dwelling unit.[3] While some buildings may be exempt from the audit requirement based on a lack of central systems, it is assumed that the incremental cost to comply with the alternative requirements is in-line with the audit costs.

Submetering & Lighting Upgrades

Typical costs for submetering were estimated at $4,000 per submeter; the monthly cost of providing tenants with data on electricity consumptions is assumed to be marginal and not requiring additional staff or expenditures.[4] A series of assumptions were made related to these upgrades, as follows:

[3] These estimates were based on conversations with NYSERDA staff, AECOM Energy, and the NYC Green Codes Taskforce Report, as well as work from Task 1.

[4] These costs are based on conversations with AECOM Energy, interviews with property owners, and Urban Green Council's Cost of Green report.

- It is assumed that submetering occurs in 10,000 square foot increments in commercial and industrial spaces.
- Retail spaces, which are typically directly metered by utilities, are assumed not to require additional submeters.
- It is assumed that 50 percent of tenant spaces in New York City are already submetered.
- There may be fewer submeters required in public and institutional buildings, since they are less likely to lease out or have multiple sublease spaces. Rather than calculating on a per square foot basis, it is assumed that each public / institutional building requires one additional submeter.

Given the two paths to compliance with the lighting retrofit component of GGBP (prescriptive versus performance-based paths), an estimate of $2 per square foot was used for the cost of compliance. This assumption is intended to cover a range of experiences, some of which may be more expensive and others which may be more affordable.

While there isn't a source for information on the square footage of spaces which are already up to code, space that was built or has undergone substantial renovation recently can be assumed to be code compliant or at least requiring only marginal retrofitting. An analysis of the GGBP buildings in the PLUTO database since 2006 indicates that an estimated 15 percent of total non-residential square footage would fall into this category, four percent of public/institutional square footage, and five percent of residential units.

Opportunity Cost of Local Spending

As described in the methodology section, some of the dollars used to pay for the GGBP capital expenditures are locally funded and represent an opportunity cost for other expenditures.

The capital investment required for all of the GGBP building upgrades, audits, and retrocommissioning will affect a number of industries:

- A wide mix of industry sectors that typically utilize office space in New York City;[5]

[5] AECOM developed a customized "office space" set of industries to reflect the industries that typically use office space in New York City. The impacts were then distributed amongst these industries in equal proportion to their relative share of employment.

- Property owners, in the form of real estate investment trusts or other similar investment vehicles, some of which may be local and some of which may have a broad geographic base of shareholders; and
- The public / institutional sector, which includes hospitals, educational facilities, government buildings, cultural and public assembly spaces, hotels, and religious buildings.

It is assumed that the cost of compliance, modeled in REMI as a decrease in production cost, is primarily distributed across buildings in equal proportion to their square footage in the GGBP/PLUTO building database.

For each subcategory of building type, a series of assumptions was made related to the percentage of capital expenditures which would represent an opportunity cost to the local economy.

Long Term Operational Cost Shift and Regional Competitiveness

The building improvements required as part of the GGBP results in an ongoing reduction in annual energy costs.

Audit and Retrocommissioning

While energy audits are integral to providing property owners with the information they need to make smart decisions about the performance and energy efficiency potential of their property, audits in and of themselves do not create energy savings. As such, this element of the GGBP was not assumed to have a savings impact.

Retrocommissioning does have the potential to reduce energy costs and is estimated to be 6.5 percent of HVAC-related costs in the first year.[6] However, the potential for lower energy costs due to retrocommissioning savings can vary widely. Furthermore, retrocommissioning savings are assumed to decline every year as the initial improvements made through retrocommissioning slightly abate. As a result of this decline in savings, over the course of seven years the average annual reduction in energy costs resulting from retrocommissioning are estimated to be 3.6 percent.

[6] Source: NYC Green Codes Task Force Report and AECOM.

Based upon Con Edison reports[7], the annual HVAC cost for commercial and public/institutional space across all of New York is estimated to average s $2.64 per square foot, with approximately 55 percent of that expense coming from fuel costs, 30 percent from electricity, 10 percent from natural gas, and five percent from steam.

In the first year of retrocommissioning, a reduction in energy costs of $0.18 per square foot is assumed, with a seven year average annual reduction of $0.105 per square foot.

Submetering

In the same way that specific energy savings were not applied to energy audits, specific energy savings are not applied to submetering either. However, it is important to note that lighting-related savings may be even more pronounced if tenants are occupying submetered space and if property owners go one step further and not only submeter space and provide electricity consumption data, but also bill tenants accordingly. When some technologies like lighting controls are used, user behavior can increase the magnitude of energy savings and billing tenants for their actual electricity consumption may induce some behavior change.

Lighting

It is estimated lighting retrofits can reduce electricity costs by 33 percent.[8] It is estimated that current average lighting-related expenditures[9] are approximately 2.78 kWh per square foot, which includes a variety of commercial and institutional uses, including theaters, retail space, hospitals, and schools, which have different lighting preferences and requirements. Given current retail electricity prices of $0.17 per kWh, this equals an average lighting-related cost of $0.47 per square foot. A 33 percent reduction translates to a decrease in costs of $0.16 per square foot annually.

4.3 Summary of Economic Impact

The following section summarizes the economic impact of the GGBP, including a breakdown of findings by category and detailed employment impacts by sector.

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[7] Con Edison's Energy Efficiency Potential Study, volumes 2-5
[8] This estimate was based on the NYC Green Codes Task Force report and Task 1 estimate of the savings potential of lighting controls
[9] Con Edison's Energy Efficiency Potential Study, volume 2

Overall Findings

Over the course of the next 17 years, from 2013 to 2030, it is estimated that the GGBP (i.e. Local Laws 87 and 88) will create an additional 400 to 900 jobs annually, with an average of 630 jobs per year between now and 2030.

Personal income increases as well, generating a total of $136 million annually in additional personal income for New York City residents by 2030. GRP also increases over the baseline from approximately $32 million in 2015 to over $77 million to 2030.

Table 3 GGBP Total Economic Impact (2015-2030)

	2015	2020	2025	2030
Employment (Net new jobs)	462	565	614	930
Personal Income (2012$M)	$30.7	$54.5	$98.2	$136.7
GRP (2012$M)	$32.8	$38.9	$60.0	$77.9

Source: AECOM

Findings by Category of Impact

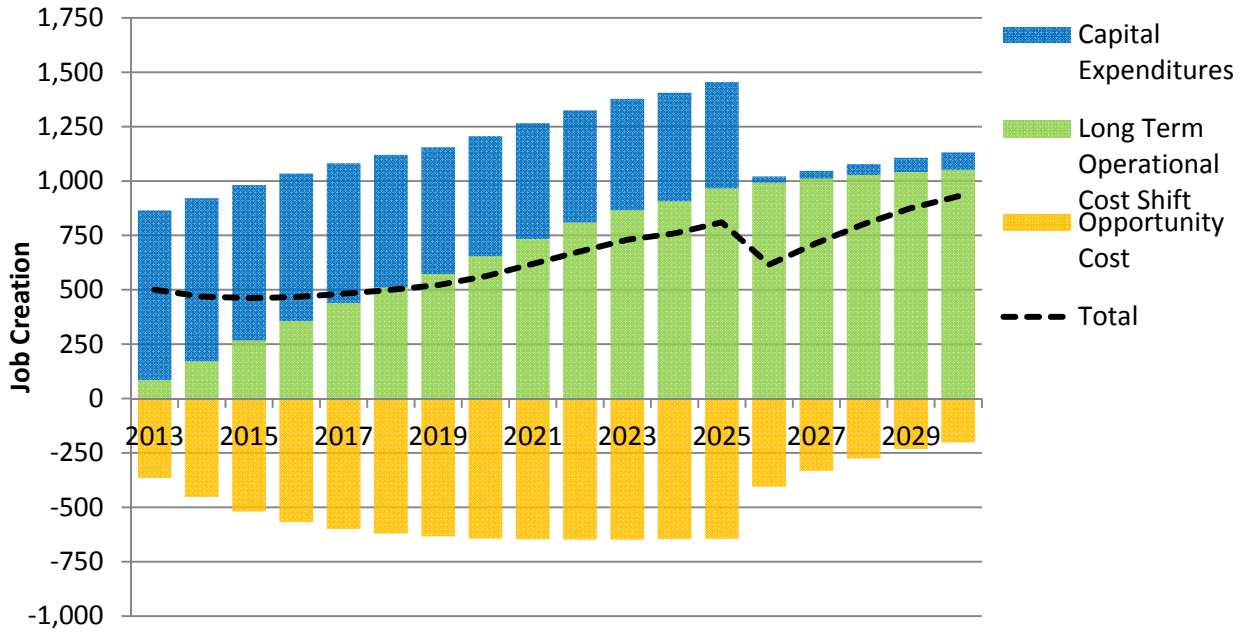
The following section reviews job creation, personal income growth and GRP by impact category.

Employment

Year-to-year variations in job creation are shown in Figure 7 and are driven by the following factors:

- Timing of capital outlays - Audit and Retrocommissioning requirements take place once every ten years, while Submetering and Lighting Upgrades have a set endpoint at 2025. As expenditures related to Submetering and Lighting Upgrades sunset in 2025, jobs are shed in the following years.
- Scale of energy savings – Reduction in energy costs accrue at a compounding rate, as the efficiency improvements resulting from investments in previous years continue to generate savings for businesses and residents. For example, by year 2015 there are savings benefits from the investments made in 2013 and 2014, in addition to those made in 2015.
- Increasing energy prices - The effect of efficiency gains from retrocommissioning and lighting upgrades is amplified as energy prices increase. By 2025 the annual capital outlays has stabilized, as submetering and lighting upgrades cease, and the square footage being retrocommissioned annually is constant. However, the total amount of savings each year increases along with energy prices.

Figure 7 Total GGBP Job Creation (2013-2030)

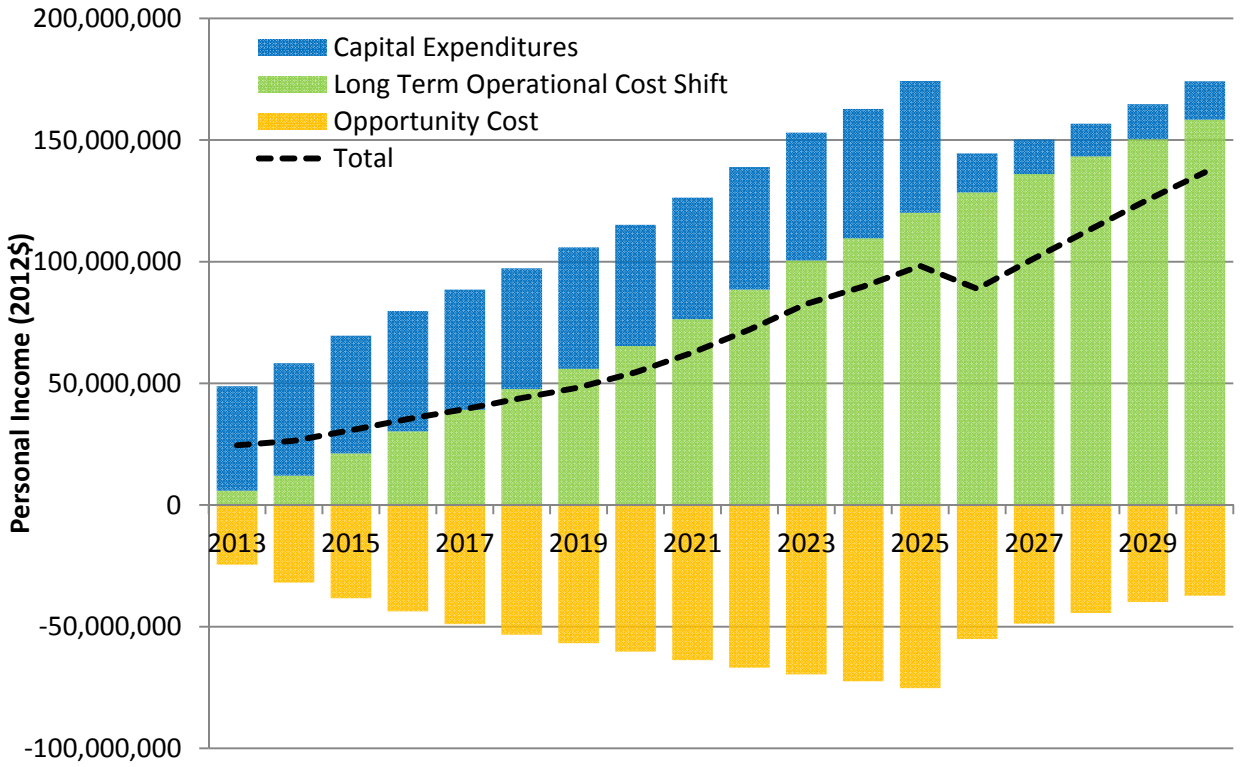


Source: AECOM

Personal Income

GGBP is expected to generate an additional $137 million of personal income in New York City by 2030. As Figure 8 shows, just as with employment, the bulk of the growth in personal income may be attributed to the long term operational cost shift associated with the program.

Figure 8 GGBP Impact on Personal Income (2013-2030)

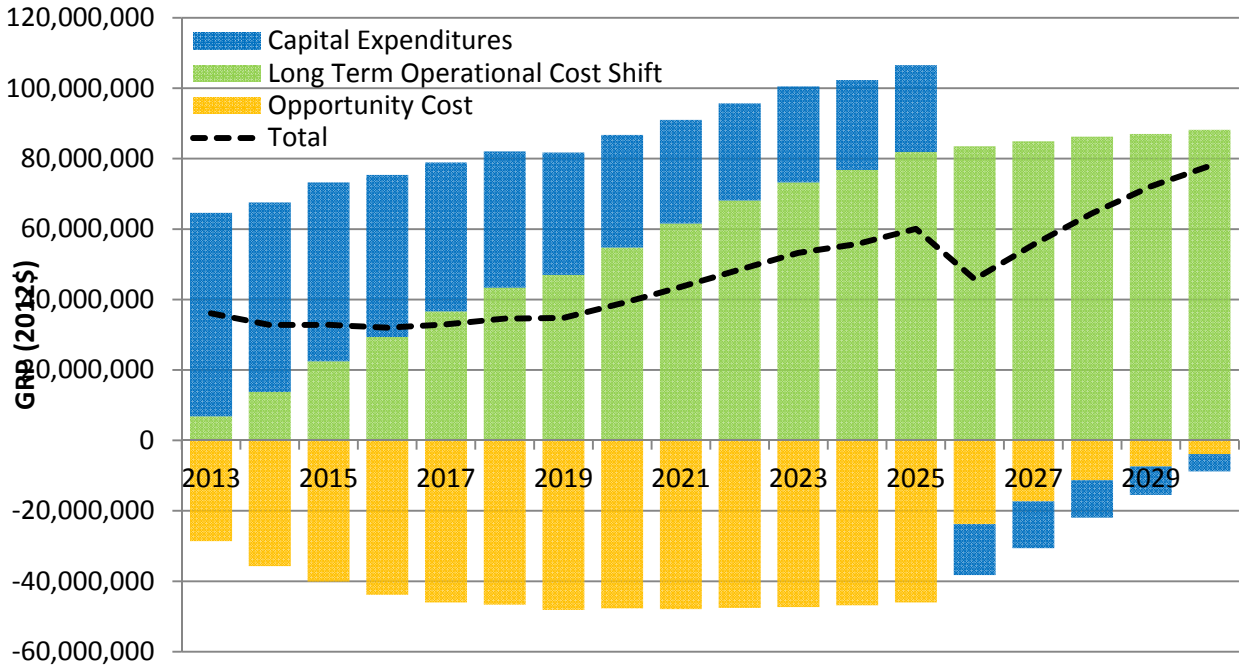


Source: AECOM

Gross Regional Product

GGBP results in a positive growth for the New York City economy as measured by GRP. As shown in Figure 9, GRP in the city is expected to increase by roughly $77 million.

Figure 9 GGBP Impact on Gross Regional Product (2013-2030)

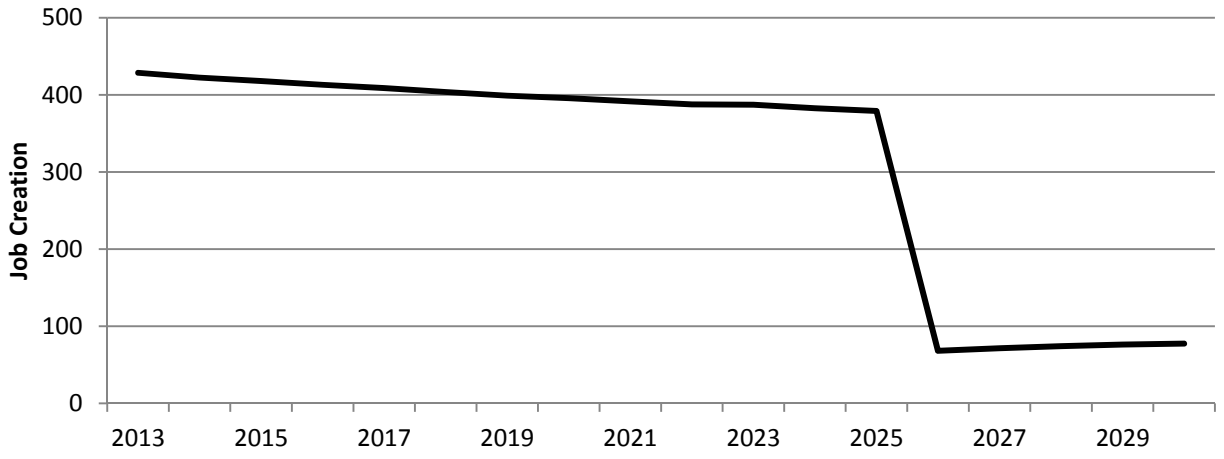


Source: AECOM

Employment Impacts by Sector

As jobs enter and leave the economy, they are distributed across different industry sectors. The largest industry experiencing growth is the construction industry, as contractors are hired to provide audit and retrocommissioning services, install submeters and perform lighting upgrades. Between 2013 and 2030, between 60 and 430 construction-related jobs are estimated to be created annually by GGBP, with a cumulative total 5,500 construction jobs. The decline in construction jobs in 2025 is due to the sunset of the submetering and lighting upgrade requirements.

