INNOVATION NETWORK
»MORGENSTADT: CITY INSIGHTS«

City Report

NEW YORK CITY

2013

MORGENSTADT: CITY INSIGHTS (M:CI)

Climate change, energy and resource scarcity, a growing world population, and aging societies are some of the large challenges of the future. In particular, these challenges must be solved within cities, which today are already home to more than 50% of the world's population. An ever-growing number of cities around the world are actively developing new and sustainable infrastructures and services in order to safeguard and improve the quality of life of their citizens.

New technologies make sustainable development of municipal infrastructure and the availability of adapted services possible. Renewable energies and systems, such as energy-efficient buildings, electric vehicles and new mobility concepts, flexible logistics and modern security systems, are developing dynamically. New information and communications technologies are saturating and connecting sectors, thereby allowing for the widespread use of these technologies. The transformation of existing cities, like the development of new cities striving towards sustainability, require a clear set of objectives, a long-term plan and the continual implementation of a plethora of projects addressing different parts of the solution. Intelligent steering of this process and active citizen participation in the conceptualization of solutions, that is to say, mature governance, are conditions for successful implementation.

With the motto "Morgenstadt – City of the Future", the Fraunhofer Organization focuses on the development of technological solutions for cities that will lead towards a sustainable future. Of the 60 Fraunhofer Institutes which conduct applied research in different areas, 14 institutes compose a network for the development of sustainable cities. The institutes contribute high-quality competencies in their respective fields and work together in an interdisciplinary manner.
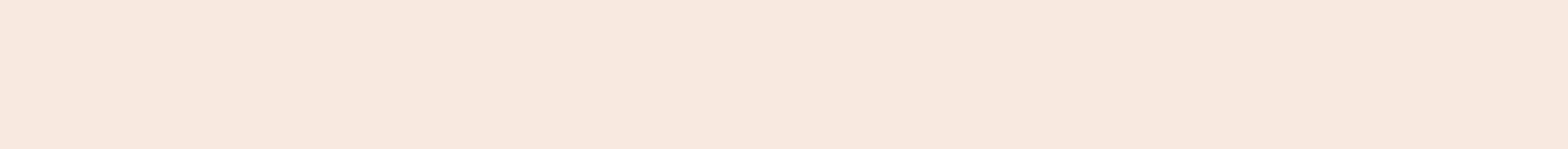
Between May 2012 and October 2013, 12 Fraunhofer Institutes conducted the project "Morgenstadt: City Insights" with 30 industrial businesses and 6 cities, with the goal of creating an inventory of effective solutions for sustainable cities. To this end, a catalogue of inspiring cities around the world was created and the following six cities were selected for in-depth study: Freiburg, Berlin, Copenhagen, New York City, Singapore and Tokyo. A team of Fraunhofer researchers traveled to each of these cities to study trailblazing projects and to learn about innovative solutions by conducting interviews, engaging in discussions and visiting project sites. The goal was to investigate how these model projects were conceptualized, initiated and implemented, measure their achievements, and identify which actors and factors contributed to their overall success. Additionally, the goal was to determine under which conditions these solution approaches could be transferred to other cities.

A team of researchers visited New York City between April 8 and April 23, 2013. This report presents the results of the on-site research that were conducted in New York City.

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City Report - New York City

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EXECUTIVE SUMMARY

Governance

In 2007 the master plan for New York City, the 'PlaNYC 2030' has been released and attracted attention as a global example of sustainable community and economic development.

Three main challenges functioned as key drivers for the development of a comprehensive, strategic plan for NYC's development: the expansion of population, the city's aging infrastructure and the impacts of climate change on NYC. Moreover, the 9/11 events have raised awareness that a city must not only provide public services, but also create a safe space in which the future-oriented economic, social and environmental needs of a diverse and prosperous city can be met. Furthermore, projections for climate change impacts on the Big Apple highlighted the need for NYC to take action by, preparing for inevitably negative impacts while striving to minimize its own impact on global warming. Thus, the concepts of sustainability and resilience became central guidelines for the future development of NYC.

PlaNYC is an ambitious agenda aimed at creating a 'greener, greater New York' even as the city's population continues to grow towards a projected nine million residents by 2030. The ten fields of action which are part of the city's sustainability strategy include: Parks and Public Space, Energy, Brownfield, Air Quality, Waterways, Solid Waste, Climate Change, Water Supply. Additionally, PlaNYC presents seven topics, which are cross-sectoral: Public Health, Food, Natural Systems, Green Building, Waterfront, Economic Opportunity, and Public Engagement.

The conception of PlaNYC and the implementation of its numerous initiatives is the result of a joint effort on part of the city, state and federal governments, citizens, neighborhood groups, non-profit organizations, community boards, private companies, as well as research institutions and universities. While McKinsey and Company assisted in writing the plan, the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) released the plan. Support from the mayor and top administration officials has been fundamental for the successful and efficient implementation of PlaNYC.

Buildings

The strongest factor in recent developments in NYC is the governmental support of building innovation, energy efficiency and sustainable city planning. A clear guideline for all decision makers and offices is manifested in PlaNYC. This helps provide transparency and facilitates faster processing and decision-making.

The energy efficiency regulations have a strong influence on building development, both for new buildings under constructions and old buildings required to undergo retro-commissioning. As part of the Greener Greater Buildings Plan (GGBP) local laws were implemented to insure energy audits of larger buildings. Such laws create new understanding and demonstrate that economic incentives for improvements and innovation pay off in the long term. It is important to remember that while sustainability is the goal, sustainable development is only achievable if it is proven financially viable. Therefore, investments into green building practices and retro-commissioning must be able to prove themselves economically beneficial in order to succeed and become widely adopted.

Another way of creating better understanding of critical environmental issues is through education on sustainability. CUNY, a 'green university', provides an excellent case in point. The university is collaborating with the local government on a project that will, in time, help shape public opinion and make developers and residents aware of the need for sustainable buildings, thereby turning sustainability features into something people will value and want in a building. CUNY's green campuses set a positive example of green development and exemplify values of sustainability in a public space thus creating curiosity and admiration. The education and programs provided by the university produces future experts in sustainable technologies and trades. Additionally, program graduates have practical experience from contributing to their universities' green development initiatives. A green university is the ideal place to conduct research on developing new methods and concepts for sustainable buildings and cities.

Another strong concept to create economic benefit from sustainable buildings is the public-private-partnership (PPP). By entrusting project with valuable goals and clear guidelines to a private partner, to implement and treat it as a normal source of income, the government can reduce its financial investment. On the other hand, the private partner is provided with a profitable project that would not have been available to them without the incentives provided by the government. In this way, innovative projects can be realized much faster and with more security for both parties involved.

Mobility

NYC ranks first in the nation in terms of passenger miles flown, transit passenger miles travelled and truck freight volume. In the year 2006, transit alone accounted for 1.8 billion passenger trips carrying 8 million passengers per day (almost 70% in subways). New Yorkers are heavily dependent on public transportation and have a much lower car ownership rate (23%) than any other major city in the country (78% average). Moreover, NYC is the only city in the United States where more than half of the households do not own a car. Were the city to follow general car ownership patterns, the city would have an additional 4.5 million cars on its streets. The transport sector emitted 11.4 million tons of CO_2 in 2010 (69% from passenger cars) and is the

second largest CO_2 emitting sector after electricity generation. Due to low private car use, about 48 billion miles (approx. 77 billion km) of travel are avoided yearly, saving the city 23 million tons of transport-related CO_2 emissions.

Security

Overall, NYC is promoting three key strategic security missions: catastrophe and disaster management, big data and infrastructure protection. In the wake of Hurricane Sandy, NYC has undergone vital measures to better prepare for and respond to natural disasters and the short and long-term consequences thereof. Based on the successful implementation of PlaNYC, A stronger and More Resilient New York, a nearly US $20 billion resiliency plan, was implemented. This plan is a comprehensive endeavor to unite and concentrate the city's core capabilities in the field of sustainability with the aim of incorporating infrastructure and activities related to the built environment-, such as coastal protection, insurance, utility supply, healthcare, water and transportation with specific community rebuilding efforts and resilience planning. The plan foresees the participation of not only official and professional bodies but also New Yorkers themselves and therefore works to keep residents thoroughly informed on the various initiatives and projects announced in the plan. Hurricane Sandy hit NYC and the surrounding urban areas with such unexpected intensity that experts agree that the city and its neighbors have begun to reconsider the city's close proximity to the ocean and the threats that may occur due to its specific location. Thus, the NYC Office of Emergency Management (OEM) is revising all flood and security-related maps to better prepare for both natural disasters and man-made catastrophes.

Big data systems are at the forefront of NYC's security strategy. The city's surveillance system, known as the Domain Awareness System (DAS), which was launched by the NYPD, provides an example of the city's interconnected big data systems. The DAS combines CCTV camera footage, reports from over 3,000 radiation sensors, license plate detectors and public data streams for the identification of threats on the streets. NYC has made it a priority to support crime prevention as well as crisis management operations using existing as well as new sensor and data systems which are based on the sharing of extremely large amounts of data. Such interoperable information gathering systems have become crucial to the work of all security-related authorities. Systems such as NYPD's DAS are designed to be transferable to other metropolitan areas which are equally densely populated and have a similar urban infrastructure. However, the cultural context in which such systems are placed is crucial for their implementation since they may interfere with civil and privacy rights causing controversies and a lack of acceptance among citizens.

As a third fundamental security mission, NYC is on the forefront of critical infrastructure and building protection. The city is still deeply stricken by the very recent consequences of Hurricane Sandy and the events of September 11 have left the city deeply scarred. The reconstruction of the World Trade Center as a key business district is strongly grounded in developing technological and emergency response-related security measures. In particular, site access control systems, above all the Vehicle Security Center, show that preparation for a possible terrorist attack is a core motivator of the overall security planning and implementation measures taken for both individual building complexes as well as surrounding interconnected infrastructure complexes in the corresponding city districts.

Water

Since 1842 New York City is receiving water from outside the city's boundaries. Nowadays, more than 9 million inhabitants and visitors of the city are relying nearly completely on water sources up to 250 km away from the city. Consequentially Mayor Bloomberg asked, as he came into office, "What could literally close down this city?" A failure of the supply system, transporting water into the city would have done that (The New York Times 2013a). While the water supply infrastructure was aging, several droughts in the 1980s made the limitation of the water resources obvious. At the same time population was and still is steadily growing. Due to these conditions, the city started successfully several strategic plans and initiated measures to achieve water conservation, to modernize the existing supply infrastructure, and to guarantee that the water resources will be sufficient for serving the population even in future times.

While the city set up rules for water conservation, in one prominent district, the Battery Park City (BPC), even higher standards were developed by the local authorities, that have to be achieved for new buildings, leading to most innovative solutions in terms of water reuse and efficiency, decentralized wastewater treatment, and energy efficiency within buildings. The practice examples of BPC are impressive showcases, presenting the water reuse and efficiency potential in combination with a high level of living quality in nowadays buildings within densely populated areas of a city.