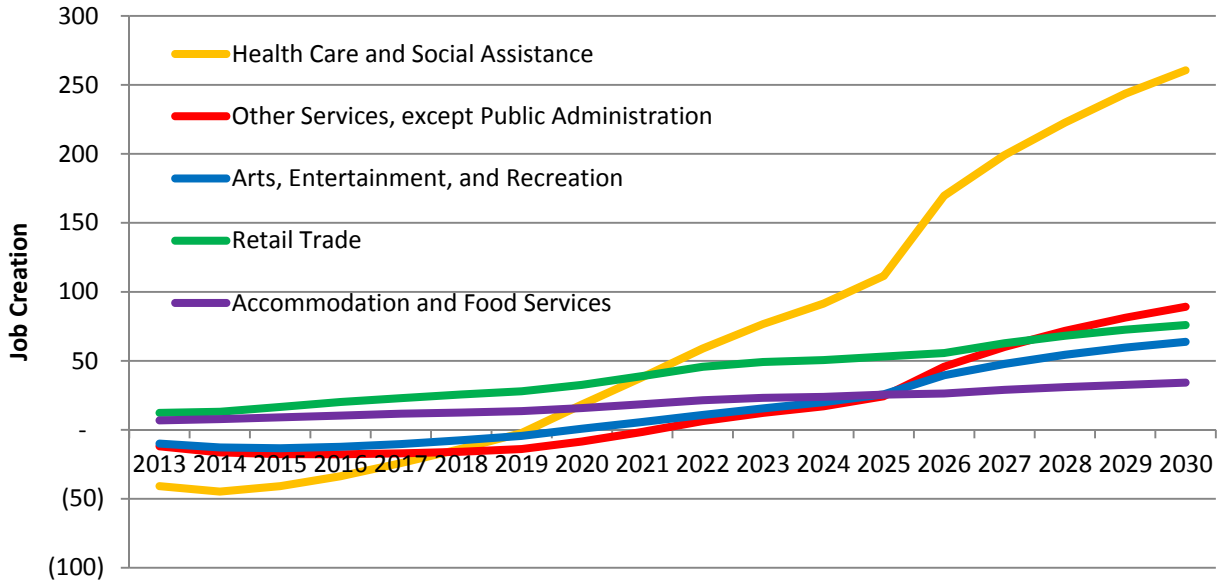
Figure 10 Total GGBP Jobs in the Construction Industry (2013-2030)



Source: AECOM

While initial capital outlay primarily supports the Construction and Building Engineering industries, the benefits from ongoing savings accrue to a diverse group of industries, as shown in Figure 11. These include Health Care and Social Assistance, Retail, and Accommodations. Figure 11 outlines change in employment in the top five industries outside of the Construction industry. Over 250 jobs in Health Care and Social Assistance are created in 2030. This is due in large part to the significant medical square footage impacted by the Greener, Greater Buildings Plan.

Figure 11 GGBP Job Creation in Key Sectors (2013-2030)



Source: AECOM

5. 30x17– Municipal Operations

5.1 Policy Overview

A central component of PlaNYC is 30x30, a roadmap for reaching a 30 percent reduction from 2005 citywide emissions by 2030. As part of PlaNYC, the City of New York has also pursued a more aggressive goal for the reduction of municipal emissions by 30 percent by 2017, referred to as the 30x17 goal. This effort is managed by the Department of Citywide Administrative Services Energy Management group (DEM), whose responsibilities include:

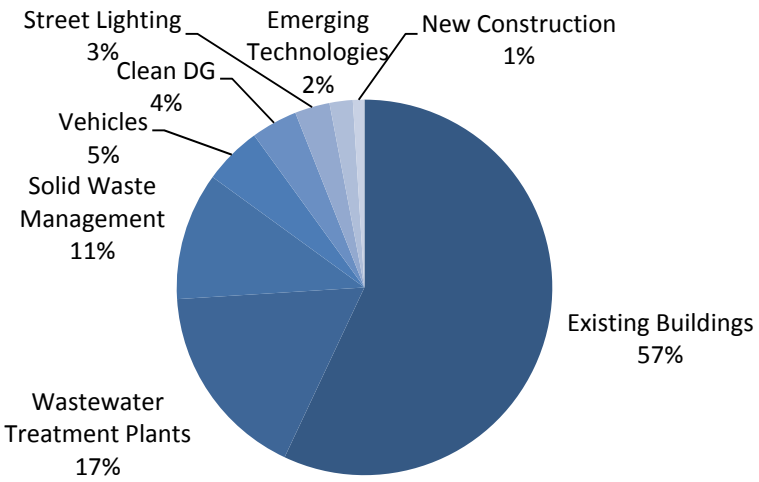
- Handling electricity, natural gas and steam accounts serving 80 agencies and more than 4,000 buildings, the Health and Hospitals Corporation, CUNY, New York, Brooklyn and Queens public library systems, and 34 cultural institutions.
- Developing the Heat, Light and Power budget for City agencies, in collaboration with the City's Office of Management and Budget.
- Overseeing the City's energy efficiency initiatives.

In order to achieve the 30x17 goal, DEM has developed strategies around building energy efficiency, clean and renewable energy and vehicle fleets. DEM is also working closely with other agencies, such as the Department of Environmental Protection (DEP) to realize other GHG reductions, such as methane capture at waste water treatment plants. A majority of greenhouse gas emission reductions are anticipated from retrofits, replacement and the improved operations and maintenance of existing buildings. Investments in wastewater treatment plants and solid waste management are also key contributing areas. While building efficiency projects play a key role, they are not enough to get the City all of major reductions that are needed, rather, a range of projects and programs are needed. These include:

- Laundry facility upgrade on Riker's Island.
- A comprehensive energy efficiency retrofit at the Department of Sanitation's 26th St. repair garage.
- Solar array at the NYC Hall of Science.
- Solar rooftop PV at the 114th precinct station.
- Addition of 70 new electric vehicles, purchased in part through grant funding provide by the Department of Energy and NYSERDA.

The distribution of GHG reductions by project area is presented in Figure 12 below, highlighting the diversity of investments.

Figure 12 Distribution of Anticipated 30x17 GHG Reductions



Source: Department of Energy Management

Progress to Date

Currently, the City is investing approximately $60 million annually in the 30x17 projects. However, a recent analysis of the current GHG inventory of municipal operations conducted by DEM indicates that the City is not investing at a high enough rate to meet the goal. At the current rate of investment, approximately $60 million per year, it would take the City 25 years to meet its 30 percent reduction goal. In order to reach the 30x17 goal, $300 million is needed annually over the next five years. While this figure represents the amount of money needed to reach the 30x17 goal, it is important to note that additional funding would be required to sustain this reduced carbon impact beyond 2017. This marginal amount has not been incorporated into the analysis.

5.2 Categories of Economic Impact

Capital Expenditures

The capital outlay for 30x17 comes in the form of equipment purchases like plug-in vehicles, energy services like building retrocommissioning, and construction renovation projects like lighting retrofits. Since these spending estimates are only preliminary and will ultimately reflect a diverse mix of projects and initiatives, spending was attributed to the local government sector rather than a specific industry.

Opportunity Cost of Local Spending

In prior years the government funds required to pay for the equipment purchases and services associated with 30x17 have come from local, state and federal sources. In particular, funds were made available as a part of the ARRA stimulus package. However, going forward, DEM does not anticipate significant funding opportunities from federal sources. Rather, DEM anticipates funding for 30x17 to come from local government sources. Since these funds are therefore not net new to the region, the spending represents a shift in local government spending. Monies that would have been spent elsewhere within local government are diverted to energy efficiency projects. As such, every dollar that is spent on 30x17 projects is assumed to come from a reduction in local government spending in some other area. It should be noted that this is a conservative assumption since in the past, 30x17 has benefited from other funding sources such as federal and state grant programs.

Long Term Operational Cost Shift and Regional Competitiveness

The investments made as a part of the 30x17 initiatives will result in an ongoing reduction in energy costs that will benefit the City over the long term. Based on the savings observed in past 30x17 projects, DEM estimates an approximately 10 year payback period for investments, which reflects an average across all 30x17 projects. Based on this payback assumption, it is estimated that the reduction in annual energy costs will be $30 million in year one and increase an additional $30 million each year until 2017, at which point it will stabilize and accrue at a constant rate of $150 million per year. An estimate of the annual savings as a result of 30x17 projects is included in the table below.

Table 4 Estimated 30x17 Savings 2013 - 2020, 2025, 2030

Year	2013	2014	2015	2016	2017	2018	2019	2020	2025	2030
Annual Savings (2012$M)	30	60	90	120	150	150	150	150	150	150

Source: DEM, AECOM.

5.3 Summary of Economic Impact

The following section summarizes the economic impact of 30x17, including a breakdown of findings by category and detailed employment impacts by sector.

Overall Findings

The City's 30x17 investments will create an average of 350 jobs annually in New York City through 2030.

Additionally, personal income increases each year, reaching a high of $31 million in 2020 and then gradually stabilizing around $22.5 million in 2030. The New York City GRP is $42 million higher than without the 30x17 investment in 2030, as shown in Table 5 below.

Table 5 30x17 Total Economic Impact (2015-2030)

	2015	2020	2025	2030
Employment (Net new jobs)	277	416	358	331
Personal Income (2012$M)	$22.0	$31.3	$25.1	$22.5
GRP (2012$M)	$16.6	$34.8	$37.9	$42.3

Source: AECOM

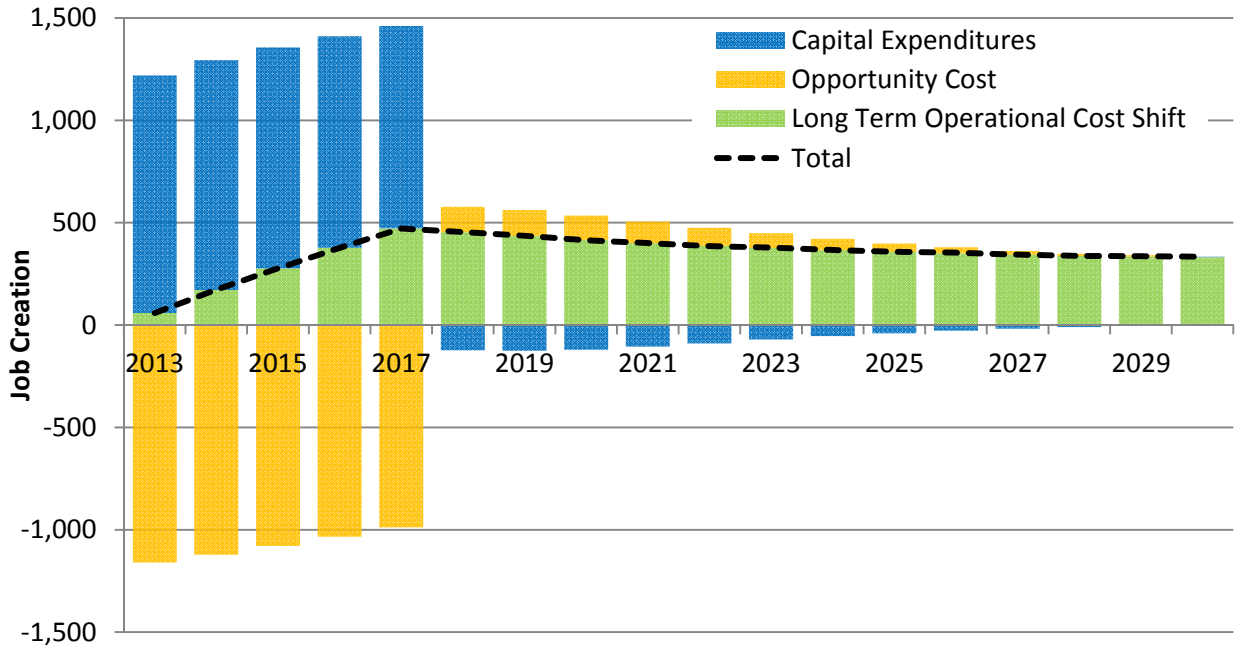
Findings by Category of Impact

The following section reviews job creation, personal income growth and GRP by impact category.

Employment

At its peak, in 2017, there is the potential to create approximately 470 jobs, as shown in Figure 13 below. This amount declines slightly year over year, stabilizing at around 350 jobs by 2050.

Figure 13 30x17 Job Creation (2013- 2030)

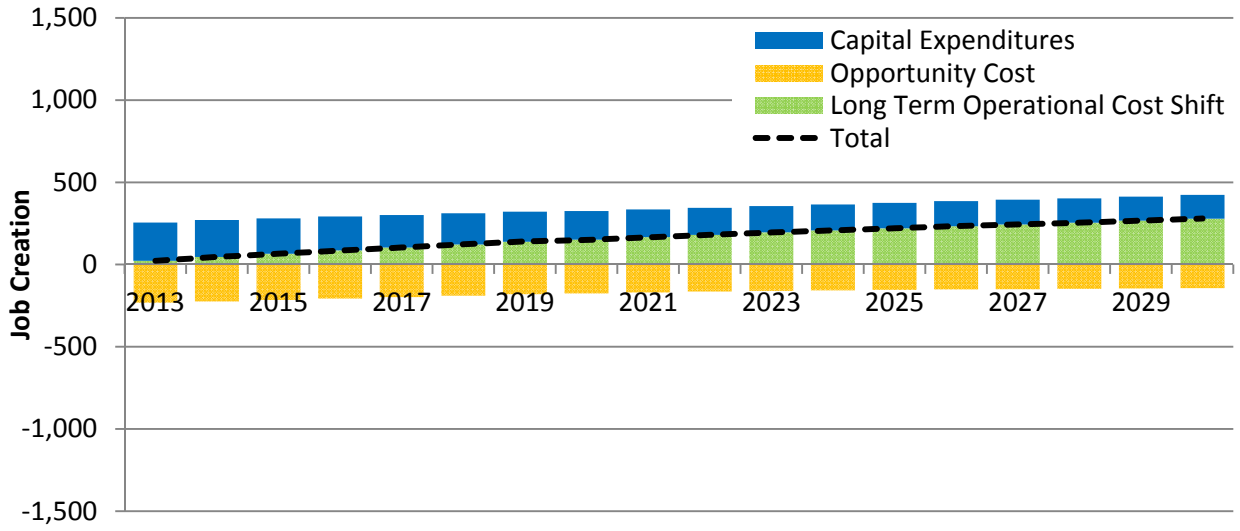


Source: AECOM

Employment Impact of Current Investment Levels

It is important to recognize that the job creation potential of 30x17 depends on providing adequate funding to make the necessary investments. At the current funding levels of $60 million per year, only 100 jobs would be created in 2017, as shown in Figure 14. While this number increases every year, it only reaches approximately 280 jobs in 2030. As savings accrue at a slower rate, the job creation potential slows as well.

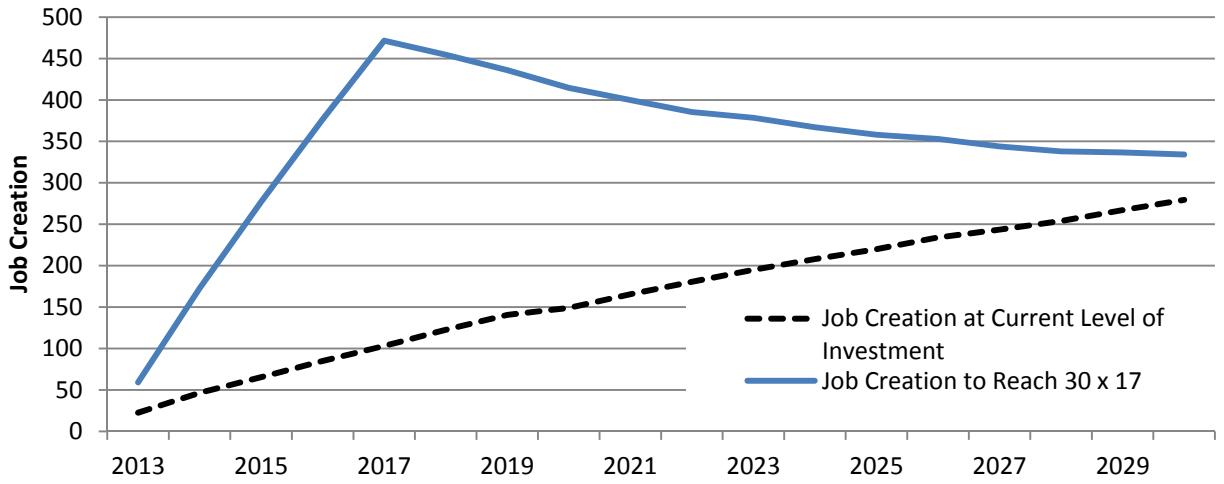
Figure 14 Job Creation at Current Level of Investment (2013-2030)



Source: AECOM

The investment required to meet the 30x17 goal results in an average of 180 additional jobs in the New York City economy per year. As shown in Figure 11 the job creation difference between these two scenarios is particularly significant during the peak of the capital outlay phase of the program in 2017, when the 30x17 investment creates an additional 370 jobs.

Figure 15 Job Creation Potential of 30x17 Compared to Current Level of Investment (2013-2030)



Source: AECOM.

Results of this analysis indicate that in all years, more jobs will be created if the 30x17 goal is reached. This finding is particularly pronounced in the near-term, as city government and the economy as a whole benefit from earlier capital investments and quicker realization of savings. Over the course of this period, as many as 370 additional jobs are created in an individual year if the 30x17 goal is reached, as shown in Table 6 below.

Table 6 Job Creation of 30x17 Compared to Current Level of Investment, 2013 to 2017

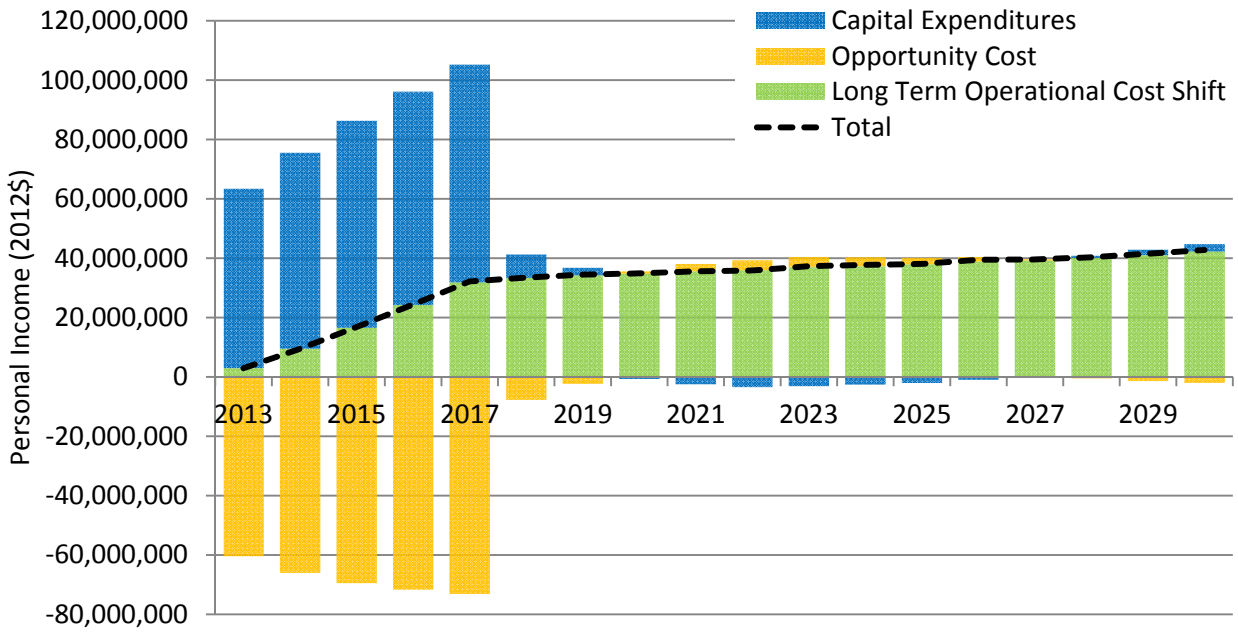
	2013	2014	2015	2016	2017
Job Creation - 30x17	59	173	277	377	472
Job Creation - Current Level of Investment	23	47	66	85	103
Difference Between 30x17 and Current Level	36	126	211	292	369

Source: AECOM

Personal Income

30x17 is expected to generate an additional $2.5 million of personal income in New York City by 2030. As Figure 16 illustrates, personal income growth generally levels off after 2017, with only slight growth through 2030.

Figure 16 30x17 Impact on Personal Income (2013-2030)

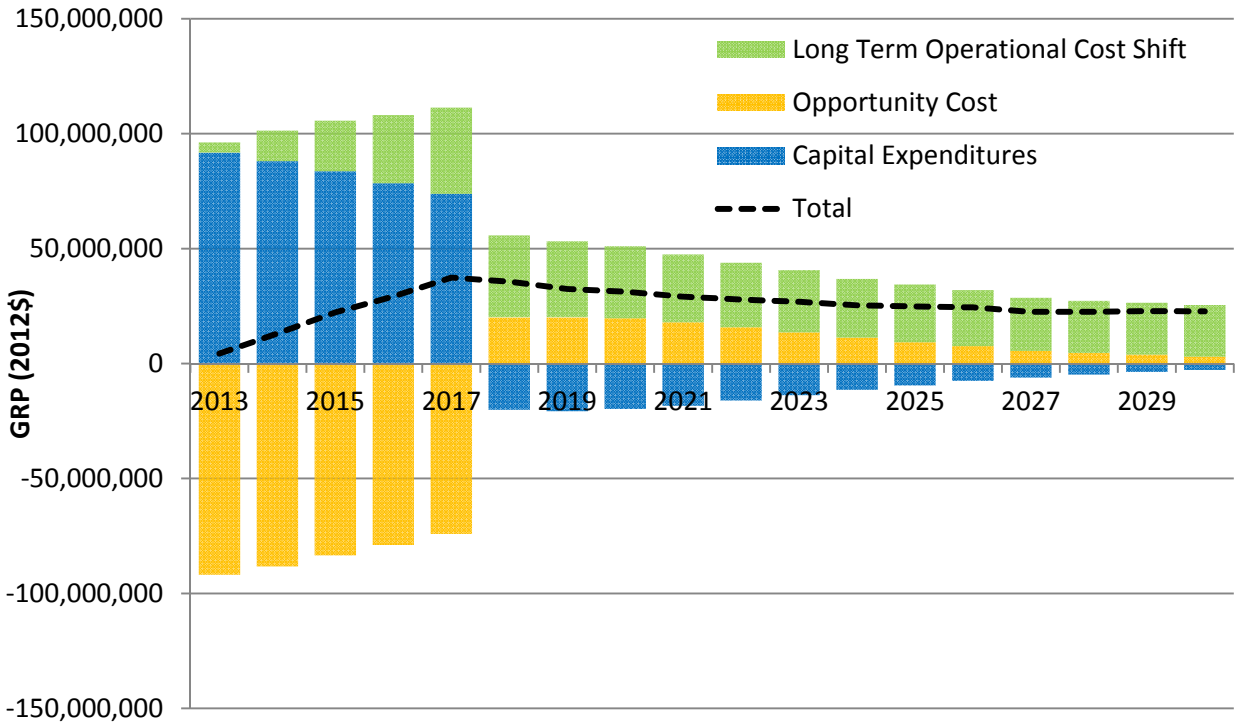


Source: AECOM

Gross Regional Product

30x17 results in a positive growth for the New York City economy as measured by GRP. As highlighted in Figure 17, while GRP continues to grow between 2013 and 2017, its growth tapers off, ending in expected increase by roughly $23 million in 2030.

Figure 17 30x17 Impact on Gross Regional Product (2013-2030)



Source: AECOM

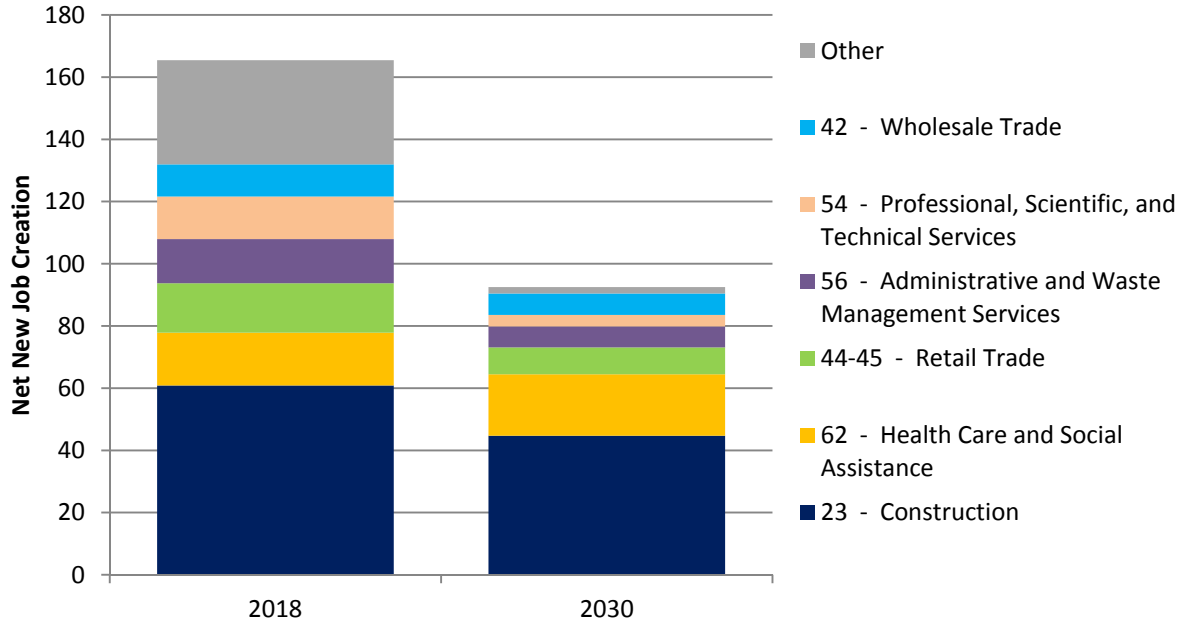
Employment Impacts by Sector

Employment impacts by sector are fairly consistent for the 30x17 initiative. Employment by key sector in the peak employment year (2018) and 2030 is presented in

Figure 18. Note, this analysis highlights employment in the private sector and does not take into account employment in the public sector which may be the result of increased local government spending. Key industry sectors that are impacted are as follows:

- Construction jobs experience the greatest increase, peaking at an increase of 60 jobs in 2018 and falling to 44 jobs by 2030.
- Key sectors that experience an increase of 10 jobs or more in 2018 include: Health Care and Social Assistance, Retail, Administrative and Waste Management, Wholesale and Professional and Technical Services.

Figure 18 30x17 Employment by Sector (2014, 2030)



Source: AECOM

6. 30x17 Mayor's Carbon Challenge

6.1 Policy Overview

The Mayor's Carbon Challenge encourages private sector participation in meeting a 30 percent reduction from 2005 emissions by 2017, similar to the City's 30x17 municipal efforts already underway. The Challenge focuses primarily on the universities, hospitals, and Broadway theaters. Thus far, 30 hospitals and universities accounting for approximately 120 million square feet have accepted the Challenge and are working towards this ambitious goal. Progress towards this goal is tracked through individual climate action plans and GHG inventories.

Participating universities include:

- Barnard College
- Berkeley College
- City University of New York
- Columbia University in the City of New York
- The Cooper Union for the Advancement of Science and Art
- Fashion Institute of Technology
- 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

Participating hospitals include:

- Continuum Health Partners
- Health and Hospitals Corporation
- Lutheran Medical Center
- Maimonides Medical Center
- Memorial Sloan-Kettering Cancer Center
- Montefiore Medical Center
- The Mount Sinai Medical Center
- New York Hospital Queens
- New York Presbyterian Hospital

- North Shore-Long Island Jewish Health System
- New York University Langone Medical Center

6.2 Policy Impact

Capital Expenditures

To estimate the economic impact of the energy efficiency investments made by universities and hospitals, the City surveyed a sample of the institutions participating in the Mayor's Carbon Challenge initiative on the project investments and the savings they had realized. Institutions reported projects including lighting retrofits, boiler improvements, efficient chillers, and pipe re-insulation. While typical costs per square foot varied from project to project, the average cost per square foot was $1.44. Combining this information with institutional square footage, annual capital outlays and savings from 2013 to 2030 were projected.

Opportunity Cost of Local Spending

To estimate conservatively where funding to pay for the energy efficiency investments made as a part of the Mayor's Carbon Challenge came from, it was assumed that universities and hospitals paid for these projects from existing budgets paid for locally. These payments effectively increased the production costs of these universities and institutions.

Long Term Operational Cost Shift and Regional Competitiveness

Savings per square foot were estimated based on the same survey of institutions participating in the Mayor's Carbon Challenge that served as the foundation for the estimate of capital expenditures. In the same way that capital expenditures varied from project-to-project, savings per square foot varied as well averaging out to $0.44 per square foot. From 2013 to 2030, these savings decreased the production costs of universities and institutions.

6.3 Summary of Economic Impact

The following section summarizes the economic impact of the Mayor's Carbon Challenge, including a breakdown of findings by category and detailed employment impacts by sector.

Overall Findings

Given the significant savings that institutions have been able to achieve as a part of the Mayor's Carbon Challenge, the economic benefits of the program are significant. By 2030, the number of jobs created

each year as a part of the Mayor's Carbon Challenge stabilizes around 550. Not only are there substantial employment gains, but personal income and GRP increase steadily year-over-year as well, as shown below in Table 7.

Table 7 Mayor's Carbon Challenge (2015-2030)

	2015	2020	2025	2030
Employment (Net new jobs)	139	407	531	558
Personal Income (2012$M)	$10.3	$30.7	$51.3	$65.6
GRP (2012$M)	$12.1	$22.9	$25.7	$23.3

Source: AECOM

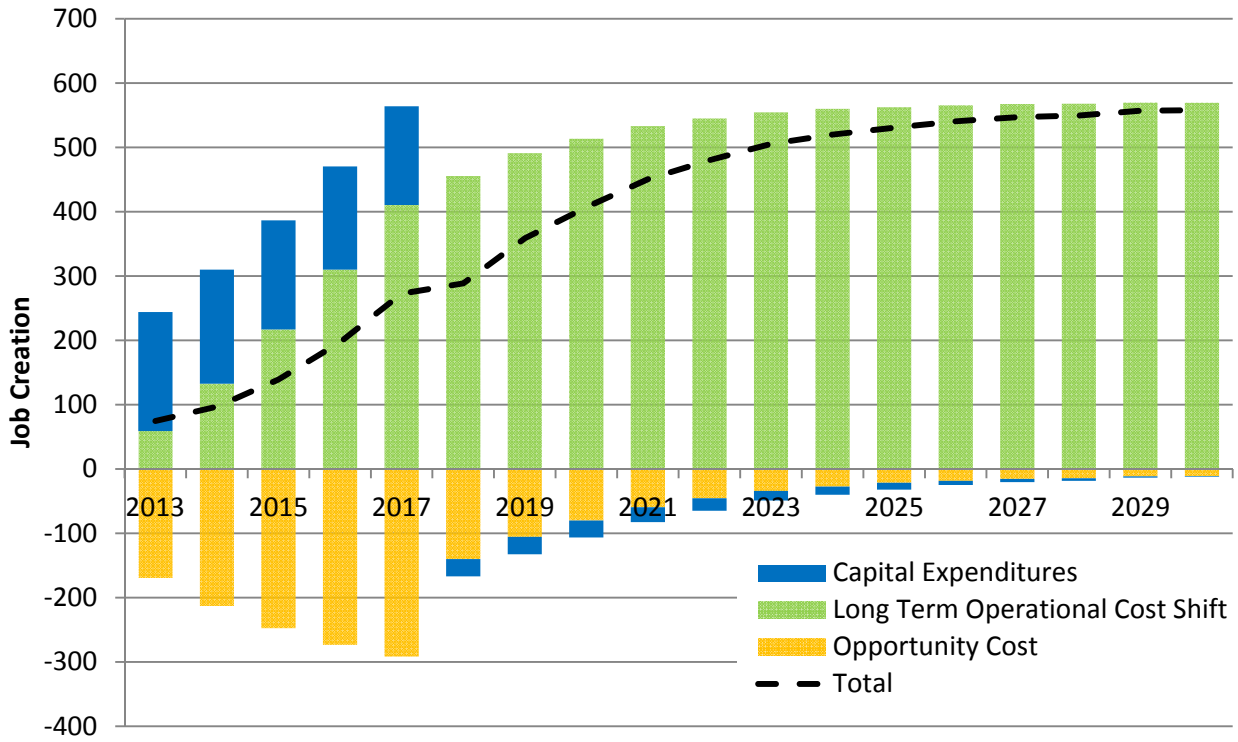
Findings by Category of Impact

The following section reviews job creation, personal income growth and GRP by impact category.

Employment

While the initial outlay of funds to pay for investments made as part of the Mayor's Carbon Challenge, the payment for these investments, and the ensuing savings are all key components of the overall economic impact of the Mayor's Carbon Challenge, the savings component is especially important. This is highlighted in Table 8.

Table 8 Mayor's Carbon Challenge Job Creation (2013- 2030)



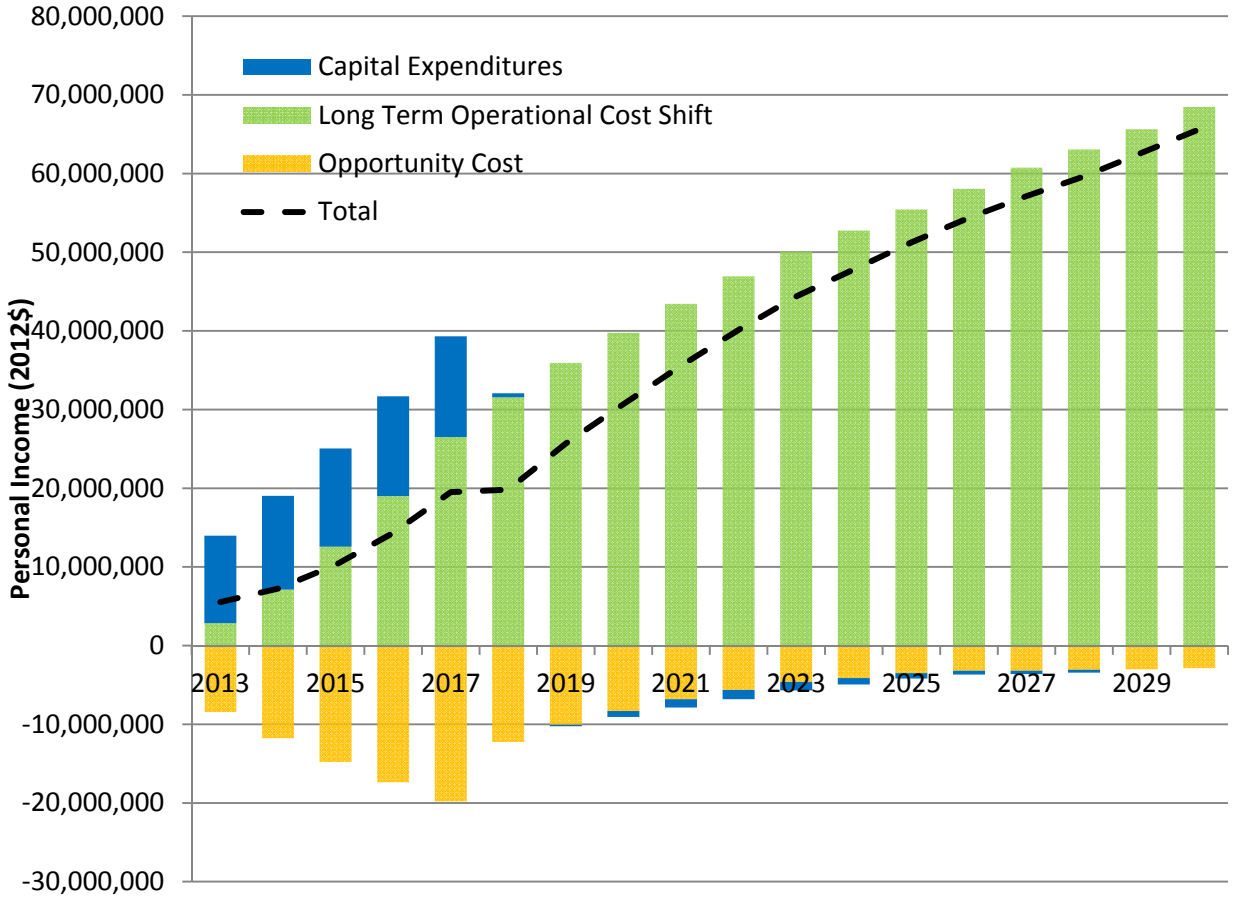
Source: AECOM.

Put simply, the essential economic benefit of the Mayor's Carbon Challenge is that hospitals and universities in New York City become more efficient, and are able to do more with less. This improves their regional competitiveness, and they are able to expand at a higher rate. For New Yorkers, this means additional job opportunities, an increase in personal income, and a more productive regional economy.

Personal Income

The Mayor's Carbon Challenge is expected to generate an additional $66 million of personal income in New York City by 2030. As Figure 19 shows, while personal income levels off at 2017, it continues to rise through 2030, as the negative impacts of the long term opportunity costs wane.

Figure 19 Mayor's Carbon Challenge Impact on Personal Income (2013-2030)

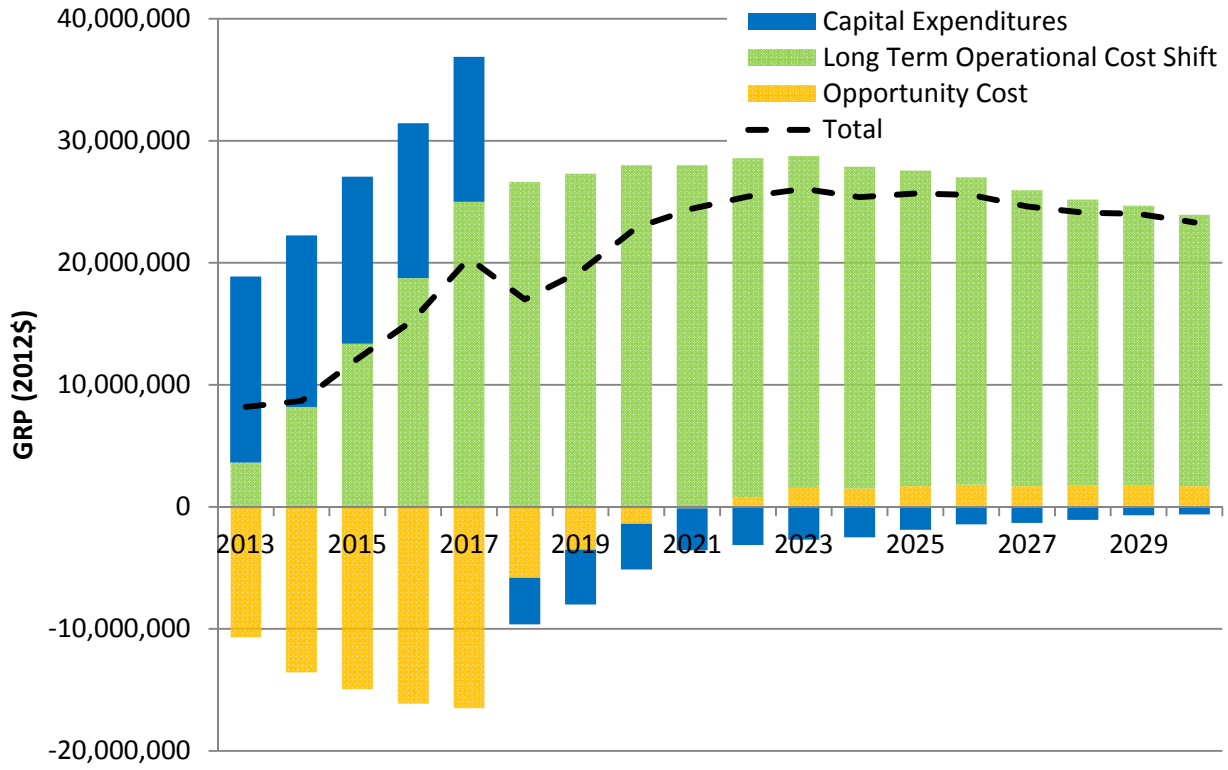


Source: AECOM

Gross Regional Product

The Mayor's Carbon Challenge results in a positive growth for the New York City economy as measured by GRP. As shown in Figure 20, GRP in the city is expected to level off at roughly $23 million above the baseline by 2030.