Increased awareness of the cities attractiveness brought in NYC the value of the many surface water bodies of the city more and more into focus in recent years. At the same time more frequently flooding of an ever broader range of communities happened, leading amongst others to regular combined sewer overflows (CSO) into the City's waterways. To prevent flooding and to avoid the pollution of the water bodies by CSOs, several strategic issues, such as the Sustainable Stormwater Management Plan, were incorporated within the City's strategic master plan, PlaNYC.

The different issues NYC is confronted with in the water sector occur all over the world more and more often. The solutions of the City, the strategic processes targeting many small and larger measures, and its consequent implementation with a documentation of its progress, can help cities everywhere to cope with their individual issues. However,

the efforts New York City has undertaken depend to a large extend on the active engagement of the authorities, on the awareness of the population and last but not least on the technological progress, which still has not come to an end.

Information and Communications Technologies (ICT)
The cooperation between NYC's mayor and police chief has been a significant structural effect factor. The implementation of CompStat and the resulting revolutionized police work in NYC was possible thanks to former NYC mayor Rudolph W. Giuliani and former chief of police Bratton who jointly developed a strategy to improve safety in the city back in 1994. The mayor of a city has the ability to set comprehensive priorities and involve other relevant public authorities in the process; because of that, interdependencies with other sectors can be exanimated and modified if needed.

Local differences in a city, and the corresponding adjustments required to adapt to individual circumstances and conditions in the various districts, pose another important factor for success. For example, in NYC local representatives are involved in the strategy formulation process for the city's police. An important part of the development of strategies and the implementation of locally adapted approaches in NYC are the CompStat meetings in which police chiefs meet with their key employees once a week to exchange knowledge on successful factors, identify existing barriers and discuss how to resolve these barriers in order to improve the city's overall anti-crime strategy. It must be ensured that such a strategy is continuously evolving and adapting in order to ensure that crucial exchange and learning is an ongoing process.

Data analysis is central to the fight against crime in NYC. A continuous review of strategies and the results of procedures contribute to the ongoing evaluation of data. Information gathered on the location, time, and specifics of a crime, combined with details gathered on the offender(s), is evaluated to optimize the fight against crime. Timely evaluation is essential and effective evaluation can, for example, lead to more focused policing of certain identified areas and enhance adaptation to local conditions.

Another important factor is to gain the support and involvement of the population in order to obtain information about crime in different neighborhoods. This has been achieved through community policing initiatives, which can also help to improve the relationship between the public and the police.

NYC's outcome-oriented approach has been a central factor contributing to the city's continued and dramatic reduction in crime rates. The focus here has not been on predicting individual crimes but on uncovering general patterns. This approach was successfully implemented to reduce auto theft in NYC.

LIST OF ABBREVIATIONS

ABS	Automatic Block Signaling
AIA	American Institute of Architects
AMI	Area Median Income
BPL	Building Performance Lab
BIM	Building Information Modeling
BIN	Building Identification Number
BPC	Battery Park City
BPCA	Battery Park City Authority
CBRNE	Chemical, Biological, Radiological, and Nuclear Explosive
CBTC	Communication-based Train Control
CCATF	Climate Change Adaption Task Force
CCNY	City College of New York
CPA	Climate Protection Act
CSO	Combined Sewer Overflow
CUNY	Sustainable City University of New York
CWRP	Comprehensive Water Reuse Program
DAS	Domain Awareness System
DDC	Direct Digital Control
DEP	Department of Environmental Protection
DHS	Department of Homeland Security
DOE	Department of Energy
DOT	Department of Transportation
EML	Environmental Measurements Laboratory
EPA	Environmental Protection Agency
EVP	Electric Vehicle Pilot
FARRA	Federal American Recovery and Reinvestment Act
FCD	Federal Cabinet Department
GGBP	Greener Greater Buildings Plan
GHG	Greenhouse Gas
HPD	Housing Preservation and Development
HVAC	Heating, Ventilation and Air Conditioning
ICLEI	International Council for Local Environmental Initiatives
ICT	Information and Communications Technologies
IPCC	Intergovernmental Panel on Climate Change
LEED	Leadership in Energy and Environmental Design
LMDC	Lower Manhattan Development Corporation
MTA	Metropolitan Transportation Authority
NHNY	New Housing New York
NRDC	Natural Resources Defense Council
NUSTL	National Urban Security Technology Laboratory
NY	New York State
NYAST	New York Area Science and Technology Forum
NYC	New York City
NYCC	NYCleantech Collaborative
NYCDCAS	NYC Department of Citywide Administrative Services
NYCECC	New York City Energy Conservation Code
NYCHA	New York City Housing Authority
NYCEEC	New York City Energy Efficiency Corporation
NYCTA	New York City Transit Authority
NYPCC	New York City Panel on Climate Change
NYPD	New York City Police Department
NYPIRG	New York Public Interest Research Group
NYSERDA	New York State Energy Research and Development Authority
OLTPS and	Mayor´s Office of Long-Term Planning Sustainability
PANYNJ	Port Authority of New York and New Jersey
PPP	Public Private Partnership
PV	Photovoltaic
RCNY	Rules of the City of New York
RPA	Regional Planning Association
SAB	Sustainability Advisory Board
SAVER	System Assessment and Validation for Emergency Responders
SWIM	Stormwater Infrastructure Matters
TLC	Taxi and Limousine Commission
USGBC	U.S. Green Building Council's
USEPA	U.S. Environmental Protection Agency
USHTF	U.S. Highway Trust Fund
VSC	Vehicle Security Center
WBCSD	World Business Council for Sustainable Development
WRI	World Resources Institute
WTC	World Trade Center

LIST OF FIGURES

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1   GENERAL INFORMATION

1.1   »M:CI« – CITY RESEARCH IN NEW YORK CITY

The six cities studied within »m:ci« were chosen following a rigorous selection process. Several international sustainability ranking models were utilized, innovative projects and solution approaches were identified and analyzed. This selection process was the basis for choosing, together with the companies and city representatives involved in »m:ci«, six cities which provided innovative and inspiring solutions in different technological sectors, located in different parts of the world and demonstrating different climatic and other framework conditions. This selection process has mainly led to the identification of large cities. New York City (NYC) has been chosen as the leading North American city and as a role model for bottom-up sustainability and sustainability planning.

All selected cities demonstrate trail-blazing projects and solution approaches for improving sustainability. Each city studied has different strong points with respect to the sectors studied in »m:ci«, which consist of the following: energy, building, mobility, water, productions and logistics, security, information and communications technologies (ICT), and governance.

The six cities selected belong to the most inspiring cities worldwide in the area of sustainable urban development. This does not mean to refer judgment on the value of the many other cities across the globe which also belong within this classification, but were not included in this project.

1.2   OBJECTIVES

It has proven to be quite difficult to compare cities in terms of their sustainability, and their projects designed to increase sustainability, as no uniform assessment criteria exist and because the framework conditions of each city are unique. This brings rise to the following: Is it even possible to learn from the experiences of individual cities?

The »m:ci« project argues that while every city with sustainability-oriented projects and approaches reacts to specific challenges, uses locally-available resources and implements its projects under local framework conditions, the main challenges addressed are, nevertheless, comparable to the challenges faced by many cities worldwide. The rojects are planned and implemented according to similar patterns. As such, the objective of the m:ci project is to understand the activities within the individual cities, to identify the specific framework conditions present, and to recognize the patterns within these activities.

Thus, the m:ci research visits were conducted with the following objectives in mind:

- To analyze the selected practice examples in relation to their motivation, conception, planning, successful implementation and measurements of success;
- To identify the key drivers and framework conditions which have affected the projects and solution approaches either positively or negatively;
- To analyze the network of actors, their roles within the studied projects and their solution approaches;
- And to discuss the transferability of projects and solution approaches to different cities.

1.3   SECTORS STUDIED

The criterion of sustainability permeates all dimensions and aspects of a city and can therefore never be wholly captured. A research project on sustainability must, therefore, always concentrate on a specific area. Seven sectors, which are strongly characterized by technological solutions, were identified within the m:ci project. The Governance sector was subsequently included as it is also considered important for the successful conception, planning, and implementation of projects designed to increase sustainability. These eight sectors are analyzed below and include the following aspects:

Energy
Import, creation, distribution and use of electricity, heating/cooling, gas und fuel.

Buildings
Energy-efficiency, comfort, holistic balance of all building styles within a city, buildings and public space, resource efficiency and recyclability of materials used.

Mobility
Range of available mobility options, modal-split, energy use, area requirements, emissions, use of public space.

Water
Water supply and disposal, water quality, reliability of supply, rainwater drainage, energy use.

Production & Logistics
Production in the city, distribution of goods to stores and to consumers, induced traffic volume and emissions.

Security
Security of public spaces and in buildings against vandalism, crime rate, terrorist attacks, security in relation to natural disasters.

ICT – Information and Communications Technology
City administration data, electronic availability of city services, information options in public spaces, ICT-infrastructure, ICT applied for intelligent steering and user-friendly options in the areas of energy, mobility etc.

BIG – Business Innovation and Governance
Policy and administration structures as well as methods and concepts applied to determine objectives, conception, decision-making, planning and implementation of solution approaches and projects aimed at increasing sustainability in relation to the initiation, organization, steering and evaluation of processes and projects, active participation of citizens and all relevant city actors, city development and planning as regards its linkage with politics and administration.

In NYC the following sectors were studied: buildings, mobility, water infrastructures, security, ICT, and governance.

1.4   RESEARCH APPROACH

The two-week research visit was conceptualized as follows:

City support
The NYC Office for Long-Term Planning and Sustainability was contacted prior to the research visit and was requested to confirm its support of the project. Additionally, several other locally based institutions (Universities, German associations and administrative offices) were contacted in advance.

Indicators
15-65 indicators were identified for each sector, and the data associated with these indicators was studied in advance of the research visit.

Practice examples
Participating researchers identified interesting practice examples in their individual sectors, in advance, which were then studied during the visit. Data and information on the examples was collected and analyzed.

Interviews
Relevant actors within each practice example were identified, and interview appointments were made for within the research period.

The interviews, typically 1.5 hours in duration, were conducted on the basis of a standardized questionnaire which was adapted to each interview. The interviews were recorded, when permitted, and later analyzed.

Viewings
The practice examples were, whenever possible, viewed/visited, in order to gain a personal impression.

Round Table
During the research visit, actors involved in the city's key projects were invited to attend an evening event during which the »m:ci« project, as well as the researcher's first impressions of NYC, were presented. The city's sustainability initiatives were discussed during a panel discussion and a subsequent reception.

Morgenstadt Lab
The 'Morgenstadt Lab' was held on the first Friday of the research stay, Following a defined methodology, Morgenstadt network members discussed several hypotheses relating to the practice examples in NYC. The hypotheses developed by the researchers were based on the interviews conducted during the first week of the research visit. The discussions served to help the researchers recognize inherent patterns in the implementation of projects and solution approaches in NYC.