Figure 20 Mayor's Carbon Challenge Impact on Gross Regional Product (2013-2030)



Source: AECOM

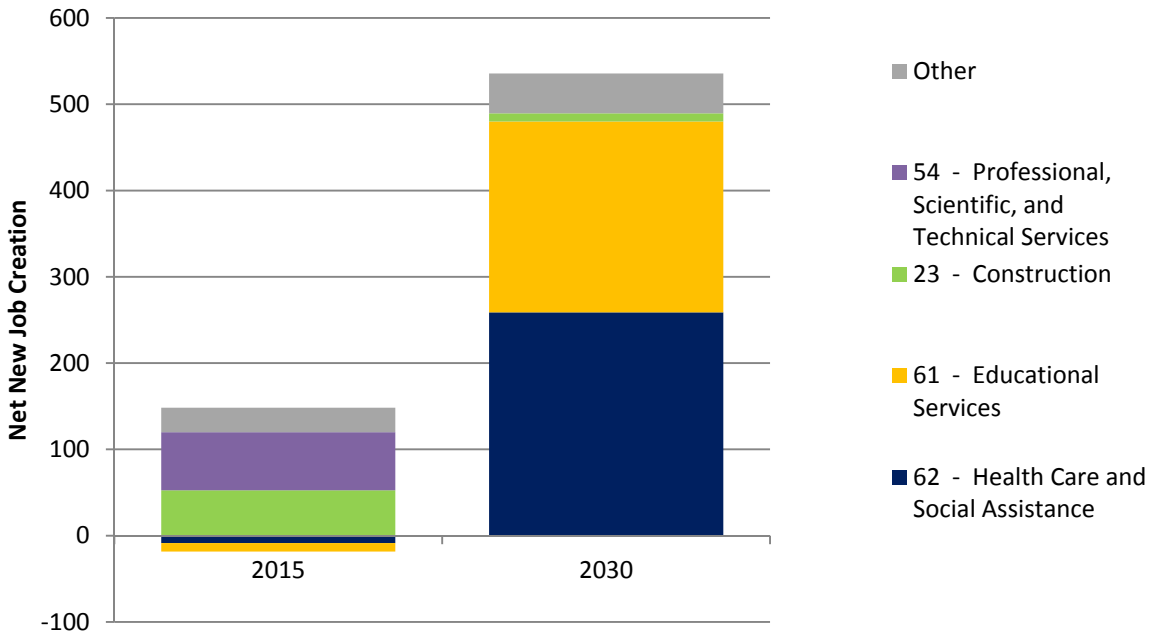
Employment Impacts by Sector

Employment impacts by sector for the Mayor's Carbon Challenge are most significantly felt by the Health Care and Social Assistance and the Educational Services sectors. This is to be expected, given the fact that these sectors align with the universities and hospitals that participate in the Mayor's Carbon Challenge. Employment by key sector is presented in

Figure 18, highlighting job creation by sector in the short-term (2015) and long-term (2030). Key industry sectors that are impacted are as follows:

- Construction jobs experience the greatest increase in the short-term, with 52 additional jobs in 2015. As investments related to the Mayor's Carbon Challenge decline after 2017, jobs in the Construction sector similarly decline.
- As savings accrue to hospitals and universities participating in the Mayor's Carbon Challenge, these institutions become more productive and increase employment in the Education and Health Care sectors in the long-term.
- Another contributing factor to job gains in the Education and Health Care sectors is that these sectors are particularly labor intensive. As output in these sectors increase, more employees are needed.

Figure 21 Mayor's Carbon Challenge Employment by Sector (2015, 2030)



Source: AECOM

7. Clean Heat Program

7.1 Policy Overview

The New York City Clean Heat Program is a series of regulations passed by the Department of Environmental Protection in early 2011 which mandate the conversion of buildings burning #6 and #4 fuel oil to cleaner heating sources.

Currently in New York City, an estimated 13,000 buildings[10] continue to burn the two dirtiest types of heavy heating fuel oil- #6 and #4. Both of these fuels contain a number of impurities that make it difficult for them to burn completely. As a result, when burned, these two types of fuels emit large quantities of fine particulate matter (PM) pollutants into the environment, particularly PM2.5, which causes serious respiratory diseases. Conversion of these buildings to cleaner heating sources is expected to reduce the total amount of PM2.5 by more than 60 percent, and subsequently results in significant health benefits for New York City residents.

The Clean Heat Program is comprised of two major components:

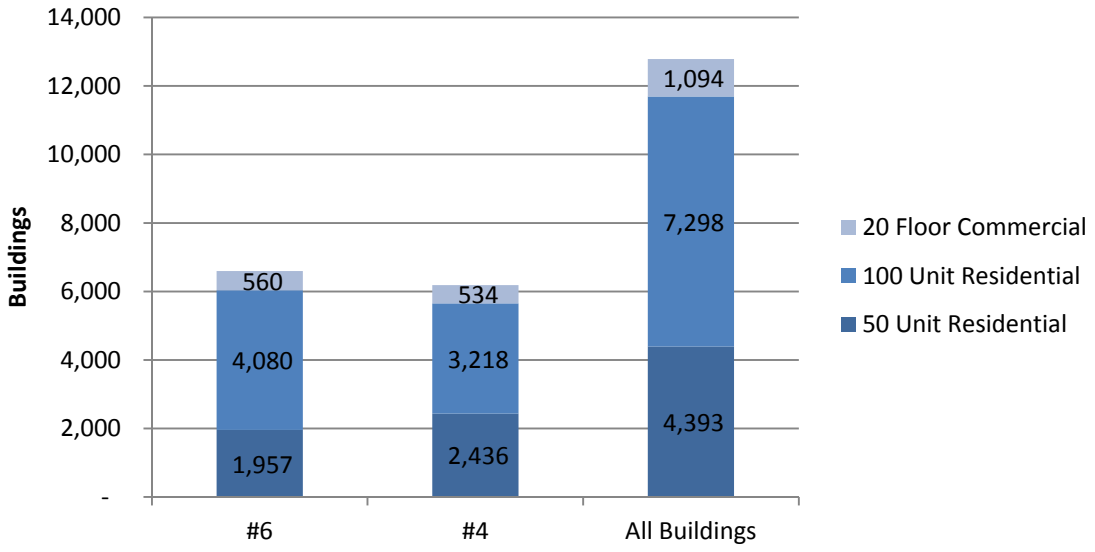
- Buildings burning #6 oil – Buildings that are currently burning #6 oil are required to convert to cleaner fuel options by 2015. These buildings can either convert to #4 oil, #2 oil, natural gas, steam, and bio diesel.
- Buildings burning #4 oil – These buildings have a longer time frame to convert to cleaner fuel options. Buildings that are burning #4 oil are required to convert to cleaner fuel options by 2030 and can convert to #2 oil, natural gas, steam, or bio diesel.

The Clean Heat Program is implemented through the renewal system for buildings' boiler certificates. If a boiler does not comply with a building's certificate, its certificate of operation is not renewed.

According to the City, nearly 13,000 buildings will be required to comply, 52 percent of which currently burn #6 oil, and 48 percent of which burn #4 oil. While the Clean Heat Program affects all types of buildings including apartment blocks, hotels, theaters, and government buildings, the vast majority of affected buildings are residential, with 91 percent residential and only 9 percent commercial (see Figure 22 for a summary of the breakdown of buildings that must comply with the Clean Heat Program).

[10] NYC Clean Heat Website, http://www.nyccleanheat.org/content/resources.

Figure 22 Clean Heat Program Buildings



Source: NYC Clean Heat Building Database (http://www.nyccleanheat.org/content/resources); AECOM

For the purposes of this study, we have considered conversions to #4 oils for #6 buildings, and #2 oil and natural gas for both #6 and #4 buildings, as they are the routes to compliance most building owners appear to be taking. Due to current understanding of the oil markets, the City has indicated that only one oil type, #4 or #2 is expected to remain viable in the next few years, particularly after the demand for oils is cut through regulations such as the Clean Heat Program. As such, for the purposes of this study, it is assumed that buildings that do *not* convert to natural gas will all convert to #2 oil. Accordingly conversion and fuel costs for #2 oil have been assumed for all non-natural gas conversions.

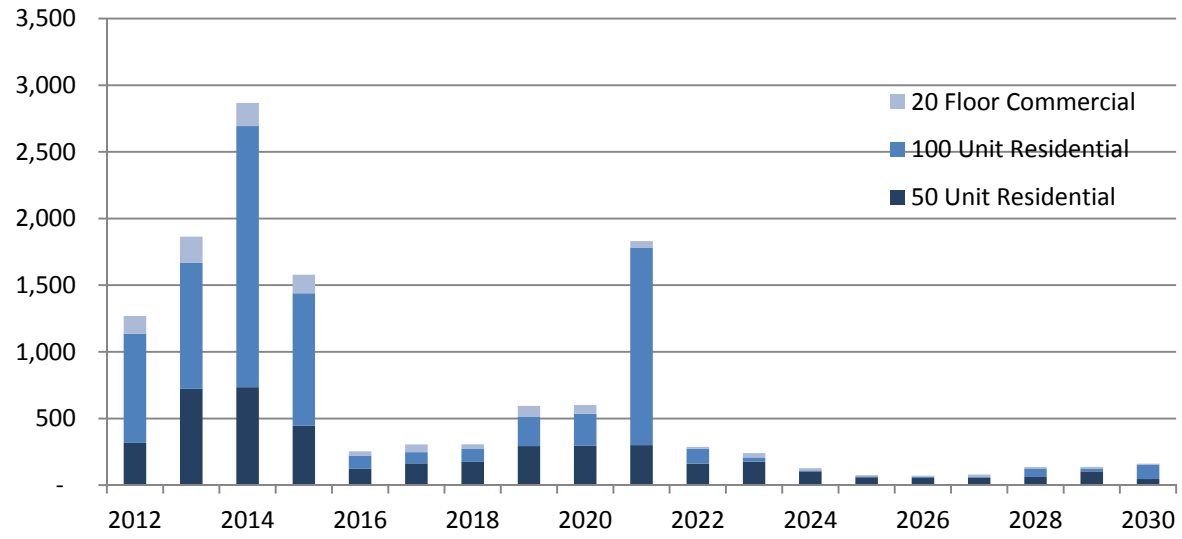
Per the City's direction three clean heat program building conversion scenarios have been considered:

1. **Conservative** – 25 percent of all buildings convert to natural gas by 2020; 50 percent convert to natural gas by 2030.
2. **Moderate** – 50 percent of all buildings convert to natural gas by 2020; 75 percent convert to natural gas by 2030.
3. **Aggressive** – 75 percent of all buildings convert to natural gas by 2020; 100 percent convert to natural gas by 2030.

Investment in efficient natural gas infrastructure has become an increasingly important objective for the City. The sooner that such infrastructure is in place to support building conversions, the earlier building owners will benefit from the long term savings, and the earlier that residents will benefit from the health benefits of reduced emissions.

For each of the three scenarios, a consistent building conversion rate has been applied. While some buildings are not required to convert their heating systems before 2030, the City has already seen large numbers of buildings convert to more efficient heating energy sources ahead of schedule. It is expected that by 2020, 75 percent of all buildings will have converted to some form of cleaner heating fuel – some on schedule with their permit renewals, and some prematurely, and 100 percent will have converted by 2030 (figure below).

Figure 23 Total Annual Clean Heat Program Conversions by Building Type (2012-2030)



Source: NYC Clean Heat Building Website Conversion Database, AECOM Estimates

7.2 Categories of Economic Impact

As with all policies reviewed in this study, compliance with the Clean Heat Program has economic impacts that extend beyond the initial investment. However, in addition to the three impact categories detailed in previous policies, implementation of the Clean Heat Program also results in significant health benefits, with tangible, economic impacts. This section reviews the three impact categories as well as the impact of the associated health benefits.

Capital Expenditures

The net new capital outlay was considered as part of this analysis, such that if an investment would have been made anyway, only the incremental amount above the baseline was analyzed.

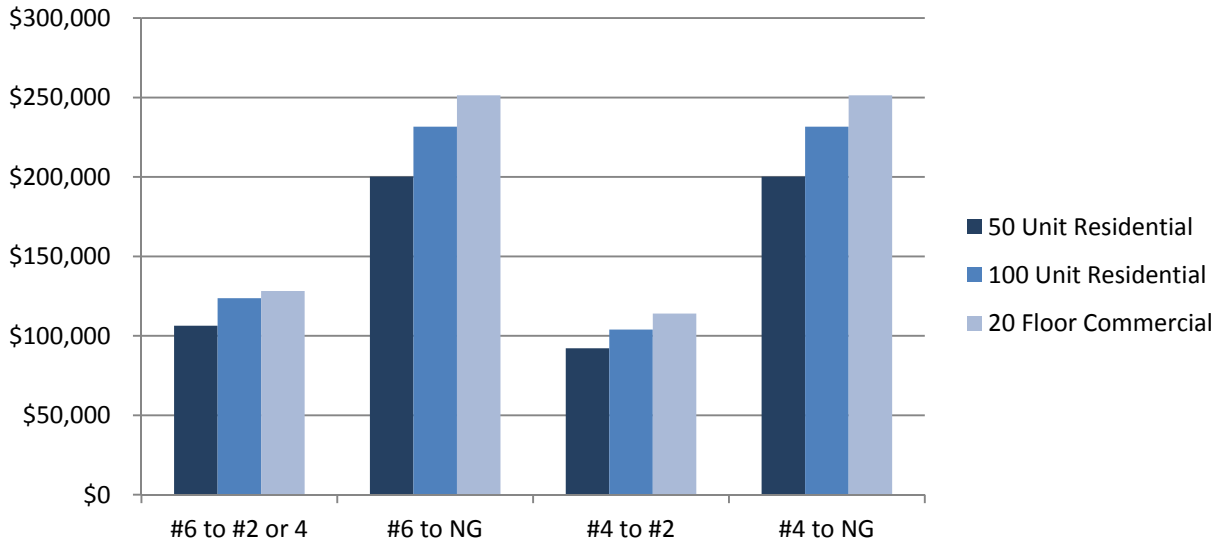
Two sources of net new capital investment are considered as part of the total capital outlay:

- Conversion investment for #6 buildings forced to upgrade early; and
- Induced ConEd infrastructure investment to meet demands of Clean Heat Program conversions to natural gas.

While all 13,000 buildings identified in the Clean Heat Program will be required to convert or upgrade their current boiler system, the program has been phased in such a way that many of the buildings will be able to make upgrades when their current system retires. Given the 2030 deadline for #4 building conversion, almost no #4 buildings will be forced to upgrade early. Additionally, roughly 23 percent of #6 buildings' systems will hit retirement before the 2015 conversion deadline. As a result, in terms of *net new* capital outlay, or investment that would *not* have happened without the Clean Heat Program, only the 77 percent of #6 buildings conversion costs, or 5,100 buildings, being forced to convert to a cleaner fuel source ahead of their regular boiler retirement schedule are included in the capital outlay. While some buildings may qualify for a conversion extension, extensions have not been considered as part of this study.

Based on a number of conversion cost ranges provided by the City, Figure 24 summarizes the conversion costs that are applied to each building and conversion type. As cost data for #4 buildings was limited, costs for #6 buildings were applied to #4 buildings as well. Conversion costs range from $90,000 to $250,000, by building and conversion type.

Figure 24 Estimated Conversion Costs by Building and Conversion Type

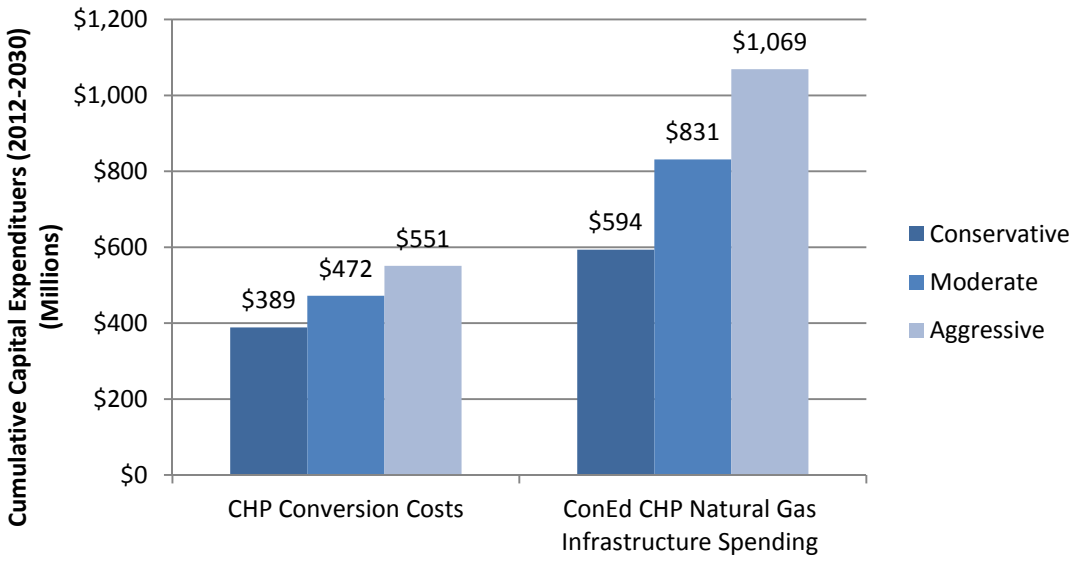


Source: AECOM Estimates, OLTPS Estimates

Figure 25 summarizes the cumulative capital investment that is expected to be made between 2012 and 2030 as a result of the Clean Heat Program for the three conversion scenarios. The ConEd infrastructure investment was estimated based on ConEd's 2010 Gas Long Range Plan 2010-2030 as well as its 2006-2016 planned spending. The infrastructure investment amount was scaled to account for an increase in conversion and required natural gas infrastructure.

Most of the Clean Heat Program spending will occur between 2012 and 2020, as buildings make their conversions. In the peak year, 2014, Clean Heat Program implementation will result in $344 million (2012$) of spending for the conservative scenario, $460 million for the moderate scenario and $575 million for the aggressive conversion scenario.

Figure 25 Total Clean Heat Program Capital Outlay (2012$) (2012-2030)



Source: AECOM; ConEd Gas Long Range Plan 2010-2030, December 2010; ConEd spending data from OLTPS.

Opportunity Cost of Local Spending

As described in the Introduction, it is important to consider source of the capital outlay expenditures and to consider the opportunity cost of dollars that would have otherwise been spent locally. Due to the complex nature of building ownership, the mix of owners versus tenant, and the inclusion of both residential and commercial buildings, not all funds are from local sources, allowing New York City to benefit from external investments into its economy. Only investment that is from local sources carries an opportunity cost and results in a negative impact to the economy.

Based on the profile of buildings included in the Clean Heat Program, it is estimated that 65 to 80 percent of the total capital outlay spent in the New York City economy is expected to come from local sources. The local sources of the local capital outlay include:

1. Local residential and commercial building owners;
2. Local residential homeowners; and
3. ConEd.

For these entities, the investment required for the Clean Heat Program represents spending that may have otherwise been spent in New York City on other goods and services, so the reallocation of this spending is modeled across three categories: consumption reallocation for consumers, a decrease in investment income, and a decrease in production cost for commercial businesses.

Long Term Operational Cost Shift and Regional Competitiveness

For ongoing costs and savings, all buildings subject to the Clean Heat Program were considered – both #6 and #4 conversions, as the change in O&M costs and industry demand are a direct result of compliance with the Clean Heat Program. The ongoing costs and savings associated with the Clean Heat Program include:

1. Changes in building O&M costs:
    - Maintenance savings associated with converted systems (cost decrease)
    - Changes in operation costs for buildings converting to natural gas (cost decrease)
    - Changes in operation costs for buildings converting to cleaner heating oil (cost increase)
2. Changes in industry demand
    - Changes in demand for maintenance services (reduced demand)
    - Changes in demand for fuel sales (reduced demand)
    - Changes in demand for natural gas sales (increased sales)

Changes in building maintenance costs were developed based on costs provided by the City7i, and include only net changes in spending. Fuel and natural gas operations costs were also developed based on information from NYSERDA and Charles River Associates. Changes in O&M costs for all buildings range from $0.9 billion in savings in the conservative scenario, to $1.5 billion in moderate scenario savings, to $2.5 billion in savings in the aggressive scenario by 2030.. The savings result from the reduction in maintenance costs and savings associated with natural gas costs over fuel, which averages about 50 percent of #6 oil costs per MMBtu for each building. The more aggressive conversion scenario provides greater long term operational savings, as more buildings convert to natural gas and benefit from the cost differential.

Health Benefits

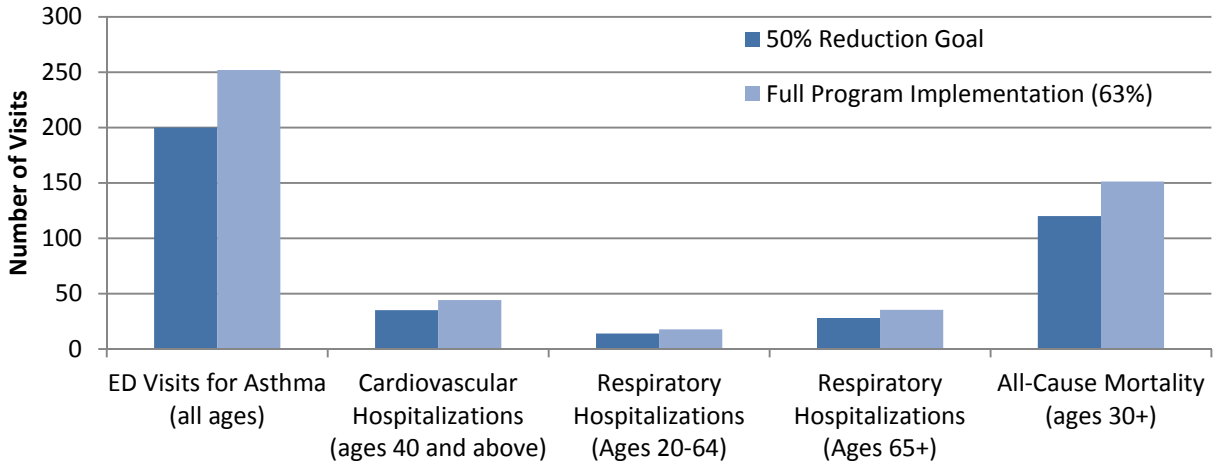
Unlike other policies reviewed, the Clean Heat Program is expected to have tangible, localized health benefits that will have an impact on New York's economy.

In its review of the impact of heating oils on the environment, the City found that building heating oil is responsible for 14 percent of all fine particulate matter (PM) pollutants. Enforcement of the Clean Heat Program is expected to result in a 63 percent reduction of these PM2.5 emissions.[11] In addition to the environmental impacts, the health benefits associated with such a reduction in particulate matter are significant. The City previously undertook a study to quantify the health benefits of a 50 percent PM2.5 reduction. The study developed high level estimates using emissions factors from the National Emissions Inventory (NEI) and the Environmental Protection Agency (EPA). Their calculations relied on additional studies of source apportionment to develop estimates of the amount of PM2.5 emitted from dirty-fuel burning buildings. Based on this work, the median health benefits were scaled from 50 to 63 percent reduction using MMBtu of the burned oil, and the additional economic impacts associated with full Clean Heat Program compliance are assessed.

Figure 26 summarizes the annual expected health benefits associated with 50 and 63 percent PM2.5 reduction. For modeling purposes, these impacts were scaled using MMBtu of conversions. Full Clean Heat Program compliance is expected to result in 250 emergency department (ED)[12] visit reductions, 20 to 40 fewer hospitalizations for cardiovascular and respiratory illnesses, and 150 fewer deaths. As such, the Clean Heat Program creates a healthier and more economically robust society.

[11] New York City Government Heating Oil, http://www.nyc.gov/html/dep/html/air/buildings_heating_oil.shtml.
[12] "ED" has been used in place of "ER" (emergency room) to reflect the language in the City's analysis.

Figure 26 Clean Heat Program Health Benefits



Source: Estimate of Benefit of 50 percent Residual Oil Reduction (11.10.11); AECOM Estimates

As fewer people visit hospitals for pollutant-related illnesses, households experience reduced spending on medical services, labor productivity improves as employees miss fewer days of work, and hospitals experience a decrease in demand for their services. Just as with the other impact categories, not all of the avoided costs of medical services will be paid from local sources.

Three key inputs are evaluated in order to develop economic impact estimates of the health benefits:

1. Avoided medical expenses – impacts on households and hospitals;
2. Value of avoided deaths; and
3. Estimate increase in economic output as a result of avoided hospital stays.

The cost and hospital stay duration estimates required to develop each of these benefits is summarized in Table 9.

Table 9 Cost of and Hospital Stay Length of Health Impacts

Health Procedure	Cost per Procedure	Estimated Days per Hospital Stay
ED Visits for Asthma (all ages)	$3,079	0.17
Cardiovascular Hospitalizations (ages 40 and above)	$49,986	4.6
Respiratory Hospitalizations (ages 20-64)	$18,982	5.1
Respiratory Hospitalizations (ages 65+)	$44,124	5.7
All-Cause Mortality (ages 30+)	$5,000,000	

Source: (1) Cost per Procedure – Estimate of Benefit of 50 percent Residual Oil Reduction (11.10.11); (2) Estimated Days per Hospital Stay – Centers for Disease Control, 2010; (3) All-Cause Mortality Value– REMI economic value of a life and reflects a one-time value.

Just as with the other impact categories, the savings associated with a reduction in medical services are expected to benefit multiple sources. Households are only assumed to be responsible for 30 percent of medical expenses, and thus only reap 30 percent of avoided cost savings. Hospitals are affected both negatively and positively, as demand for the hospital industry's services decline, countered by the reduction in uninsured patients who are unable to pay their full bills.

The increase in economic output resulting from avoided hospital stays is estimated by applying the average hospital stay length to an average daily output value for the New York labor force.

7.3 Summary of Economic Impact

The following section summarizes the economic impact of the Clean Heat Program, including a breakdown of findings by category and detailed employment impacts by sector.

Economic Impact without Health Benefits

The economic impact of the Clean Heat Program was summarized first without health benefits in order to illustrate the basic impact of the capital outlay and change in ongoing operations and maintenance costs.

The Clean Heat Program and the three evaluated scenarios provide an excellent example of how a policy's structure significantly affects its larger economic impact. The following tables summarize the economic impacts of the three reviewed scenarios and highlight the increase in economic impact enjoyed by both the New York City economy and in personal income as a result of more aggressive conversion rates, and in particular, conversion to inexpensive natural gas as a heating fuel.

Table 10 Clean Heat Power Total Economic Impact (2015-2030)[13]*- **Conservative Scenario***

	2015	2020	2025	2030
Employment (Net new jobs)	280	183	1028	1,559
Personal Income (2012$M)	-$11.7	$24.0	$180.9	$280.3
GRP (2012$M)	$82.7	$105.3	$309.8	$409.8
Avoided Hospital Spending (2012$M)	$2.9	$3.7	$4.7	$4.9
Additional Output as a Result of Avoided Hospitalizations (2012$M)	$0.3	$0.4	$0.5	$0.6

Source: AECOM

[13] For purposes of comparison with other policies, the employment, personal income and GRP indicators do *not* include the economic impacts of the modeled health benefits.

Table 11 Clean Heat Power Total Economic Impact (2015-2030)[14] ***Moderate Scenario***

	2015	2020	2025	2030
Employment (Net new jobs)	1,155	1,250	2,020	2,758
Personal Income (2012$M)	$72.8	$164.7	$345.9	$492.4
GRP (2012$M)	$206.7	$265.9	$484.3	$611.2
Avoided Hospital Spending (2012$M)	$2.9	$3.7	$4.7	$4.9
Additional Output as a Result of Avoided Hospitalizations (2012$M)	$0.3	$0.4	$0.5	$0.6

Source: AECOM

Table 12 Clean Heat Power Total Economic Impact (2015-2030)[15] *-* ***Aggressive Scenario***

	2015	2020	2025	2030
Employment (Net new jobs)	1,886	2,084	2,834	3,760
Personal Income (2012$M)	$148.0	$287.8	$494.8	$685.2
GRP (2012$M)	$308.8	$387.5	$623.8	$769.2
Avoided Hospital Spending (2012$M)	$2.9	$3.7	$4.7	$4.9
Additional Output as a Result of Avoided Hospitalizations (2012$M)	$0.3	$0.4	$0.5	$0.6

Source: AECOM

Findings by Category of Impact

The following section reviews job creation, personal income growth and GRP by impact category.

Employment

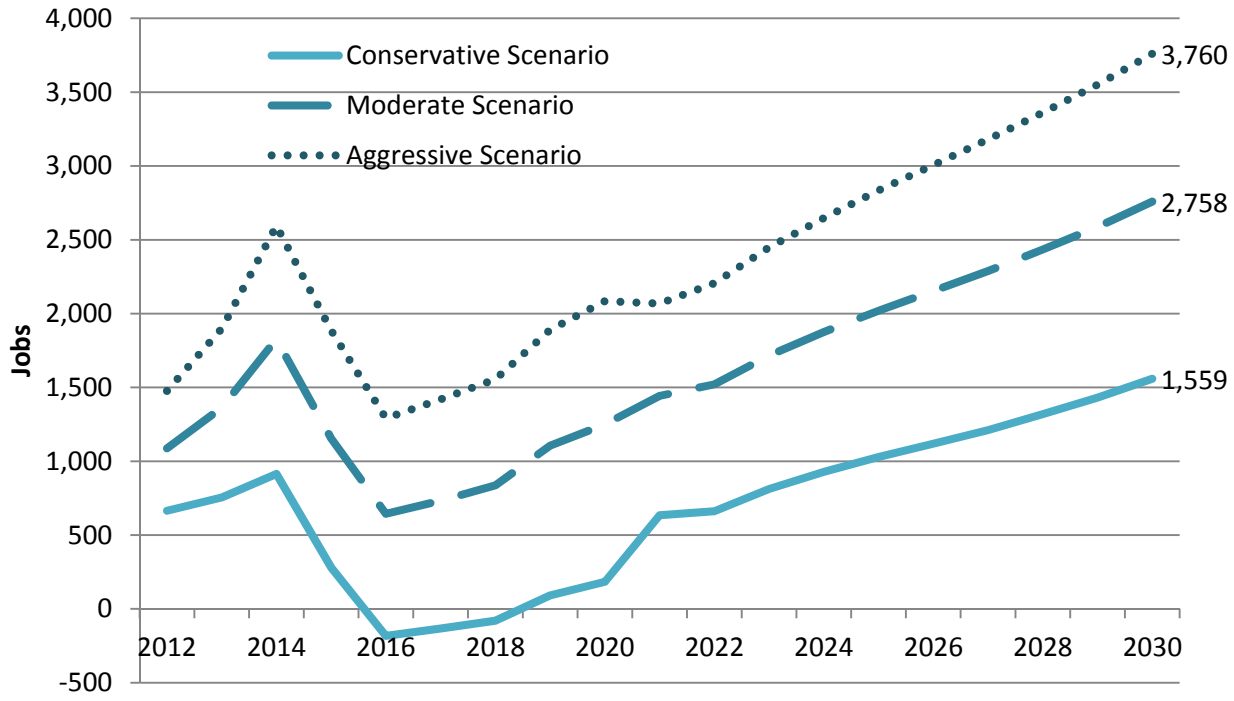
As one of the most important and tangible economic indicators, employment by category is an important data point for the impact of a given action. As the following scenario figures show, the spike in employment is highest during the initial capital outlay, or construction phase, although the impact is somewhat muted by the opportunity cost of local funds for the capital outlay. The increase in operating

[14] For purposes of comparison with other policies, the employment, personal income and GRP indicators do *not* include the economic impacts of the modeled health benefits.

[15] For purposes of comparison with other policies, the employment, personal income and GRP indicators do *not* include the economic impacts of the modeled health benefits.

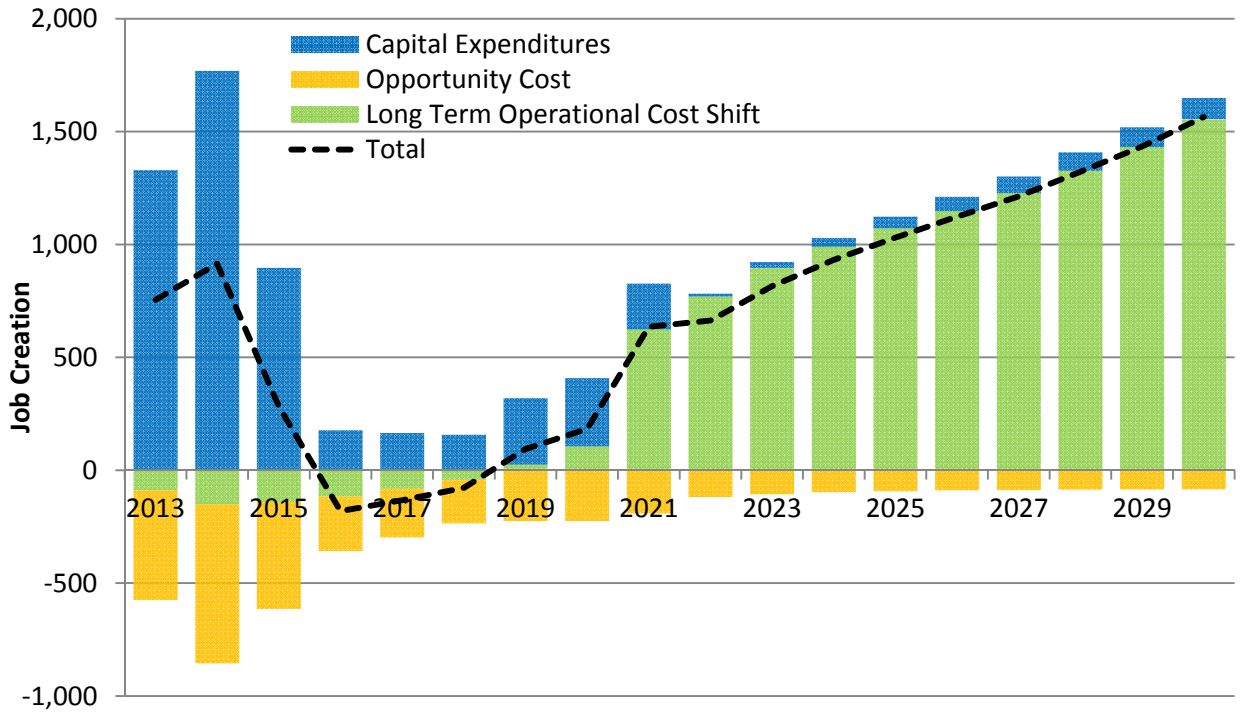
costs associated with maintenance and fuel type early in the program results in a drop in employment, which rebounds as buildings that have converted to natural gas begin to realize operations savings.