1.5   CITY TEAM NYC

The following Fraunhofer researchers conducted the study during the research visit:

Sector	Researcher
ICT	Dominik Kalisch *Institute for Industrial Engineering IAO, Stuttgart*
Security	Daniel Hiller *Institute for High Speed Dynamics EMI, Freiburg* Hanna Leisz *Institute for High Speed Dynamics EMI, Freiburg*
Buildings	Elvira Ockel *Institute for Building Physics IBP, Stuttgart*
Mobility	Martha Loleit *Institute for Industrial Engineering IAO, Stuttgart*
Water Infrastructure	Felix Tettenborn *Institute for Systems Research and Innovation ISI, Karlsruhe*
Governance	Katrin Eisenbeiss *Institute for Industrial Engineering IAO, Stuttgart*

2   NYC AN OVERVIEW

This chapter summarizes key characteristics of NYC and provides an overview of the general framework conditions of the city. The historic, economic, political, and structural developments and conditions of NYC are highlighted and analyzed. An overview of key data and the status quo on the various sectors within the city is provided by Fraunhofer researchers.

2.1   BASIC INFORMATION

The City of New York is located on the East Coast of the State of New York and is surrounded by the Hudson River and the East River. With an average height of only six meters above sea level, the city infrastructure is highly vulnerable to storm surges and has been hit several times in the past.

The rivers divide the city into its five boroughs, which also comprise counties of the State of New York: Manhattan (New York County) is the business center of the city, home

to administrative offices and tourist attractions, and the most densely-populated borough of NYC. Brooklyn (Kings County) is the most industrial borough of NYC. Queens (Queens County) is the borough with the largest geographic area and home to over 50% of the city's foreign-born population. The Bronx (Bronx County) is the city's only mainland borough and home to the lowest income population of the city. Finally, Staten Island (Richmond County) is the least populated borough and the only one without access to the city's subway system but with a ferry connection to Manhattan.

„One of the world´s great urban centers, New York is in some ways a microcosm of the Nation as a whole. In other ways, it is unique in its traditional role of financial, business, and professional services powerhouse, a world cultural and social leader, and a crossroads for the exchange of information and the interaction of diverse population groups." (Liu 2011)

Table 1: General Indicators for NYC compared to Berlin

Indicator	New York City	Berlin
Population		
Population (2012)	8,336,679	3,292,365
Population growth (p.a.) (2002-2012)	2.1%	1.2%
Population density (p/km²)	10,630	3,692
Economy		
GDP 2012 (in Mio.)	256.8 US$	103.6 €
GDP per capita GDP per labor person (US-$)	31,417 US$ 64,173 US$	29,153 €
Ø economic growth (2010)	5.1 %	2.1%
Per capita debt (US-$) (FY 2011)	8,763 US$	17,958€
Unemployment rate (2012)	9.25 %	12.3%
Environment		
NOx (µg/m³)	14.57	55
PM10 (fine particles) µg/m³	22	33
Amount of waste	14,000,000 t	990,000 t
Recycling rate	50%	53%
CO_2- emissions per capita (2010)	6.66 t	5.2 t
Price of drinking water	8.78 US-$/ft³	2.2 €/m³
Water consumption per capita	476 l/day	112 l/day
Ecological footprint	11.72 gha/pers	4.4 gha/pers

Sources: Bureau of Economic Analysis 2013; DEC 2011; NY Population Estimates Program 2012; The City of New York 2012c; Liu 2011; The City of New York n.y.; U.S. Census Bureau 2012; U.S. Bureau of Labor Statistics 2012

2.2 ECONOMY

NYC is famous for many superlatives in its economy. It boasts the world's largest stock exchange, the most globally-influential media corporations, publishing houses and production studios, and the largest harbor in the United States. With a total GDP of $256.8 billion and 8.6 million employees, the City of New York is the second largest global urban economy after Tokyo, Japan.

86% of New York's employees work in the private sector. Public services and FIRE (Finance, Insurance & Real Estate)

are the most important sectors in the Big Apple, employing almost two thirds of the city's workforce. In 2012, with an unemployment rate of 9.25%, NYC was 1.75% above the average national unemployment rate of 7.5% in 2012 (U.S. Bureau of Labor Statistics 2013).

Unlike other cities in the United States, most jobs in NYC are located in the urban center of Manhattan or in one of the other four Boroughs instead of being connected to so-called "edge cities". Therefore, the majority of New Yorkers have the unusual luxury of commuting to work via public transit.

In terms of the cost of living, the Big Apple is the most expensive city in the United States. On average, New Yorkers spend 38% of their monthly household income on rent and another 25% on groceries. In Manhattan, living is more than twice as expensive as the national average (Pearson Education 2008).

2.3 WATER INFRASTRUCTURE

The NYC water supply and wastewater disposal system is one of the largest municipal water infrastructure systems worldwide serving more than nine million residents and visitors of the city (The City of New York 2013g).

Water Supply System
Until the beginning of the 20th century, with the shutdown of the last reservoir in Central Park in 1925, NYC's water supply was predominantly based on local water sources found within the city limits. By the mid-19th century, the first aqueducts were built to satisfy the city's increasing water demand. The Old Croton Aqueduct was placed in service in 1842 to carry water from sources outside of the city's boundaries (The City of New York 2013l).

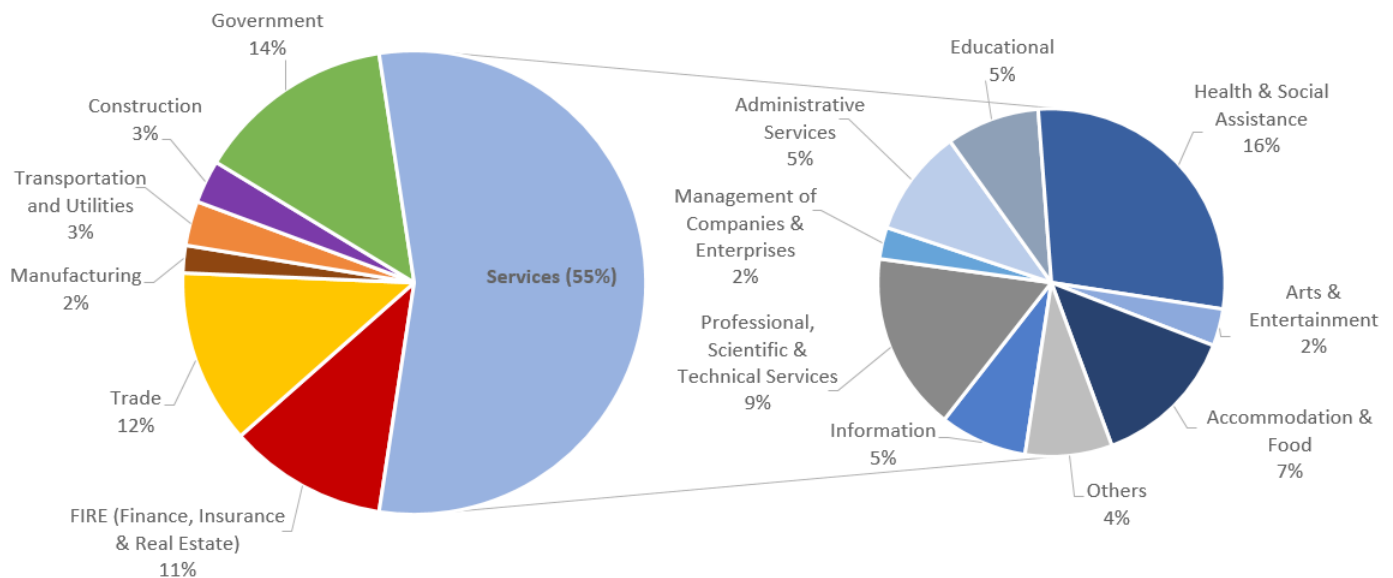Figure 1: New Yorker's place of work by borough of residence (U.S. Census Bureau 2010)

Figure 2: Division of employees by sector in NYC in March, 2013 (U.S. Bureau of Labor Statistics 2013)

Today, NYC's main water supply comes primarily from several reservoirs located in three different areas of the city: the Catskill/Delaware supply (via a more than 250 km long aqueduct); the Croton supply; and a groundwater supply in southeastern Queens. These reservoirs are interconnected to permit the exchange of water from one to the other. In 2012, 100% of the City's drinking water was supplied by the Catskill/Delaware reservoirs. The total amount of water supplied to the city is about 3.8 million m³ per day resulting in an overall per capita consumption of approximately 420 liters per day (The City of New York 2013o).

Aside from the large investment required to build and maintain such an infrastructure, two salient points stand out: First, NYC's water quality is reportedly amongst the best in the country, requiring no special water treatment (e.g. filtration) besides chlorination, which is a standard procedure in the United States. Second, nearly all of the water is supplied by gravity, requiring only very little energy in order to maintain the desired pressure in the city's water supply network (The City of New York 2013p).

Stormwater Management and Wastewater Disposal System (NYC DEP 2013d)
The city's wastewater, amounting to approximately 380 liters per capita per day is transported within a sewage system nearly 10,000 km in length to be treated together with most of the city's stormwater runoff (The City of New York 2013j) Fourteen wastewater treatment plants, located throughout different districts of the city, purify the water by activated sludge treatment and disinfection (with sodium hypochlorite) of the effluent. The total capacity of the wastewater treatment plants is about 6.7 Mio. m³ (The City of New York 2013h). By the late 1980s, congress banned the disposal of sludge into the ocean. Nowadays, the sludge generated by the wastewater treatment process is treated (thickened, digested, dewatered) and most often disposed of in land applications (e.g. in parks, farms, lawns, and golf courses) and landfills. To achieve his vision of a greener, greater New York, NYC's Mayor, Michael Bloomberg, was looking into more cost effective technologies with which to treat the city's wastewater (Sklerov; Román 2010).

In certain neighborhoods of the city, street runoff from rain and melting snow is carried by separate storm sewers directly to local streams, rivers and bays. However, approximately 70% of the city's domestic and industrial runoff and wastewater is collected in a combined sewage system. During heavy rains CSO can be discharged at nearly 500 permitted outfalls into the City's waterways (The City of New York 2013i). The city's median annual precipitation rate is 1150 mm (1869-2012), ranging from about 650 mm in 1965 to 1850 mm in 2011 (Fisk 2012). While historically, some communities of NYC have been prone to flooding, in recent years, "flooding has occurred more frequently than in the past, affecting a broader range of communities than ever" (The City of New York 2013d). According to NYC de-

partment of environmental protection (DEP), the main causes of flooding in recent years include the local topography with its surrounding rivers, coasts, the densely populated areas with a high amount of impervious surfaces, the aging infrastructure system and increasing extreme weather conditions (The City of New York 2013d).

PlaNYC Water Issues
Sustainable development initiatives, with respect to the city's water sector, are based on the city's overall strategic plan for sustainable development. PlaNYC targets the following topics:

- Assurance of quality drinking water (i.e.: the continuation of the Watershed Protection Program, protection of the water supply from hydrofracking for natural gas, and innovative efforts in water treatment).
- Maintenance and enhancement/modernization of the water supply infrastructure, including the inner-city distribution networks (i.e.: initiatives targeting the Delaware and Catskill Aqueducts, and the building of Water Tunnel No. 3 and a backup tunnel to Staten Island).
- Improvement of the efficiency of the water supply system (i.e.: by increasing the operational efficiency with new technology and increased water conservation).

Figure 3: Map of NYC's Water Supply System (The City of New York 2007a)

- Continued implementation of grey infrastructure upgrades (i.e.: upgrades to wastewater treatment plants, reduction of CSOs, and the expansion and optimization of sewage networks).
- Use of green infrastructure to manage stormwater (i.e.: the expansion of the Bluebelt program, building public green infrastructure projects, engaging communities in sustainable stormwater management and generating incentives for green infrastructure).
- Development of strategies to remove industrial pollution from waterways.
- Protection and restoration of wetlands, aquatic systems, and ecological habitats.

2.4 BUILDINGS

Buildings in NYC make a significant contribution to the city's total energy consumption. The NYC building sector is responsible for 75% CO_2 emissions, 94% of end-use electricity and 85% of potable water consumption. Lighting needs of buildings alone account for 27% of all electricity consumed in NYC and 12% of the city's CO_2 emissions. While buildings larger than 500,000 square feet make up only 2% of all of NYC's buildings, they consume 45% of the energy used in the entire buildings sector (OLTPS 2011).

NYC has an extensive social housing structure. The New York City Housing Authority (NYCHA) manages nearly 178,000 social housing units, providing residence to approximately 400,000 New Yorkers. The government under NYC's current mayor, Michael Bloomberg, has placed emphasis on the provision of affordable housing in NYC. In 2007, Bloomberg's administration issued a 23-year guideline, PlaNYC, for the development of a more sustainable city by 2030. PlaNYC includes the New Housing Marketplace Program (NHMP), outlining $7.5 billion to be invested into the development of 165,000 social housing units by the

end of 2013. The NHMP requires that all new housing be constructed to be more efficient and sustainable.

Energy Codes
In general, it is still difficult to make new developments in NYC energy efficient and it is particularly challenging to convince building owners to make energy efficient refurbishments to existing buildings. According to Russel Ungar, Executive Director of "Urban Green", the U.S. Green Building Council's (USGBC) New York chapter, a contractor's willingness to make efficiency retrofits is dependent upon their knowledge of sustainability and the economic benefits of building efficiency.

With respect to energy efficiency, building codes in the United States have improved in recent years. However, there is still a gap between code and enforcement and the gap between knowledge and implementation is even larger. Many developers and planners are uneducated on the intricate details of construction that can be employed for substantial improvements in building performance. Thus, the challenge of greater building efficiency is designing an educational strategy that will close the gaps between professionals and the industry. Building codes alone cannot bridge these gaps.

Sector Impacts
Sector-by-sector analysis suggests that the most promising sectors for efficiency improvements are multifamily buildings, which collectively represent 80% of all properties in NYC and 65% of the city building's total square footage. Multifamily buildings are not nearly as energy intensive as office buildings and other building types, such as hospitals or retail spaces. Therefore, their proportional energy use is not as pronounced and accounts for less than 50% of all building energy consumption. Office buildings, on the other hand, are the second largest sector. Because they are
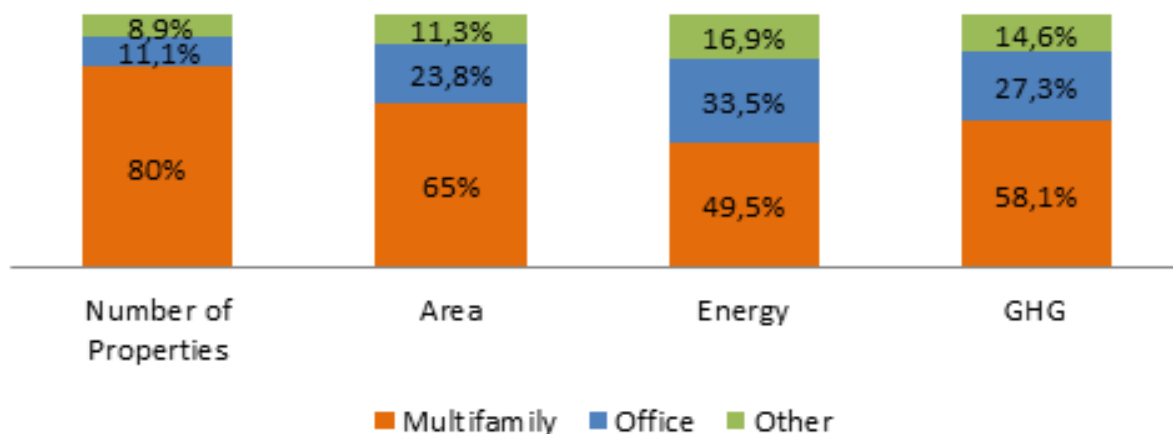

Figure 4: Proportional Impact of Multifamily, Office and Other Properties (OLTPS 2012a)

large and energy intensive, they account for just 11% of the large buildings (over 50.000 square feet) in NYC, but almost a quarter of total square footage and over a third of total building energy use (OLTPS 2012a).

Leadership in Energy and Environmental Design (LEED)
LEED helps to push buildings towards sustainability by encouraging building performance superior to energy code requirements. However, there are a lot of tradeoffs with LEED. The main problem is LEED's rating system, which is only useful for short-term improvements because it neglects long-term performance. Specifically, LEED is not concerned with building envelopes. LEED is a big driver in NYC's commercial real estate, as such developments have large energy consumption, and their developers' goals are often shortsighted. LEED is, however, having a positive effect on greenhouse gas (GHG) emission reductions, as the majority of new buildings are obtaining LEED certification. LEED affects codes by nudging the leaders along. Politically, if the major developers agree with a certain regulations, the City will then be able to pass new code requirements with relative ease. As such, a leading building takes practices that were previously considered cutting edge and standardizes them.

Funding
Funding for sustainable development in NYC is predominantly available as robust tax incentives for solar technologies and cash reimbursements for energy efficiency projects. The New York City Energy Efficiency Corporation (NYCEEC) was launched in 2011 with $37 million in Federal American Recovery and Reinvestment Act (FARRA) funds to provide financing for public and private energy efficiency projects (GGBP 2008). In 2007, the Office of the Mayor released Executive Order 109 requiring NYC to invest 10% of its annual energy bill to fund GHG reduction projects. The city has also allocated 10% of its annual budget, roughly $80 million, to implementing energy efficiency measures in government buildings (GGBP 2008). The New York State Energy Research and Development Authority (NYSERDA) will reimburse building owners for up to 25% of the cost of solar technologies and installations. Additionally, owners can receive a NY State Tax Credit for 20% of the costs above $5,000 and a 30% Federal Tax Credit and a 10% City Property Tax Credit on the full cost of equipment and installation.

2.5 MOBILITY

NYC ranks first in the nation in terms of passenger miles flown, transit passenger miles travelled and truck freight volume. In the year 2006, transit alone accounted for 1.8 billion passenger trips carrying 8 million passengers per day (almost 70% in subways) (CUNY Graduate Center 2008). New Yorkers are heavily dependent on public transportation

(Forbes 2013) and have a much lower car ownership rate (23%) than any other major city in the country (78% average). Moreover, NYC is the only city in the United States where more than half of the households do not own a car. Were the city to follow general car ownership patterns, the city would have an additional 4.5 million cars on its streets. The rate of increase in the use of electric vehicles on New York's streets is amongst the highest in the country. Alone in the past year, the amount of electric cars driven in NYC has tripled (ChargePoint 2013) Given the abovementioned factors, NYC residents save approximately US$19 billion in car-related expenses per year, thereby boosting local purchasing power. The transport sector alone, however, emitted 11.4 million tons of CO_2 in 2010 (69% from passenger cars) and is the second largest CO_2 emitting sector after electricity generation (The City of New York 2011b). Due to low private car use, about 48 billion miles (approx. 77 billion km) of travel are avoided yearly, saving the city 23 million tons of transport-related CO_2 emissions (Cortright 2010).

Since NYC is home to the most extensive and complex public transportation network in the United States (Mediabridge Infosystems Inc. 2013) its residents – across all income-levels – primarily use mass transit (subway, train, bus or ferry) to commute to work (56.8%). With the exception of Staten Island and Queens, workers living and working within the same borough mainly bike, walk, hail a taxi, drive motorcycles or work at home while those commuting outside of their boroughs largely travel by subway, rail or ferry. For all boroughs of NYC, except Staten Island, the majority of the workers commute to work without the use of a private car (The City of New York 2013e). Manhattan has the highest rate of public transportation use of any borough with only 5% relying on private cars to travel within the same borough and 16% to travel into or out of Manhattan (The City of New York 2013a). In fact, apart from the borough of Manhattan, which hosts the highest number of employees – of which approximately 60% reside in other boroughs or outside the city – most people work in the same borough they reside in.

Compared to the rest of the state or country, although the trip purpose distribution is similar, the number of trips per day, the length per trip and the miles travelled per person are significantly lower in NYC (Hu; Reuscher 2007). While, in 2011, the average American travelled approximately 41 miles per day, NYC residents travelled only half as much. Without a doubt, the high affinity towards public transportation is directly correlated to the city's population density and that, in highly populated areas, the majority of the trips are made using public transit or walking. In light of these circumstances, and taking into account the incredibly high population density of NYC (particularly of Manhattan), efforts are less concerned with moving people away from cars and more interested in improving the city's existing public transportation system. The biggest focus on transportation in recent years has been on non-motorized transportation

- highest flown passenger miles
- highest transit passenger miles
- highest truck freight volume
- most extensive and complex public transportation network
- low car owner ship
- low distance travelled per day
- high use of public transportation

Figure 5: Facts and figures about transportation in NYC

- 23 % car owner level
- <50% households own a car
- US$ 19 bilion saved on car ralated expenses
- 48 bilion miles avoided per year
- 23 million CO$_2$-tonnes avoided per year

Figure 6: Facts and figures about car ownership in NYC (U.S. Census Bureau 2013)

modes. Transit, especially, is struggling with huge daily public demand and limited capacity leading to congestion.