*Figure 27 Total Clean Heat Program Job Creation (2013-2030) – **Scenario Comparison***



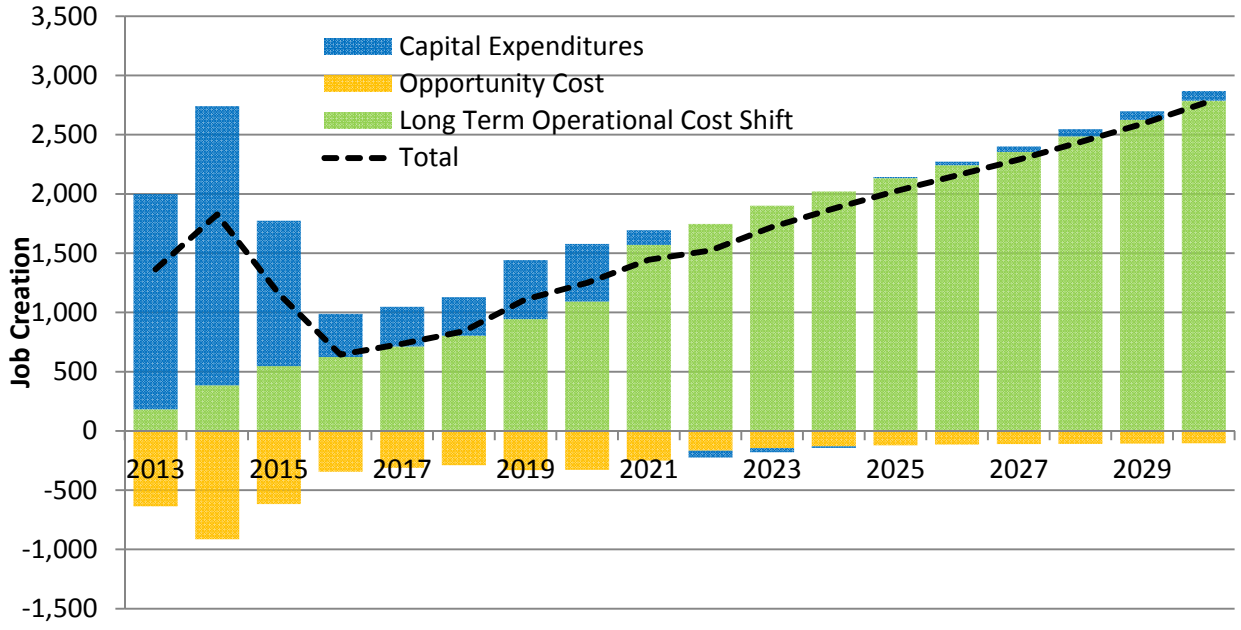
Source: AECOM

*Figure 28 Total Clean Heat Program Job Creation (2013-2030) – **Conservative Scenario***



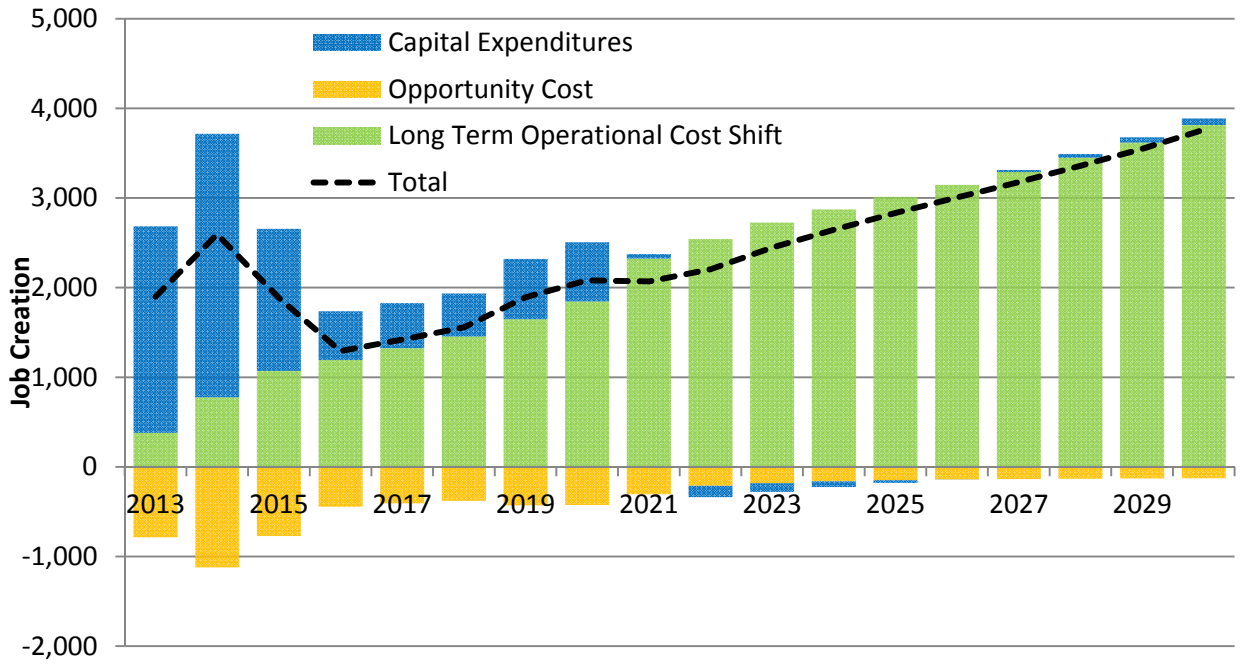
Source: AECOM

*Figure 29 Total Clean Heat Program Job Creation (2013-2030) – **Moderate Scenario***



Source: AECOM

*Figure 30 Total Clean Heat Program Job Creation (2013-2030) – **Aggressive Scenario***

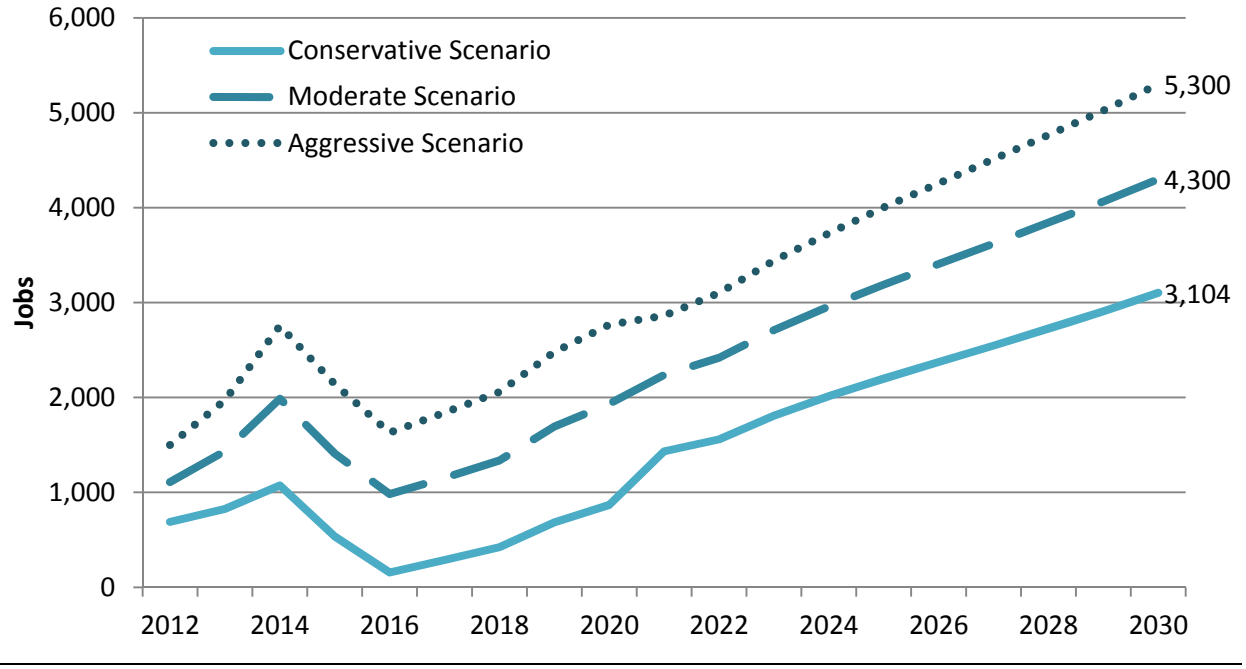


Source: AECOM

Economic Impact with Health Benefits

The Clean Heat Program is likely to result in a number of localized health benefits. As shown in Figure 31, which outlines the economic impact including the health benefits, there are significant economic implications of improving the health of New York City's residents and increasing the productivity of its labor force. At full Clean Heat Program compliance, the region would gain an additional 1,550 additional jobs.

Figure 31 Clean Heat Program Job Creation with Health Benefits (2013-2030) - ***Scenario Comparison***

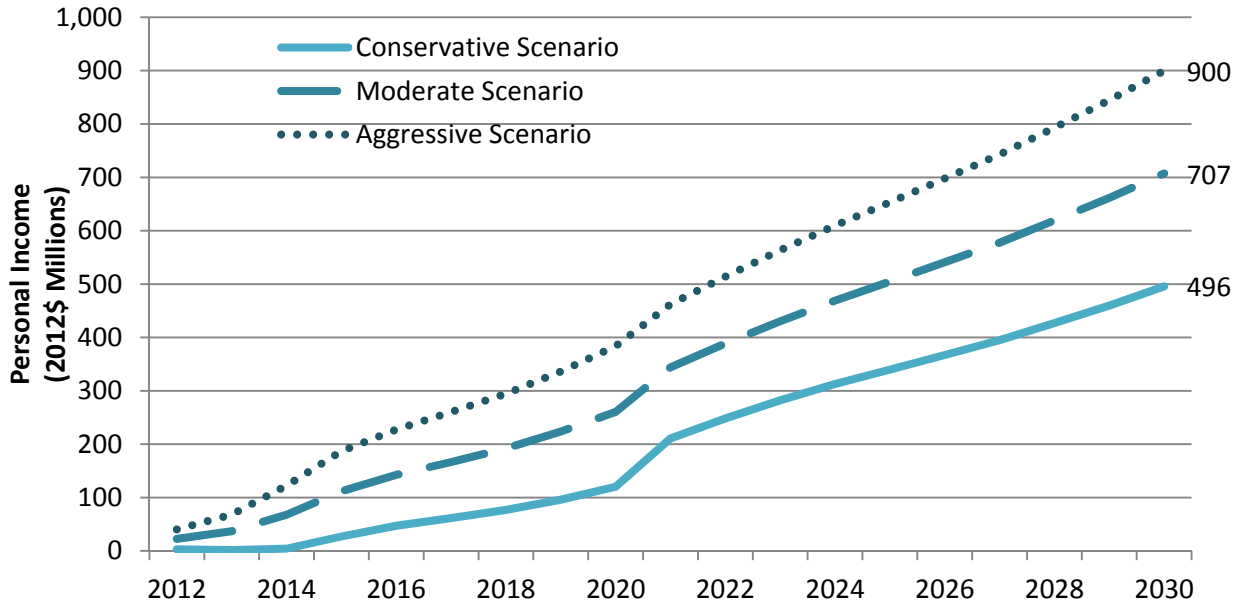


Source: AECOM

Personal Income (Including Impacts from Health Benefits)

Without the health benefits, the Clean Heat Program would generate an additional $280 to $690 million of personal income in New York City by 2030 (or full compliance). With the economic impacts of improved health, the Clean Heat Program is expected to create between $500 and $900 million in net new personal income depending on conversion scenario. This includes the slight negative impact of avoided medical spending on the healthcare sectors as well as the positive impact of a more productive labor force and the amenity or quality of life improvement by avoiding 150 premature deaths from long-term exposure to PM2.5 (see Figure 32).

*Figure 32 Clean Heat Program Impact on Personal Income (2013-2030) – **Scenario Comparison***

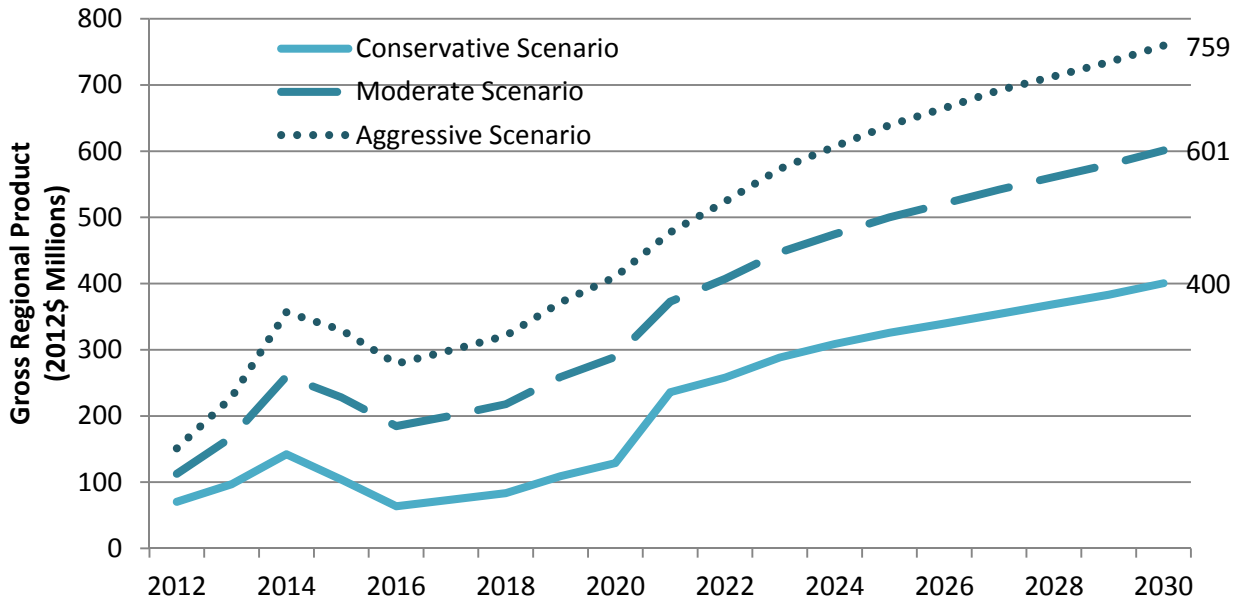


Source: AECOM

Gross Regional Product (Including Impacts from Health Benefits)

The Clean Heat Program results in a positive growth for the New York City economy as measure by GRP. As shown in Figure 33, health benefits play a significantly smaller role in the program's economic impact, and ultimate shrinks the GRP growth expectation. Without accounting for the health benefits, GRP in the city is expected to increase by between $500 and $760 million depending on scenario.

*Figure 33 Clean Heat Program Impact on Gross Regional Product (2013-2030) – **Scenario Comparison***



Source: AECOM

Employment Impacts by Sector

Employment impacts by sector vary throughout the different impact categories of the Clean Heat Program. As would be expected, the industry sectors are impacted differently during periods of capital outlay or changes in operational spending. As the three reviewed scenarios present a similar ratio of employment impacts across sectors, only the employment impacts by sector for the *moderate scenario* are presented here. Impacts for the other two scenarios are proportionally larger or smaller, yet the affected industries remain the same. Key industry sectors that are impacted are as follows:

- The Professional, Scientific, and Technical Services sector, which includes architecture and building engineering, experiences an employment increase of 920 jobs in 2014 associated with the initial capital outlay. New employment in this sector dips in 2022 and then levels off by 2030.
- Construction jobs also increase by an additional 710 jobs in 2014. The employment impact for sectors decreases in 2022 and then levels off by 2030.
- The Utilities sector experiences steady growth in new employment to 470 new jobs in 2030, as ConEd expands its natural gas services to meet growing Clean Heat Program building demand.

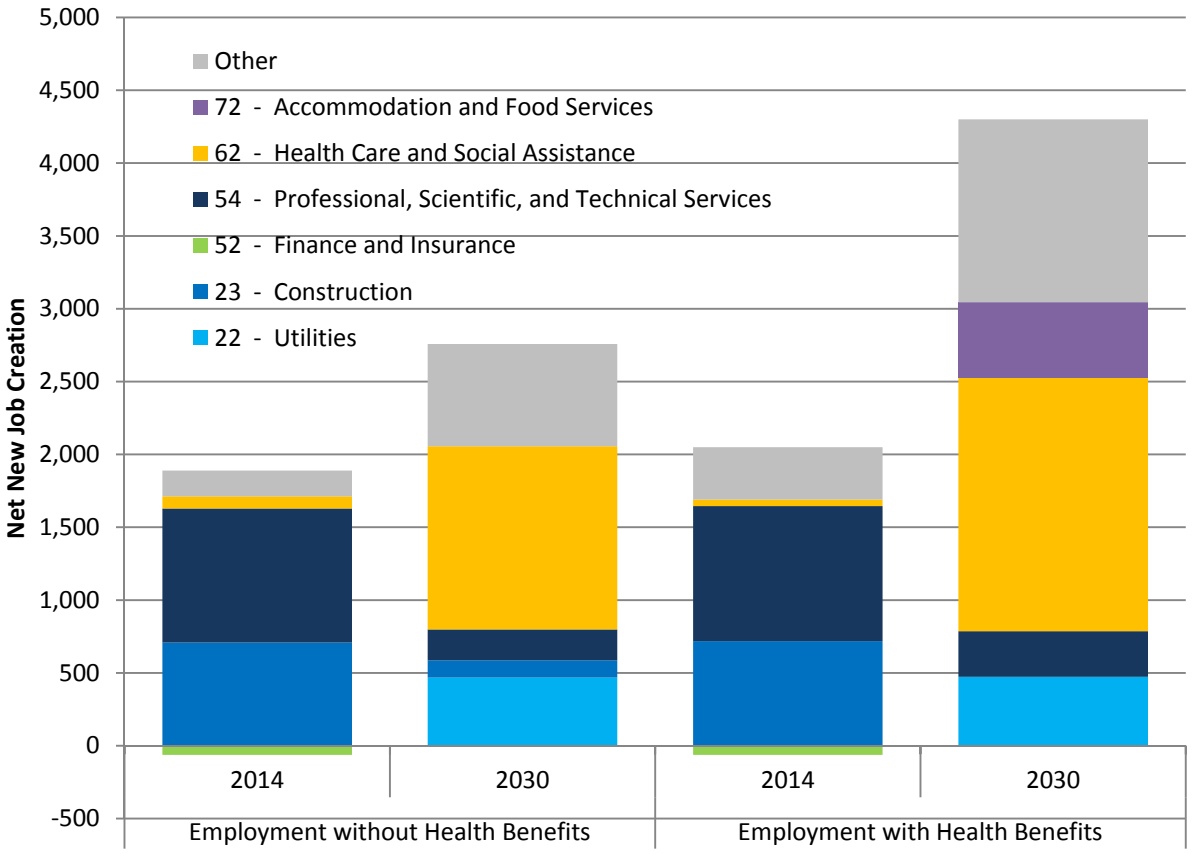
- The Health Care and Social Assistance sector steadily increases to provide an additional +400 jobs by 2030.

Including the Clean Heat Program health benefits in the employment by sector analysis has some significant impacts on sectors that now benefit from a healthier, more attractive New York City environment. In addition to affecting new sectors, the health benefits also temper some of the employment losses experienced in sectors highlighted above. Notable employment sector growth includes:

- By far, the largest impact of the health benefits on employment is within the Health Care and Social Assistance sector. The sector experiences strong growth, resulting in +1,700 new jobs by 2030. The employment growth is spread evenly across the subsectors, ambulatory health care services, hospitals, nursing and residential care facilities, and social assistance. This growth occurs primarily as a result of increased production and mortality reduction, whose health employment impacts outweigh employment losses experienced in the sector as a result of decreased demand.
- The increased attractiveness of New York City, resulting from its healthier environment also increases employment in the Accommodation and Food Services sector. Employment in this sector increases by over 515 new jobs by 2030.
- Employment in Educational Services increases for similar reasons, reaching an additional 350 jobs by 2030.
- Retail Trade, Professional, Scientific and Technical Services, and Construction sectors also benefit from the increased health of New York City residents and the attractiveness of New York City as a place to visit.
- The Wholesale and Retail Trade sectors are two sectors that are negatively impacted by the program, results in between 300 and 400 fewer jobs in 2030.

As shown in Figure 34, employment by sector shifts significantly between the peak construction period, in 2014, and full program implementation in 2030. As detailed above, while early program implementation results in growth in the Professional, Scientific, and Technical Services and Construction sectors, full program implementation strengthens other sectors.

*Figure 34 Clean Heat Program Employment by Sector (2014, 2030) – **Moderate Scenario***



Source: AECOM

9. PV Permit Streamlining

9.1 Policy Overview

The final 30x30 policy to be reviewed was the streamlining of the solar photovoltaic (PV) permitting process. By reducing the overall cost of installation, PV permit streamlining can be a critical piece in making PV installation an affordable option for residential and commercial building owners, as well as for third-party installers. As such, reduced costs often result in installations occurring earlier than they otherwise would.