Public transportation in NYC is mainly managed by three agencies: the Metropolitan Transportation Authority (MTA), which is responsible for all transit activities including the NYC subway, the NYC buses, and the Staten Island Railway, the Port Authority of New York and New Jersey (PANYNJ), which is in charge of operating three major rail systems and three airports in the area, and the Taxi and Limousine Commission (TLC), which oversees yellow taxi cabs and many for-hire vehicles. In addition, the NYC Department of Transportation (DOT) manages most of the city's transportation infrastructure with the aim of making mobility as safe, efficient and environmentally sound as possible. Since 2007 the NYC DOT is led by the mayor-appointed Commissioner Janette Sadik-Kahn.

Approximately 40% of NYC's transit agency funding is generated by revenue made from passenger fares, tariffs and subsidies. Struggling with budget deficits, the MTA imposed a 50-cent surcharge on yellow taxi fares in 2009 in an effort to help subsidize their costs. Federal, state and local taxes, along with other financial sources, provide the remaining funding. As a result, transit agencies rely heavily on the national economy and are, therefore extremely vulnerable to economic fluxes. One of the funding sources, for example, is the gas tax that is collected by the United States Highway Trust Fund (USHTF). This gas tax is the primary source of funding for the MTA. The fund distributes the tax money to the Highway Account, the MTA and the Leaking Underground Storage Tank Trust Fund. Funds collected by the USHTF are forwarded to the state DOT where funds are allocated solely to capital projects, not operations. Compared to the federal gas tax, at approximately 4.9 cents per liter, drivers in the State of New York are charged the highest gas tax in the country at 18.2 cents per liter (Juva-Brown 2013). Although some states, such as New York, contribute more to the USHTF than others, this does not necessarily imply that the same amount is gained back.
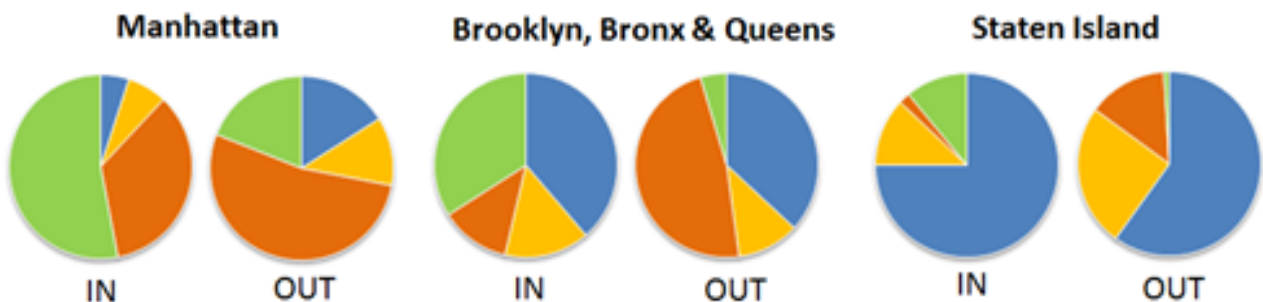
Figure 7: Modal split of NYC residents by borough and by workers living and working in the same borough (IN) and workers commuting outside borough of residence (The City of New York 2010b). Blue: Car; Yellow: Bus; Orange: Subway/RR/Ferry; Green: Other (Bicycle, Walk, Taxicab, Motorcycle, Work at Home)

In light of NYC's many transportation challenges, which face the additional strain of a growing urban population (forecasted to be augmented by 1 million by 2030) and ambitious carbon reduction goals, Mayor Bloomberg has included a range of initiatives in PlaNYC to tackle and improve the city's transportation infrastructure, reduce congestion and expand transport service. Some of the planned mobility-related measures include promoting car- and bike-sharing programs, improving and expanding subway and taxi services, enhancing walking and cycling conditions and testing the concept of congestion-pricing methods. Since the implementation of PlaNYC, significant progress has been made within this sector. Over 25 city agencies have been mobilized and are collaborating towards achieving a greener, greater New York.

2.6 SECURITY

During recent decades, NYC has suffered from numerous disasters. Varying in type and degree of gravity, these disasters include the World Trade Center (WTC) bombings of 1993, the attacks of September 11 and the complete destruction of the WTC, and the recent disastrous consequences of Hurricane Sandy. As a result, resilience and security are at the very core of the city's efforts to protect its citizens and provide for a functioning urban system. Such disastrous events have proven that not only the crisis managers of the relief forces, such as the New York Police Department (NYPD) and the Fire Department of New York (FDNY), but also other actors in research, society and industry must understand what it takes to establish a resilient urban system. Each actor plays a vital role in improving the city's response to, and eventual recovery from, catastrophes such as Hurricane Sandy.

With respect to security and resilience measures, NYC has proven to be on the forefront of many technological and infrastructural innovations. NYC's authorities have recognized that a resilient city requires both thorough risk and crisis assessment – i.e.: digital mapping systems for areas with a high vulnerability to natural and man-made disasters and precise analysis of the social and infrastructural composition of these possibly affected areas – coupled with a resilient infrastructure equipped with technology to support the action taken in case of an emergency. Therefore, the NYPD has implemented various real-time technology systems for crime detection and surveillance. The Domain Awareness System (DAS), for instance, integrates numerous sensors, such as video cameras and license plate and facial recognition systems, to provide security agencies with large amounts of information on possible suspects or dangers (McDuffie 2008).

In terms of the various natural and man-made threats the city is facing, an increase in public awareness and citizens' access to meaningful information and education in preparation of catastrophic events, belong to the essential strategic goals of the overall emergency management activities of the city.

Based on the successful implementations of PlaNYC, the city implemented "A Stronger More Resilient New York", a nearly 20 billion ($US) resiliency plan. in order to better respond to disasters such as the recent hurricane which resulted in 43 deaths, 6,500 patients evacuated from hospitals, nearly 90,000 buildings affected by inundation and 1.1 million children and youth unable to attend school for one week. This plan combines numerous initiatives to further protect the coastline as a first line of defense against storm flood events and improve building infrastructure strength and vitality. A healthy city relies on a properly functioning energy grid, transportation system, parks, telecommunication, healthcare, and water and food supply networks. As an information source for New Yorkers both professionally and privately involved in disaster preparedness, response and recovery, "A Stronger More Resilient New York" (The City of New York 2013b) provides structured information on all key actors and institutions of NYC, including information on emergency management agencies and other important administrative and operational bodies (The City of New York 2013b).

As mentioned above, the Lower Manhattan area is NYC's most densely populated borough. Manhattan is considered a particularly vulnerable area since it is not only home of the financial district and the new WTC – featuring the tallest building in NYC as well as a highly complex underground parking and service tunnel system, and a large transportation hub – but is also the location of several other interdependent critical infrastructure facilities such as electric, telecommunication and wastewater facilities, hospitals and several transportation services. The reconstruction of the WTC site, after its complete destruction on September 11, 2001, represents a highly vulnerable area prone to natural as well as man-made threats. Despite the unique aspects of the WTC reconstruction project, which does not allow for generalization, the project serves as a key practice example for this report with its unprecedented security and resilience solutions.

The following chapters represent a collection of NYC's best practices. Each of the practice examples was defined and analyzed by the Fraunhofer-representative of the corresponding sector. Please note that this is not a complete representation of all best practices and sustainability projects within NYC. The following collection represents a selection of best practices that serve as good examples to other cities seeking to strengthen their sustainable development.

2.7 HISTORICAL DEVELOPMENT

The New York Bay was discovered by European explorers in 1524. At that time, the island of Manhattan was home to Native Americans. Exactly one century later, the Dutch West India Company settled in the bay. With the foundation of the New York stock exchange in 1729, the city's further development was determined. By 820, NYC was the most populated city in the United States with 123,000 inhabitants. The New York Times newspaper, with its first edition printed in 1851, as well as the completion of the Statue of Liberty in 1886, has contributed to the city's fame worldwide.

The growth of NYC's population was driven by immigration from the very beginning, and today, the city is the main gateway for legal immigration into the United States. It is a city with over 800 languages these days and only 52% English native speakers (New York Reporters 2013). One of the city's main challenges is that it has the US-wide highest segregation rate between white and black citizens of about 79% (Logan; Stults 2011).

Today, with 8 million inhabitants, NYC is the most heavily populated city in the United States. As a global financial center and tourist hot-spot, the New York Metropolitan Area, with 22 million residents, boasts the nation's highest GDP.

With respect to demographic and economic development, NYC has not always fared so well. In fact, NYC has historically experienced a fluxuating population. After a phase of substantial growth in the late 1960's, NYC suffered from the oil crisis and economic recession of the mid 1970's and lost a sixth of its employment base (ICLEI 2010). During this period of population decline, the city shifted course and turned its economy away from manufacturing and towards the development of finance, services and construction. This shift resulted in a successful decade of growth between 1976 and 1987, during which time 400,000 new jobs were created, predominantly in the private sector. However, by the 1990's, NYC was again affected by the national recession, suffering a cutback of over 100,000 jobs in the service-producing sector (Ehrenhalt 1993).

Due to the crime reduction efforts of former mayor Rudolph W. Giuliani, the image of NYC as the world-famous dangerous city has been improved dramatically. Giuliani achieved
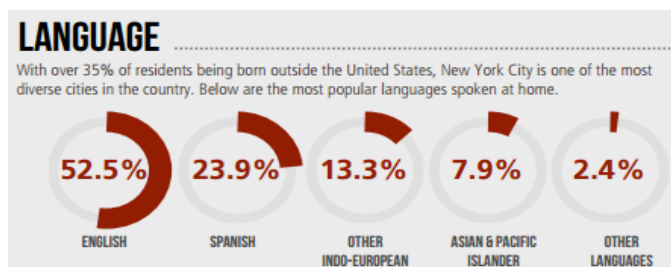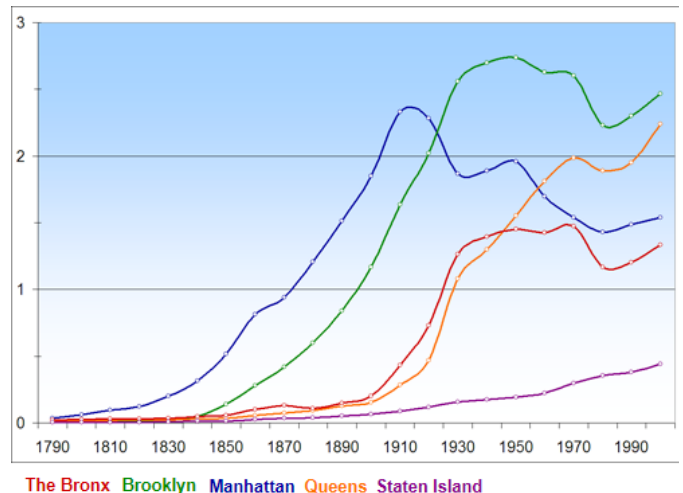
Figure 9: Population development of NYC´s Boroughs since 1790 (Schorzman 2006)

this by implementing the nation´s largest and most successful 'welfare-to-work' initiative. He enacted a record of over 2.5 billion in tax reductions while turning the city´s 2.3 billion dollar budget deficit into a multi-billion dollar surplus. With his aggressive crime-reduction, welfare-reform and economic growth initiatives, coupled with a disciplined fiscal plan, Mayor Giuliani led the City of New York into "an era of broad-based growth" (OLTPS 2013), reaching record levels in tourism and a new quality of life for its residents.