Because a PV permit streamlining policy or approach has not yet been developed, high-level assumptions were developed about a potential streamlining program based on research and case study data from similar programs around the United States.[16] Assumptions have been adjusted to reflect New York City's unique context, and supplemented with available data from NYSERDA's current PV permitting program through interviews and research.[17]

Impacts of Permit Streamlining

In its 2011 study of the impacts of solar permit streamlining, SunRun, Inc. found that by implementing nationally-recognized strategies, permitting costs could be reduced by as much as 76 percent, or $0.38 per installed watt.[18] This assumption has been applied to both residential and commercial installations.

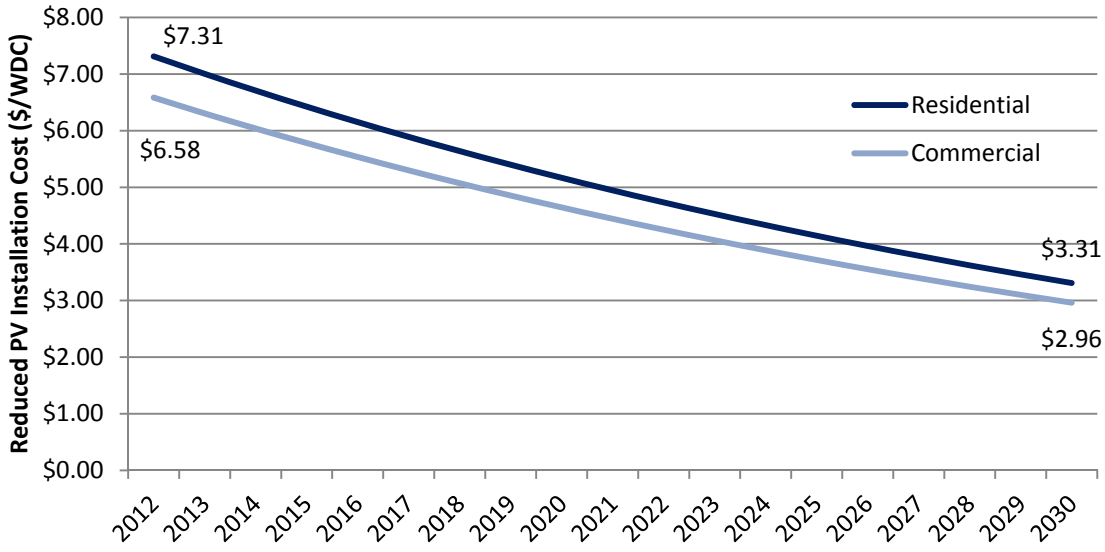
Two thousand twelve installation costs for the residential sector in New York City average at $7.65 per W_{DC}, with residential installations averaging around $6.99 per W_{DC}. These installations costs have been falling at an average of 45 percent per year for residential installations and 60 percent per year for commercial installations since 2003 and 2004 respectively. Based on these historic trends, and factoring in U.S. DOE projections for installed price reduction, Figure 35 presents the projected streamlined installation costs for New York City applied in this study.

[16] Two key reports include (1) A national-level review of the potential impacts of the solar permitting process published by SunRun, Inc., in January 2011, which is built around the U.S. Department of Energy (DOE) adopted the Solar America Board for Codes (Solar ABCs) expedited permitting process; and (2) AECOM's July 2011 report entitled *Economic and Fiscal Impact Analysis of Residential Solar Permitting Reform*, also conducted in partnership with SunRun, Inc..

[17] NYSERDA Power Clerks website. http://nyserda.powerclerkreports.com/Default.aspx?ReportId=1

[18] SunRun, Inc., The Impact of Local Permitting on the Cost of Solar Power, January 2011

Figure 35 Projected PV Installation Cost ($/$W_{DC}$) (2012-2030)



Source: AECOM, Based on historic NYSERDA installed PV cost data and US DOE equipment cost projections. Projections include reduced cost associated with permit streamlining.

Total Rooftop PV Market

Total expected rooftop PV installation quantities for New York City were developed as part of Task 1 80x50 work. According to Task 1, full rooftop PV penetration, 60 percent of available rooftop space, will be reached by 2035. Data from previous AECOM studies indicates that reductions in installation price, including those from PV permit streamlining effectively shift installations earlier, but do not typically result in an overall increase in installations at full market penetration. In other words, the total number of installations by 2035 is expected to remain constant, but the timeframe for those installations between now and 2035 will likely shift forward. This shift is significant, as generation capacity increases earlier, and buildings as well as utilities are able to benefit from the economic and environmental impacts of increasing renewable energy generation earlier on.

Based on available data from NYSERDA and its Power Clerks reports, the average residential installation in New York City has a capacity of 5.40 kW, while the average commercial building installation has an average capacity of 25 kW. Current industry standards indicate an average of 100 square feet per kW of

solar PV capacity.[19] Given these data points, New York City's current solar installations cover roughly 880,000 square feet of roof top space, or 0.24 percent of all available roof area.[20] This represents 0.4 percent of total expected roof top installations. Due to the low level of current market penetration, this analysis includes an aggressive annual growth rate in order to achieve the 60 percent rooftop coverage rate goal by 2035.

Between 2003 and 2012, there have been a total of 262 residential PV installations, and 250 commercial installations within New York City.[21] Permits have steadily increased each year, with a 40 percent annual growth rate for residential installations, and a 55 percent annual growth rate for commercial installations.[22] As NYSERDA's data clearly shows, however, the number of installations is not directly tied to the overall cost of installation. This is consistent with other studies, which indicate that while gross installation cost is an important factor, other important installation drivers include education, awareness, ease and timeline of installation, electricity price, and availability of financing.

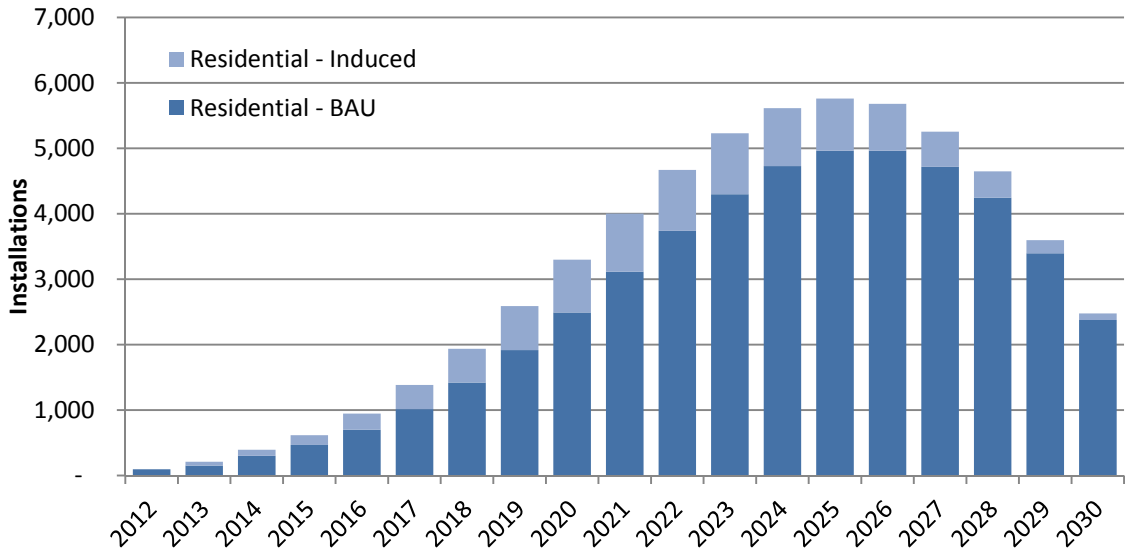
Expected PV Installations

Based on the above assumptions as well as case study inputs, an estimate was developed of expected PV installations that would have occurred without PV permit streamlining (business-as-usual / BAU), and induced installations that were installed earlier than expected as a result of streamlining (see Figure 36 and Figure 37).

By 2035, induced installations are expected to account for roughly 15 percent of total installations. This is consistent with what has been projected and observed in other studies. Additionally, by 2035, it is estimated that roughly 12 percent of the additional generation capacity from the streamlined permitting process will come from residential installations, and 88 percent will come from much larger scale commercial installations.

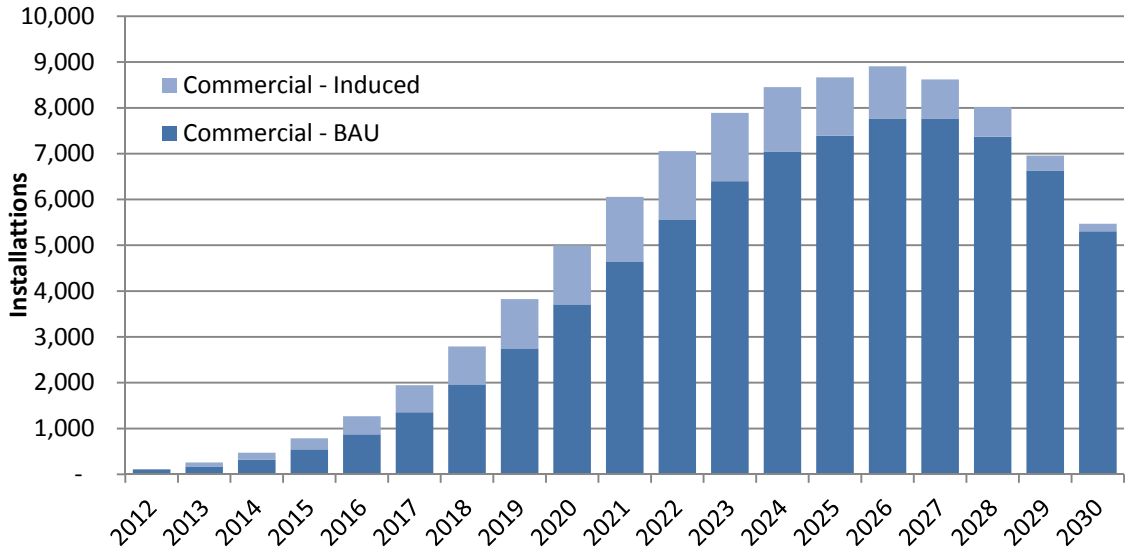
[19] Based on Task 1 work, efficiency of solar panels (kW per square foot) is expected to increase 6 percent annually between 2012 and 2015, and 1 percent annually between 2015 and 2050.
[20] Task 1 reports a total of 360 million square feet of roof space in New York City.
[21] NYSERDA Power Clerks website. http://nyserda.powerclerkreports.com/Default.aspx?ReportId=1
[22] For commercial installations, growth rate between 2004 and 2012, as there were no commercial installations recorded in 2003.

Figure 36 Annual Residential Installations (2012-2030)



Source: AECOM, Based on data from Task 1 work; Case studies.

Figure 37 Annual Commercial Installations (2012-2030)



Source: AECOM, Based on data from Task 1 work; Case studies.

9.2 Categories of Economic Impact

Capital Expenditures

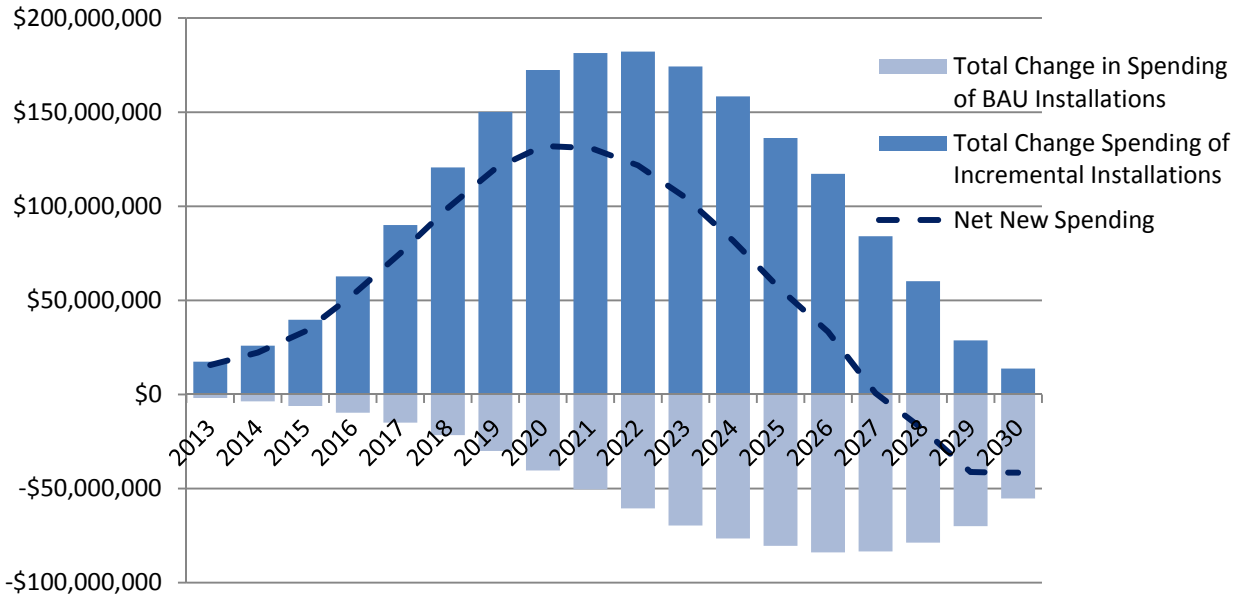
There are two major types of capital expenditure impacts for a PV Permit Streamlining policy:

1. Net new spending created by the induced installations; and
2. Decreased incremental on the already expected BAU installations due the lower average cost of installation associated with reduced permit costs.

Given average system sizes of 5.4 kW for residential installations and 25 kW for commercial, in 2013 (in 2012$), average installed system costs with permit streamlining are $37,800 and $157,600 respectively. The average decrease in cost per BAU installation is estimated to be approximately $2,100 for residential installations and $9,500 for commercial installations.

Based on the assumed installations presented in Figure 36 and Figure 37, Figure 38 summarizes the total capital investment that is expected to be made between 2013 and 2030 as a result of PV permit streamlining. Because induced installations are front-loaded in time, net new spending peaks in 2020 with $132 million in additional spending, and then dips towards the second half as the number of induced installations fall and New York City nears full penetration, or 60 percent of rooftop area.

Figure 38 Total PV Permit Streamlining Capital Outlay (2013-2030)



Source: AECOM

Opportunity Cost of Local Spending for Capital Expenditures

The second category of the analysis looks at the sources of money for the capital outlay discussed in the first category. While total system installation costs can be large, there are a number of federal and state subsidies that significantly reduce the total cost for building owners and third-party installers.[23] Residential installations may benefit from a Federal Tax Credit, a NYSERDA Incentive, a New York State Tax Credit, Sales Tax Exemption, and a New York City Property Tax Abatement. Commercial installations may benefit from a Federal Tax Credit, the Modified Accelerated Cost Recovery System, a New York State NYSERDA Incentive, a New York City Property Tax Abatement, and the NYC Solar Empowerment Zones Incentives. Not all of these incentives affect *installed* price, and not all installations comply with incentive criteria, but on average, an estimated 50 to 65 percent of residential and 50 to 75 percent of commercial installation costs are covered by installation subsidies. While almost all of the included installation subsidies are expected to expire before 2017, for the purposes of this study, it is assumed that the subsidies will continue to the point where out-of-pocket installation costs for the residential and commercial units reach $\$1/W_{DC}$, the point at which analysts agree that solar becomes widely

[23] City University of New York, Solar PV Incentives (http://www.cuny.edu/about/resources/sustainability/solar-america/installingsolar/incentives.html)

affordable. As with the other policies, federal subsidies, which bear no opportunity costs for New York City, are not considered as part of the capital payment category.

Given the building ownership and lease structure of most buildings in New York City, it is understood that most building owners would not be incentivized to invest in solar because they would not benefit from the electricity cost savings. As a result, it is expected that 75 percent of all installations will be conducted by third-party installers. This is consistent with the growing trend of third-party solar installations seen throughout the United States. In 2012, Greentech Solar reported that between 50 and 90 percent of all solar installations in the residential market were done by third-party installers.[24] This trend is expected to continue.

The sources for the capital outlay include:

1. Residential and commercial building owners;
2. Third-party installers; and
3. Federal, state and local government subsidies.

Long Term Operational Cost Shift and Regional Competitiveness

The key ongoing savings for PV installations are clearly savings in electricity costs, or in the case of third-party installers, revenue generated through electricity sales. Because BAU installations are not net new, this category only considers induced installations, as their savings have increased as a result of PV permit streamlining. In order to calculate annual savings or profit, average payback periods were applied to residential and commercial systems. Residential systems are expected to break even in 8 years, while commercial installations are expected to break even in 10 years.[25]

While there are a number of different lease structures for third-party installers on residential and commercial roofs, for the purposes of this study, it is assumed that third-party installers pay building owners 15 percent of their annual revenue in the form of rent or lease. The remaining 85 percent would go to the installers, 60 percent of which are assumed to be local.

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[24] U.S. Solar Market Insight: US Solar PV Installs 684MW in Q3, Looking for Huge Q4. December 11, 2012. http://www.greentechmedia.com/articles/read/US-Solar-PV-Installs-684MW-in-Q3-Looking-for-Huge-Q4

[25] This considers out-of-pocket, after subsidy costs, not gross costs.

9.3 Summary of Economic Impact

The following section outlines the results of the four impact categories on economic impact described in the previous section. Overall findings are presented, followed by a breakdown of findings by category, and detailed employment findings by sector. Because the PV permit streamlining policy has not yet been defined, the economic impact highlighted below is high level and is meant to give a sense of scale of expected impacts.

Overall Findings

Because PV permit streamlining has an overall impact of *shifting* installation time, rather than resulting in significant net new installations, the overall economic impacts are similarly shifted. Table 13 summarizes the key economic impact indicators for PV permit streamlining as a whole program. Net new employment ranges from 110 additional jobs in 2015 to zero change against the baseline in 2030. Personal income and GRP, however, do experience net gains, resulting in an additional $24 million in personal income growth and $13 million in GRP growth by 2030.