In the meantime, NYC has become a role model not only for other large cities in the United States, but for many cities around the world.

Sadly, the city received more publicity on the 11th of September, 2001 – a day which went down not only in American but in global history. The loss of nearly three thousand lives and the city´s famous skyline has affected the security sentiment of many Americans to this day. The events of 9/11 collectively traumatized the entire nation. However, the events also provide valuable insights into a society which chose to focus on the tradition of American patriotism and on a new city dynamic: a dynamic of humanity, of real empathy and of people who care for one other and spring into action when help is needed. Sixty years after the first foreign attack on US soil in Pearl Harbor, today's generation has not only learnt how to recover, but in doing so New Yorkers have discovered the value of resilience and self-help structures.

Last year, the city was reminded of this value when Hurricane Sandy hit the east coast of New York on October, 29. The physical damage caused by this natural disaster cost the lives of approximately 50 people and amounted to over 20 billion US-$ in damages. However, this time the city government was prepared and utilized a new force in order to enhance society's capacity for reaction: Social media. Social media channels emerged as the best and most

LANGUAGE

With over 35% of residents being born outside the United States, New York City is one of the most diverse cities in the country. Below are the most popular languages spoken at home.

52.5%	23.9%	13.3%	7.9%	2.4%
ENGLISH	SPANISH	OTHER INDO-EUROPEAN	ASIAN & PACIFIC ISLANDER	OTHER LANGUAGES

Figure 8: Language diversity in NYC (New York Reporters 2013)

accessible tools for authorities and citizens to use in order to provide information about the best evacuation routes, where to find a save place to stay or find a friendly neighbor with food reserves. The city government published several articles on how to stay connected via Facebook, Twitter, and other social media. First Aid apps were shared (Estes Cohen 2013) During Hurricane Sandy, the city institution "NYC Digital" monitored social media for public reaction to the event, sending daily reports to City Hall. The government provided information and answered questions on the city's Tumblr, Twitter and Facebook accounts, and the city's regular information service provider, "nyc 311", received so many inquiries via phone, text message and email that volunteers were called in to support the city employees.

Not only did Hurricane Sandy put neighborhoods´ self-hel-

ping structures and the government´s capacity of adopting up-to-date communication for an effective organization in times of emergency to the test, but it also increased citizens´ awareness of the impacts of climate change and forced understanding of the urgent need to prepare and prevent. With Damocles' Sword hanging over them, New Yorkers stepped up their efforts to learn from the past, prepare for the present and anticipated the future.

2.8 CITY PLANNING, POLICIES, LEGAL CONDITIONS

The city government of NYC is designed to follow the so-called 'strong mayor-council government model', one of two local government forms most commonly used by mu-
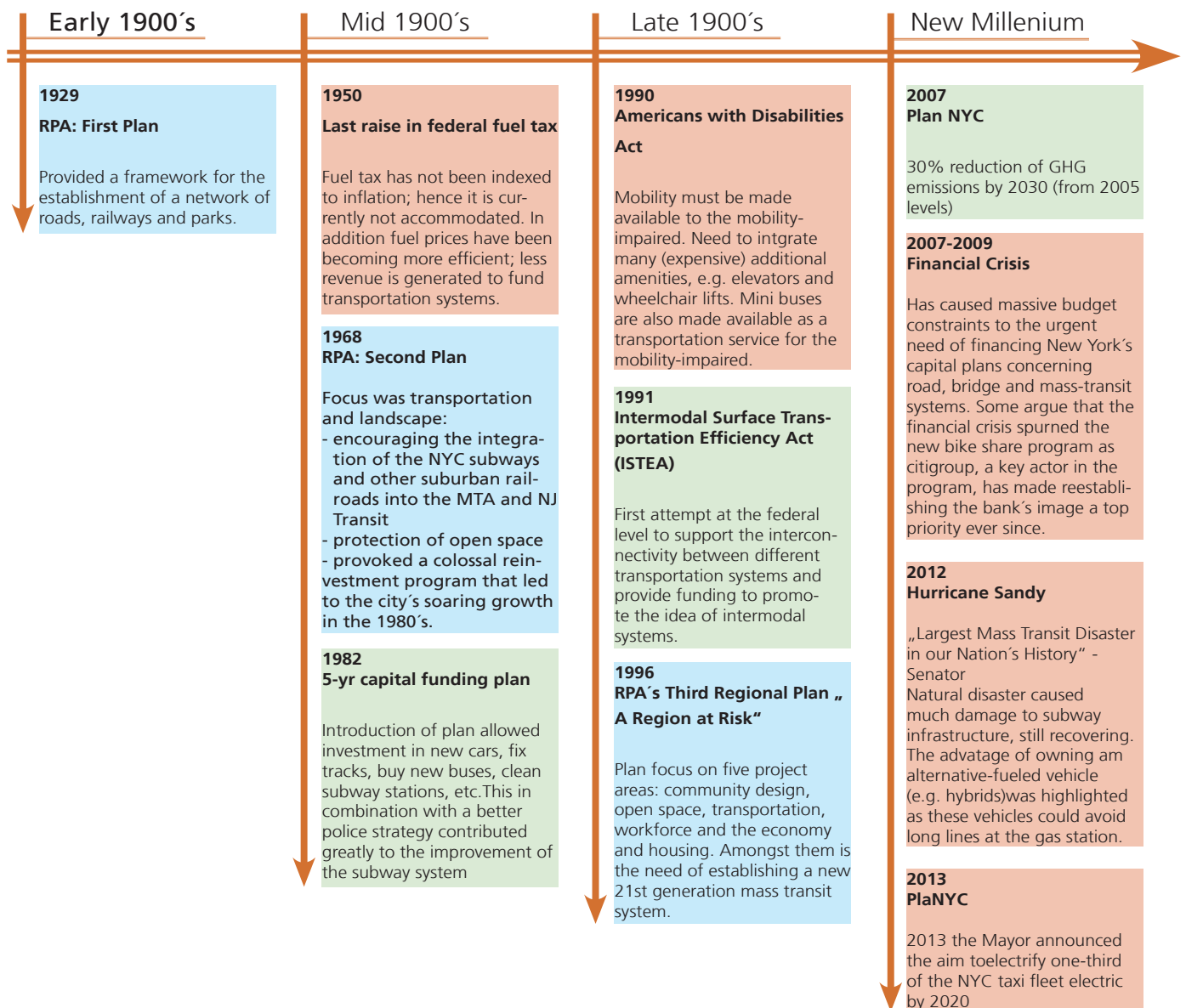

Figure 10: Timeline of historic developments affecting the mobility sector of NYC. Divided into guidelines of improvement (blue), sustainability plans or acts (green) and events that hinder development (red) (own graphic)

Non-City Control of Capital Assets in New York City

	Federal Govt.	State Govt.	Port Authority	MTA	Other Authorities*	Private Sector
Transportation		✓	✓	✓	✓	✓
Transit		✓		✓		✓
Environmental Protection						
Education		✓			✓	✓
Housing					✓	✓
Public Protection & Justice	✓	✓				
Health	✓	✓				✓
Parks, Libraries & Culturals	✓	✓				✓
Sanitation						✓
Energy					✓	✓
Telecommunciations						✓

Note: ✓denotes capital asset holdings by government, authority or private sector in that functional area.

*Capital assets controlled by "Other Authorities" include assets owned or managed by the New York State Thruway Association (transportation), the Dormatory Authority of the State of New York (education), the Battery Park City Authority (housing), the Roosevelt Island Operating Corporation (housing), and the New York Power Authority (energy).

Figure 11: The control of capital assets in NYC (Citizens Budget Commission 2007)
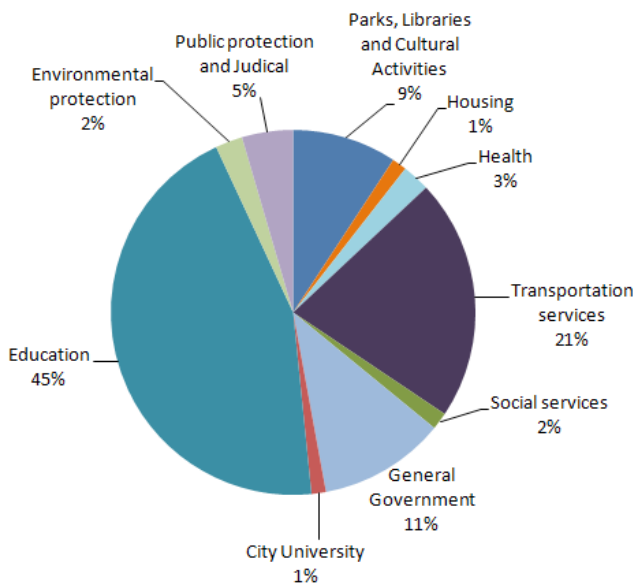

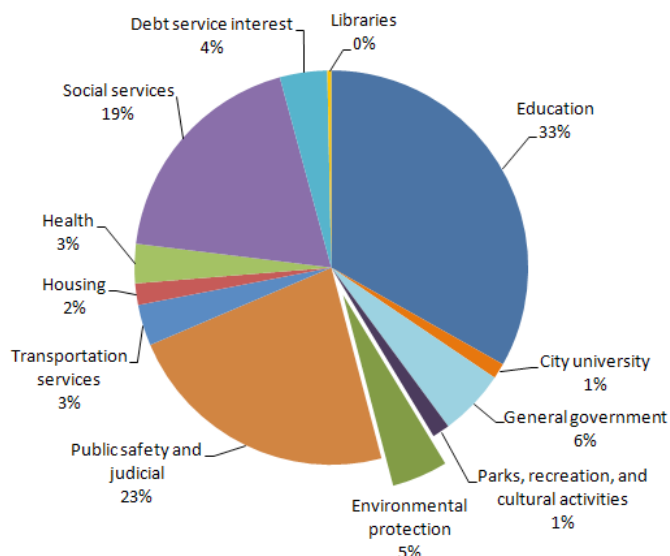Figure 12: City-owned capital assets in New York by share of total net book value (The City of New York 2012a)

Figure 13: Expenses of the city government of NYC (The City of New York 2012a)

nicipal governments in the United States. Compared to the so-called 'council-manager government model', under the 'strong mayor-council' model one of the city government's main pillars is the Mayor himself, who is elected by citizens for a regular term in the city's legislature. What makes this a 'strong' system is the relationship between the Mayor and the City Council. Whereas the 'council-manager' model represents the legislature within a tri-dimensional understanding of the division of powers, the city mayor under the 'strong mayor-council' model holds nearly total administrative authority. This includes the authority to designate individuals to top positions of the city's various departments.

The regulative power of the city government is, however, highly restricted with respect to the government's influence on the private sector and consumer behavior. The government of NYC can only set standards and make recommendations for sustainable standards, e.g. how a building should be built. As long as no person is negatively affected directly, the city governments cannot write legislation in favor of climate change. Mayor Bloomberg's administration found a way to strengthen sustainability in NYC by market regulation via freedom of information. Thus, the city government of NYC has made it a requirement to provide information e.g. on the energy consumption of buildings. Based on this information the consumer can decide on which building he or she wants to live in: a more or less sustainable one. The market – as assumed – will shift in the right, energy efficient direction. In the end, the decision is not about being better or worse, greener or less green, it´s about costs for energy consumption and cost savings for private households. "The money is the deciding factor, because that´s the way the US-economy works", says Sandy Hornick, former Deputy Executive Director for Strategic Planning at the Department of City Planning.

2.9 CITY CONTROL OVER CAPITAL ASSETS IN NYC

The city government´s range of influence on capital assets is limited due to the fact that many assets are under the jurisdiction of other entities. For instance, the city government does not have authority over the majority of NYC´s most important infrastructure systems such as the transit system, which is controlled by the MTA, the energy delivery and telecommunication systems, which are owned by the private sector, and the inter-regional transportation and transit systems, which are in the hands of the MTA and the Port Authority (Citizens Budget Commission 2012).

"The net increase in the City's capital assets during fiscal year 2012 was $1.747 billion, a 4% increase. Capital assets additions in fiscal year 2012 were $8.001 billion, a decrease of $514 million from fiscal year 2011" (The City of New York 2012a).
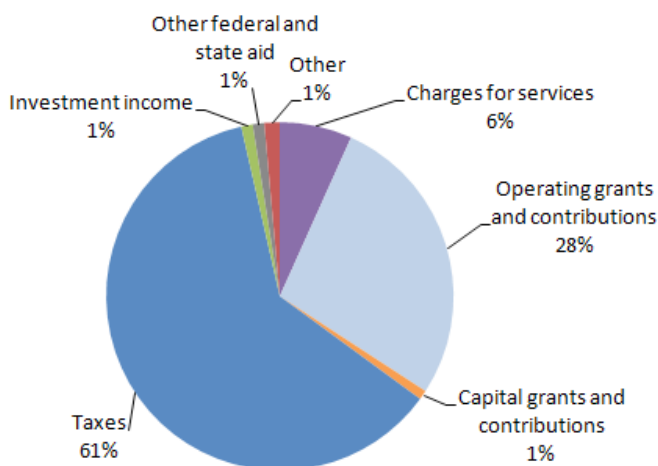
Figure 14: Revenues of the city government of NYC (The City of New York 2012a)

2.10 KEY ACTORS IN THE SECTORS ANALYZED

2.10.1 Political Decision-Making Bodies and the City Administration

The majority of city governments in the United Stated can be classified into either the weak or the strong mayor-council government models discussed above. As the government of NYC belongs to the latter type, the following key decision-makers and most importance sectors of the city's administration are discussed below.

The Mayor
As mandated by the NYC Charter, the mayor is the chief executive officer of the city. Once a year, the mayor has to prepare a statement on the financial and governmental situation of the city to the City Council. This statement includes a summary of the activities of the 41 city agencies and their contribution as well as the city's progress in pursuing the targets contained in its most recent strategic policy (The City of New York 2004).

Additionally, the mayor must report twice a year to the City Council and the public at large on the performance of municipal agencies in delivering services in what is known as the Mayor's Management Report. In light of this, city agencies must report directly to the Mayor's Office. The report includes all activities that have impacted NYC's citizens and is structured in accordance with the key public service areas, such as 'Public Safety and Legal Affairs' and 'Health and Human Services'. The report discusses 'Critical Objectives' within these service areas as well as the agencies' goals and 'Performance Statistics' in order to reveal the progress made in achieving defined indicators throughout the service areas (The City of New York 2011e).

Apart from these reporting obligations, the mayor has the power to appoint and remove the heads of administration, departments, commissioners and other officers not elected by the people. The mayor himself/herself is elected for a four-year-term in office, but can be removed by the governor of the State of New York at any time. Mayor Bloomberg's current term will end after three consecutive terms in office, at the end of 2013. NYC will hold elections on November 5, 2013, and the newly elected mayor will take office on January 1, 2014 (The City of New York 2011e).

Michael Bloomberg became mayor of NYC in 2002. He is a business magnate and owner of Bloomberg L.P., a famous global financial data and media company based in NYC. As the 7th-richest man in the United States, Bloomberg is not only financially, but also politically, independent. For example, he exchanged his annual salary of $225,000 for a symbolic salary of $1. Previously a Democrat, Mr. Bloomberg switched political parties before running for mayor in 2001. Two years later he left the Republican Party and was elected to his third term as an independent candidate in 2009, after successfully campaigning to change the city's term limit laws.

Bloomberg is well known for his engagement in sustainable development not only for the City of New York, but also as a model for other city mayors with similar visions. As the leader of the C40-group, Bloomberg is kindly regarded and NYC's history of development during his terms in office serve as a prime example of how large cities can evolve their image from an old, grey era of industrialization towards a new, green era of attractive spaces; spaces designed for a successful togetherness of economic actions and society's needs in an ecological balance. Bloomberg is convinced that the best way to pursue the targets of sustainable living in urban spaces around the world is for cities to learn from one another. He wants to share the experience of NYC's performance in this process with other cities and visionaries (ICLEI 2010).

The City Council
As the legislative body of the city, the NYC Council has the power to adopt local laws. Local laws apply to all citizens equally and must be consistent with the City Charter, federal and state laws and the Constitution of the United States. After a local law is passed by the council and certified by the clerk of the council, it is presented to the mayor for approval. Only if the mayor signs the local law is it returned to the clerk and can be deemed adopted (The City of New York 2004).

The City Council consists of a public advocate and 51 council members. One council member is elected out of each council district of the city's five Boroughs. Similar to the mayor, the public advocate and the council members are elected to serve four-year terms (The City of New York 2004).

Under NYC's 'strong' mayor-council government model, the City Council can be understood as the mayor's counterpart, given that the City Council serves as a monitoring body for the city agencies. In other words, the council reviews the

activities of the city agencies on a regular basis, evaluating their performance, attainment of service goals and their management. Therefore, to avoid conflicts of interest, council members are not allowed to be employees of any city agency (The City of New York 2004). Furthermore, the council has the sole accountability to authorize the city budget.

The public advocate, elected by the voters of the city, has the right to participate in the council discussions but has no vote. His or her role is to monitor public hearings, review complaints concerning city services and oversee other administrative actions of city agencies (The City of New York 2004).

Comptroller
The Comptroller of NYC is elected on the same principle and for the same term as the mayor. The comptroller´s function is primarily to advise the mayor and the council with regards to the financial condition of the city by recommending and critiquing the fiscal policies and financial operations of the city. Furthermore, the comptroller has the power to audit and investigate all matters of finances throughout the city´s transactions, the city agencies and the expenditure of city funds.

Borough Presidents
Each of the five Boroughs throughout NYC elect one resident as president at the same time – and for the same term – as the mayoral elections. As representatives of their boroughs, the role of the borough presidents is to make recommendations to the mayor in the interest of the people of their respective borough. They propose capital projects (e.g. streets, parks, sewers, bridges), hold public hearings, make budget recommendations to the mayor and the council, review and analyze proposed budgets and consult with the mayor in the preparation of the executive expense budget as well as the executive capital budget.
Furthermore, the borough presidents monitor the performance of public service delivery throughout their borough and oversee the coordination of a borough-wide public service complaints program. Complaints of borough residents are reported to the mayor, the council president and the public.
In addition, the borough presidents prepare strategic policy statements for their borough, including long-term issues with respective policy goals and proposed strategies for meeting these goals. These statements are presented to the mayor, the council and various community boards in the respective boroughs. Moreover, the presidents' role is to propose new legislation to the council. Borough presidents must establish both a budget and planning office to support their work.

Community Boards
As mandated by the City Charter, the community boards must submit budget priorities pursuant to the different public service areas. These budget priorities are based on the annual report on social indicators that the mayor submits to the city council, the borough presidents and the various community boards. The report analyzes "the social, economic and environmental health of the city and proposing strategies for addressing the issues raised in such analysis" (The City of New York 2004).

The Department of City Planning and the City Planning Commission
The Director of City Planning, as the head of the department with the same title, advises and assists the mayor, the borough presidents and the council in matters related to city development and strategic planning. Physical planning and the goal of public improvement is monitored by continuous studies and statistics, conducted and collected by the department of city planning. In addition to this data-based approach, the department of city planning provides community boards with staff and technical assistance.

In addition to the Department of City Planning, the City Charter of New York provisions call for a City Planning Commission. This commission consists of a commission chair and twelve other members. The commission is responsible for "the conduct of planning relating to the orderly growth, improvement and future development of the city" (The City of New York 2004). Furthermore, the commission oversees the implementation of laws that require environmental reviews of actions taken by the city and should establish procedures for such reviews of proposed actions by the city, which are required by law.

2.10.2   Other Key Actors

U.S. Department of Transportation (DOT)
Established in 1966, the Federal Cabinet Department (FCD) is responsible for all issues associated with NYC's transportation system. The FCD provides funds from the FARRA to various transit projects, including the New York commuter rail extension and subway project. The DOT promotes the use of sustainable modes of transportation and enhances transportation infrastructure. The agency in New York, NYC-DOT, manages one of "the most complex urban transportation networks in the world" (The City of New York 2007b).

NYCTA aka. MTA of NYC
The New York City Transit Authority (NYCTA), branded the MTA, is in charge of North America's largest transportation network. With an average ridership of more than 8.5 million per day, this public authority manages and operates the majority of public transportation in NYC including the NYC Bus, the NYC Subway and the Staten Island Railway. The MTA has committed the past 20 years to restoring and improving old transit networks and will continue to do so with the 2010-2014 Capital Program. The MTA suffers under extreme financial burden and is unable to operate on revenues gleaned from rider fares and road tolls alone. Thus, the MTA relies heavily on external funding (e.g. real estate taxes for transportation or bonds) – leading to debt. All the

while, government support has been declining.

Port Authority of New York and New Jersey (PANYNJ)
The PANYNJ is responsible for managing many bridges, tunnels, airports and transit systems in both cities. It is involved in various actions to promote sustainability. For example, the PANYNJ supports green transportation by employing hybrid-electric, plug-in-electric, CNG or ethanol powered vehicles for the majority of their fleets and are integrating more secure infrastructure for cyclists. PANYNJ does not have the power to charge taxes nor does it benefit from receiving tax money. The authority operates on revenues collected from rents, tolls, fees and facilities.

Regional Planning Association (RPA)
The RPA is a non-profit organization that aims to provide recommendations for the improvement of quality of life, sustainability, infrastructure and economic competitiveness that shape the tri-state region.