Table 13 PV Permit Streamlining Total Economic Impact (2015-2030)

	2015	2020	2025	2030
Employment (Net new jobs)	109	334	81	-4
Personal Income (2012$M)	$5.6	$23.4	$22.9	$24.0
GRP (2012$M)	$9.7	$27.7	$7.9	$12.7

Source: AECOM

Findings by Category of Impact

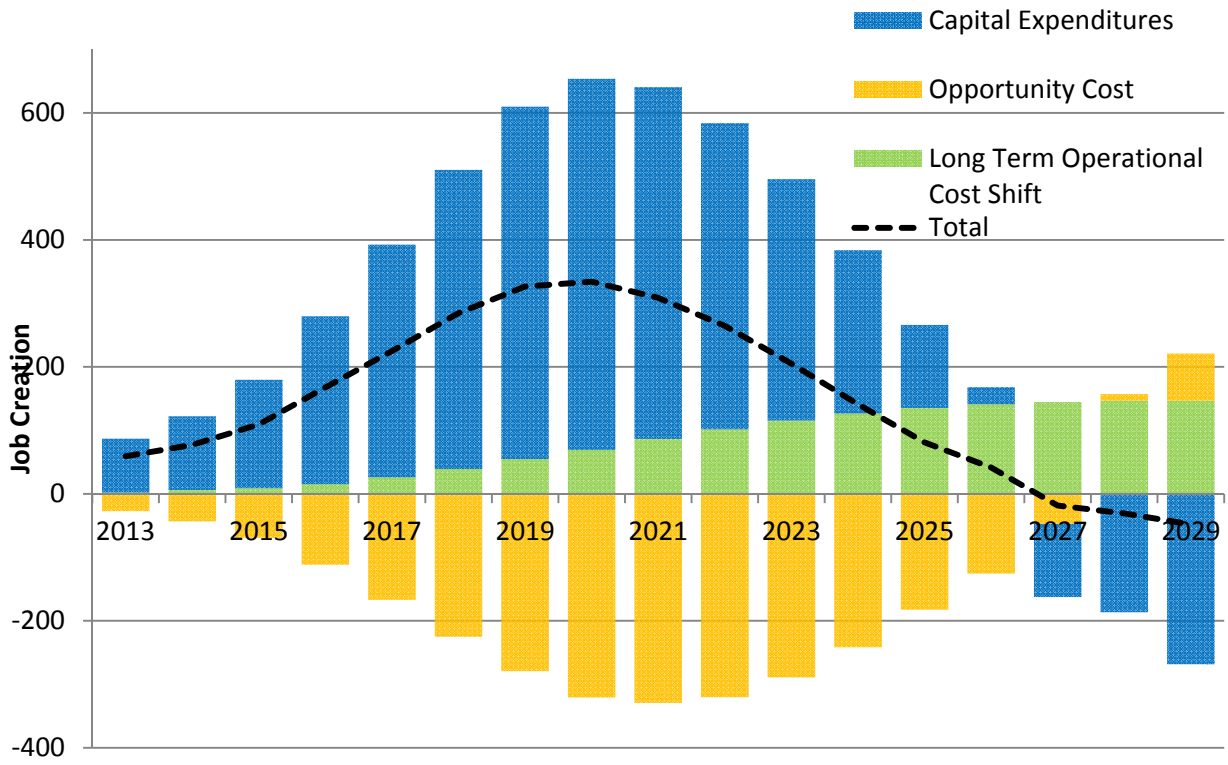
The following section reviews job creation, personal income growth and GRP by impact category.

Employment

As one of the most economic indicators, employment by category is an important data point for the impact of a given action. As with other policies, Figure 39 illustrates that the installation phase is by far the greatest producer of net new jobs. Because installations are shifted to an earlier point, later capital outlay drops below the baseline level and results in a decrease in jobs. Because not all sources of installation costs are local, the employment drop due to the payment of the initial installation is less great. The ongoing costs and savings, however, maintain growth as induced installations benefit from their investment. Employment peaks in 2020 at 330 new jobs, dipping to -50 jobs in 2029 before growth

rebounds to -4 jobs in 2030. This rebound is due to both cumulative electricity savings and revenue and the increase in production costs associated earlier investment in installations.

Figure 39 Total PV Permit Streamlining Job Creation (2013-2030)

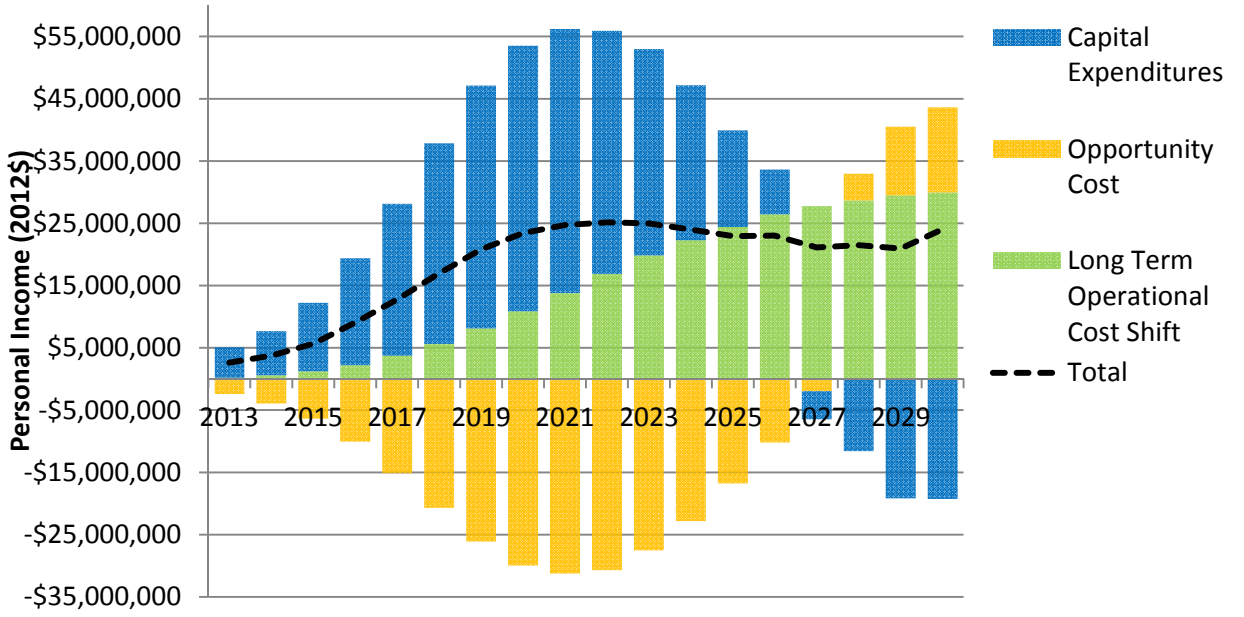


Source: AECOM

Personal Income

In personal income, PV permit streamlining results in a net increase. A hypothetical policy is expected to create $24 million in net new personal income. Figure 40 illustrates the growth in personal income for permit streamlining.

Figure 40 PV Permit Streamlining Change in Personal Income (2013-2030)

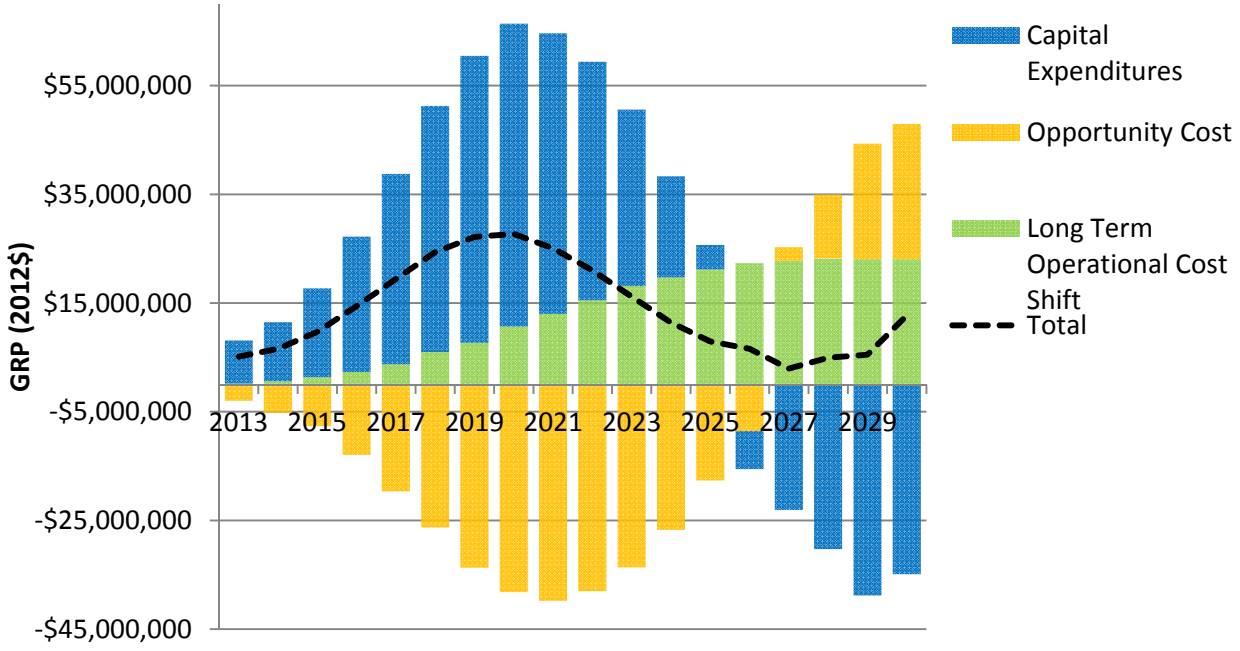


Source: AECOM

Gross Regional Product

Permit streamlining results in a positive growth in GRP for the New York City economy. The fluctuation in installations heavily affects growth, while the ongoing savings have less of an impact. Although net new GRP fluctuates over the next twenty years, GRP in the city is expected to increase by roughly $12 million by 2030.

Figure 41 PV Permit Streamlining GRP (2013-2030)



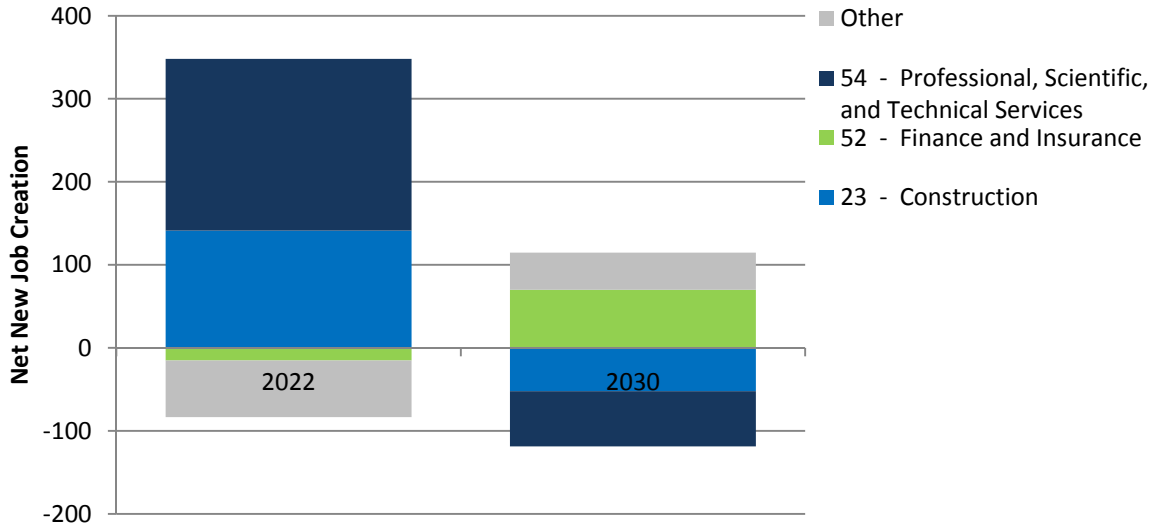
Source: AECOM

Employment Impacts by Sector

As would be expected from this policy, employment impacts are almost entirely limited to the Construction and Professional, Scientific, and Technical Services sectors.

As shown in Figure 42, employment by sector shifts significantly between the peak construction period, in 2022, and full program implementation in 2030. As with other policies, PV permit streamlining implementation results in growth in the Professional, Scientific, and Technical Services and Construction sectors, as well as growth in the Finance and Insurance sector, which represents PV third-party installers.

Figure 42 PV Permit Streamlining Employment by Sector (2022, 2030)



Source: AECOM

Key industry sectors that are impacted are as follows:

- The Professional, Scientific, and Technical Services sector, which includes architecture and building engineering, experiences an employment spike of an additional 240 jobs by 2020, due to the rise of induced installations. New employment in this sector dips in 2029, before starting its recovery in 2030. In 2030, there would be an estimated 65 fewer jobs.
- The Construction sector enjoys a similar jump in employment by an additional 170 jobs in 2020. New employment in this sector similarly dips to its lowest point of 55 fewer jobs in 2029.

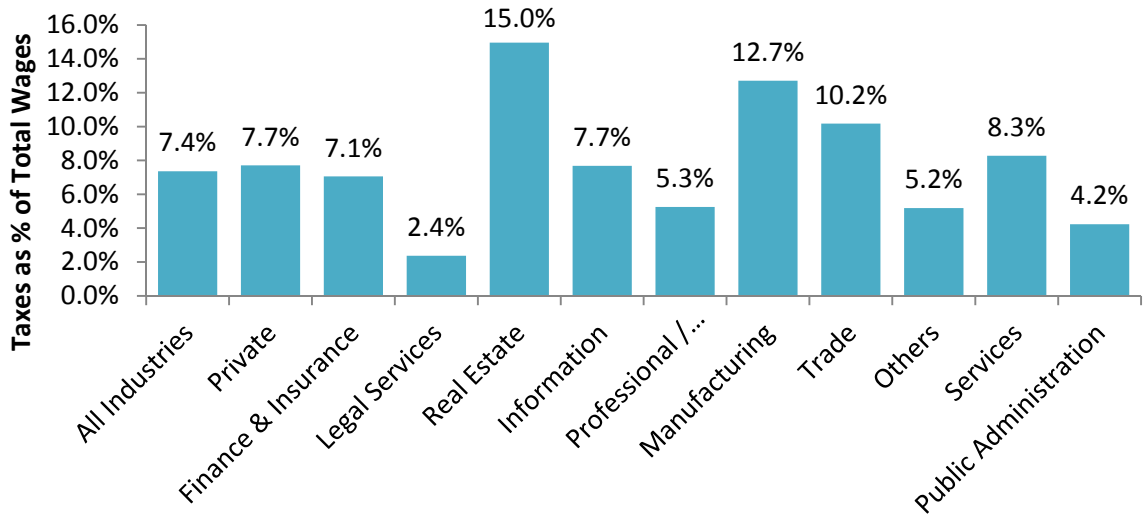
- The Finance and Insurance sector is the only other sector whose employment trend is notably affected by the policy. Employment in the sector dips by20 jobs in 2020 before rebounding to 70 additional jobs by 2030. This sector is affect primarily because of the Investment subsector, which accounts for a percentage of building ownership, installation payments and third-party installers. As would be expected by the capital outlay pattern, the investment subsector would invest more money earlier, and benefit from less investment later, after the induced installations have occurred.

The remaining sectors see very little fluctuation in their employment patterns. Net decrease and increase in ranges between -10 and +10 jobs.

10. Fiscal Impacts

In addition to evaluating the economic impact of the five policies included within PlaNYC's 30x30 plan, high-level estimates of fiscal impact were estimate by developing a *taxes-to-wages ratio*, based on methodology provided by New York City's Center for Economic Transformation. The latest available tax figures (2007) from the State Department of Finance[26] are combined with total wage information from the New York State Department of Labor[27] to develop the ratio. The estimated ratio for individual sectors is presented in Figure 43, reflecting that wages in industries such as real estate, manufacturing and trade contribute a greater percentage to taxes than wages in legal services or public administration.

Figure 43 Taxes to Wages Ratio by Sector



Sources: City of New York Department of Finance 2011 Annual Report on Tax Expenditure; New York State Labor Department, New York City's Center for Economic Transformation; AECOM

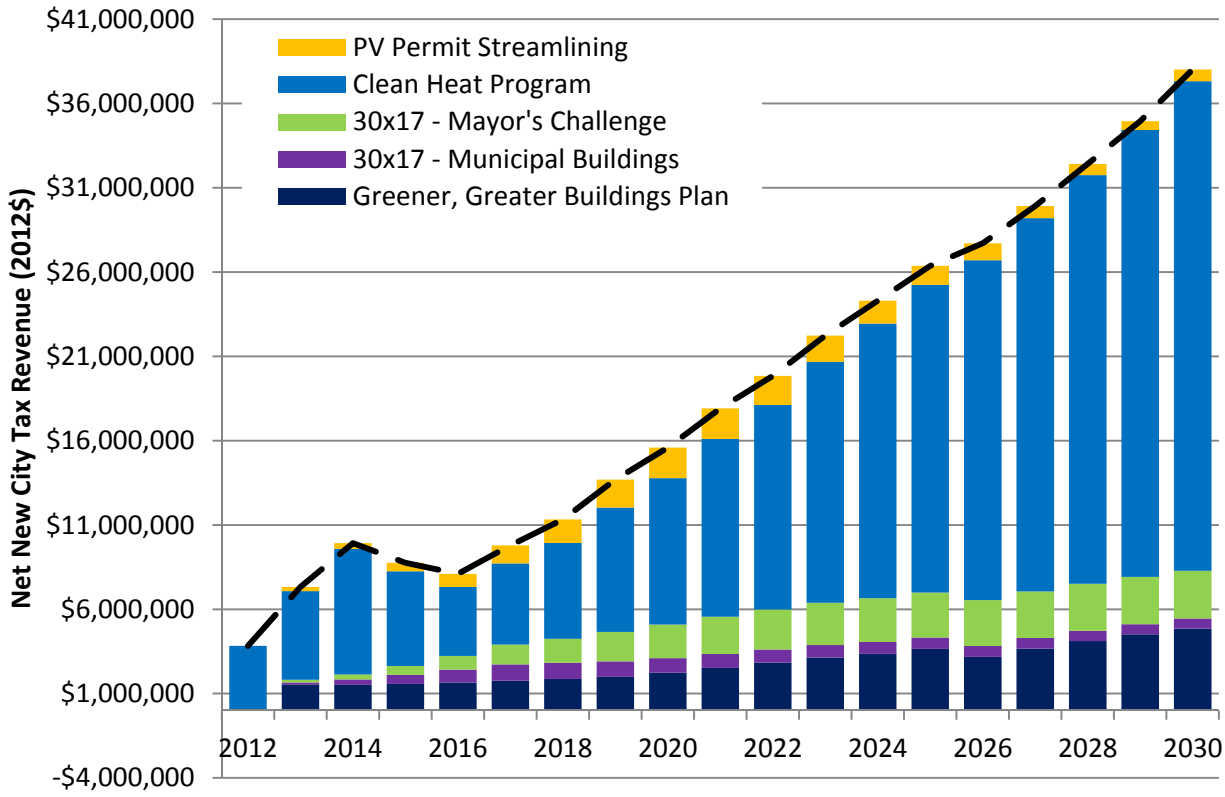
[26] City of New York Department of Finance Office of Tax Policy, "Annual Report on Tax Expenditures – Fiscal Year 2011." http://www.nyc.gov/html/dof/html/pdf/11pdf/ter_2011_final.pdf

[27] http://www.labor.ny.gov/stats/lsqcew.shtm

For the purposes of this study, only private, non-governmental wages have been considered as part of the fiscal impact. Some policies, notably 30x17, do result in significant changes in local governmental employees.

Based on the ratios presented above and the total wages by industry for each policy, Figure 44 illustrates how each of the five policies contributes to tax revenue for New York City. By 2030, the policies combine are expected to generate just over an additional $38 million in revenue. The Clean Heat Program is by far the most fiscal revenue-generating policy, resulting in $5.2 to $29.0 million annually. The 30x17 – Municipal Building policy is expected to have the smallest impact on fiscal revenue, generating just under $600,000 in tax revenue by 2030.

Figure 44 Total Anticipated Net New City Fiscal Revenue (2013-2030)



Source: AECOM

AECOM
605 3rd Avenue
New York, NY 10158
www.aecom.com