Taxi and Limousine Commission (TLC)
The TLC is the most active taxi and limousine licensing regulatory agency in the country. TLC is the only agency responsible for the licensing and regulation of NYC's medallion taxicabs, for-hire vehicles, commuter vans, paratransit vehicles and certain luxury limousines. The chairman of the commission, David Yassky, was appointed by the Mayor.

United States Environmental Protection Agency (USEPA)
The United States Environmental Protection Agency (USEPA) is a Federal Government agency that develops and enforces regulations in accordance with laws established by Congress in the interest of protecting the environment and human health (e.g. Clean Air Act Amendment). In 2011 the agency sought to regulate GHG emissions for the first time ever with the so-called 'Clean Air Acts'.

3

3 SUSTAINABILITY OBJECTIVES

3.1 OBJECTIVES AND THE DEFINITION OF SUSTAINABILITY – THE VISION OF A "GREENER, GREATER NEW YORK"

"Thirty years ago, a plan for New York´s future would have seemed futile." (OLTPS 2007).

These are the introductory words of the first master plan for the city development of New York. Released in 2007 under the name "PlaNYC 2030" (the "Plan"). The Plan has become famous among city planners and politicians for its ambitious, comprehensive goals and successful implementation of the same (ICLEI 2010). Although the terms 'sustainability' and 'sustainable' are minimally used throughout the 158 page plan, PlaNYC serves as a global example of sustainable community and economic development.

By looking at which institutions promote PlaNYC, one can assess the level of influence the principals of sustainability have had on the strategic policy of NYC. The OLTPS, which was founded in 2006 has been one of the most important initiatives of the Bloomberg administration. The OLTPS is not only responsible for the conception of PlaNYC, but it also defines achievement indicators for the plan's self-imposed objectives and evaluates the progress of the involved city agencies in the pursuit of its targets. The OLTPS achieves this by monitoring the respective indicators, guiding the agencies´ activities and realigning indicators and strategic measures when needed.

The OLTPS's complex definition of sustainability is based on three pillars: encouraging economic development, meeting social needs and environmental protection and resilience. With this understanding of sustainability, the city government of New York has aligned itself with the terms' original definition, which was first presented in the Brundtland report. While all city agencies must prescribe to the abovementioned definition of sustainability, PlaNYC, the master plan of NYC's development, does not present sustainability in precisely this way. PlaNYC focuses on key terms such as 'greener' as coined in the plan's official slogan: A 'greener, greater New York'. Therefore, many citizens and even some city employees, understand sustainability as a synonym for environmental protection. This partial understanding of sustainability will make it challenging for PlaNYC to communicate common objectives and target timelines in future updates.

The first und most recent update of PlaNYC was released in 2011. It includes 132 initiatives and more than 400 specific milestones with a deadline set for December 31, 2013. The ten fields of action, including a list of their individual goals, indicators (quantitative and qualitative), milestones and initiatives are listed in Figure 15.
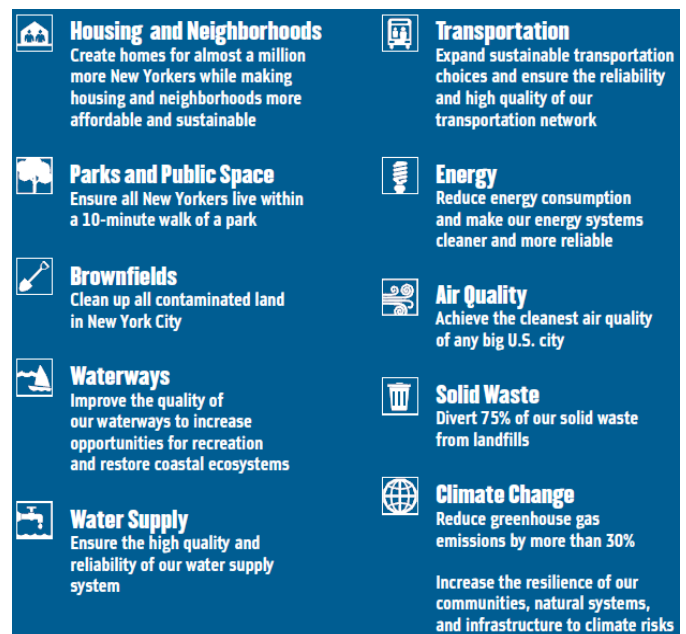
Figure 15: The overarching goals of New York´s sustainability strategy (The City of New York 2011d)

PlaNYC presents seven additional interconnected topics, along with their subsequent proposals for action, which are either not under the direct responsibility of a specific city agency or are presented by subject area, such as the "Greener, Greater Buildings Plan". The seven topics include:

1. Public Health
2. Food
3. Natural Systems
4. Green Building
5. Waterfront
6. Economic Opportunity
7. Public Engagement

The City Government of New York has committed, under local law 55 of 2007, to reduce the municipal GHG emissions by 30% below 2006 levels by 2017 and the citywide GHG emissions by 30 % below 2005 levels by the end of 2030 (The City of New York 2010a; The City of New York 2012b).

3.2 THE DEVELOPMENT OF PLANYC 2030

3.2.1 Key Drivers and Framework Conditions for the Birth of PlaNYC

The three main challenges, which functioned as the key drivers for the development of a comprehensive, strategic plan for NYC's development, are described below:

1 **We will be getting BIGGER.**
(Much bigger)

Together we can

openNYC

2 **Our infrastructure will be getting OLDER.**
(And it's pretty old to begin with)

Together we can

maintainNYC

3 **Our environment will be AT RISK.**
(And that's not a risk worth taking)

Together we can

greenNYC

The population of NYC, and with it the private sectors as well as the tax-revenue for the city, continue to grow at an exhausting rate. NYC must prepare for this continual expansion in order to handle the challenge of organizing this growth in a desirable manner that will enhance, instead of damage, the city's societal, economic and environmental integrity.

The majority of the city´s infrastructure was built during the first half of the 20th century. This infrastructure is becoming dated and visually unattractive. In order to sustain the vision of a city that is not only full of economic opportunity, but also a city with a high quality of life, the city of New York must modernize and recreate itself.

The city´s future depends on an intact, healthy environment that is in balance with the life of its inhabitants. Currently, due to its coastal location NYC is severely threatened by the impacts of global warming. The city's large population and current practice of dumping its waste into landfills place the city in further danger. It is time for NYC to abandon this dangerous trajectory and embark on a path towards a truly sustainable, 'green' future.

Population growth has always been both a central goal as well as a never-ending headache for the City Government of New York. As outlined in chapter 2.3, the city has experienced various waves of population growth and decline during recent decades and has, in the past, struggled to remain attractive to newcomers due to its reputation as the city with the highest crime rate and dirtiest streets in the world. In the mid-70´s, when the economic recession hit, employment decline and sub-urbanization trends threatened the future of Big Apple, the city government recognized the importance of population growth for the development of cities. With decreased tax-revenue and a fall in demand for public services, the infrastructure of NYC

"fell into a state of disrepair and the City became a more dangerous and less desirable place to live" (ICLEI 2010)). As a result, strong efforts were made to attract newcomers to the city.

However, the city's aging infrastructure, the majority of which was built during the first half of the 20th century when the city´s was experiencing a steady increase in population largely due to immigration, was not prepared for this population growth. Around this time a new awareness of 'the limits of growth' was emerging, raised by discussions by the Club of Rome and supported by various discourses and events including the forest decline (Waldsterben) in Germany, the nuclear reactor accident in Chernobyl, the Brundtland report – as the take-off point for the meanwhile exploited use of the term 'sustainability' – and, finally, the climate change debates which emerged from Rio-92 and the global and local Agenda 21-processes.

Projections for climate change impacts on the Big Apple highlighted the need for NYC to take action by, preparing for inevitably negative impacts while striving to minimize its own impact on global warming. Considering the data available, it became even more evident that NYC, with

By 2010, New York will have added a population the size of Salt Lake City By 2015, our temperatures will have risen by half a degree By 2020, 40% of our power plants will be more than 50 years old By 2025, more than 2 million people will live more than 10 minutes from a park By 2030, will you still love New York?

It's up to you.

plaNYC

Figure 16: Brochure cover announcing the goals of PlaNYC in local newspapers in 2007 (ICLEI 2010)

its immense capital in real estate on the one hand and an aging infrastructure on the other, has one of the highest energy consumption rates in the building sector in the United States (ICLEI 2010).

Moreover, the experience of the events of 9/11 has raised awareness among New Yorkers and city employees that a city must not only provide public services but also create a safe space in which the future-oriented economic, social and environmental needs of a diverse and prosperous city can be met. Thus, the concepts of sustainability and resilience became the central guidelines for the future development of NYC.

3.2.2 Key Steps in the Evolution and Implementation of PlaNYC

PlaNYC is an ambitious agenda aimed at creating a 'greener, greater New York' even as the city's population continues to grow towards a projected nine million residents by 2030 (The City of New York 2006). Prior to PlaNYC, the government of NYC continued to adhere to its pro-growth agenda (ICLEI 2010; The City of New York 2011c) despite the fact that the city's physical infrastructure, environmental condition, private sector and public services - safety, health and education - were not prepared for this challenge. As such, a strategic plan was urgently required in order to reconcile the city's goals of economic and population growth with the vision of a livable city amidst the threat of global warming and its imminent impacts on the city.

In 2005, the government of NYC took an initial step towards this goal by setting about the task of assessing the challenge of balancing economic and population growth goals with quality of life and environmental protection objectives (ICLEI 2010). Thirteen city agencies met to discuss the impacts of the projected population growth on various public services. In doing so, the agencies recognized that environmentally-friendly (and affordable) housing initiatives are not enough to ensure the city's resilience and long-term sustainable development. With this, the city government pushed the process towards today's comprehensive approach which takes the ten key areas of action described in Figure 15 into consideration and includes the cooperation of 25 city agencies. In other words, PlaNYC has its historical roots in the building sector and resulted from the enormous pressure of the aforementioned current and projected strain population growth was placing on the city.

In September of 2006, the creation of the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) as well as the Sustainability Advisory Board (SAB) were publicly announced. While the OLTPS is responsible for the coordination and oversight of the 25 city agencies involved in the implementation of sustainability initiatives, local and national experts sit on the SAB, working tirelessly to guide the work of OLTPS by providing advice and critique to potential strategies as well as assistance with research and data evaluation in order to identify "the highest-priority issues the new sustainability agenda should address; setting the targets the City should aim to achieve; and choosing the best methods of achieving

Jan. 2002

Michael Bloomberg takes the office mayor of the city of New York and becomes the leading force for a sustainable, long-term thinking city development.

Summer 2005

13 city agencies recognizing during discussions about the challenge of population growth, that **comprehensive efforts** throughout all fields of city development are neccessary for a sustainable and resilient New York of the future.

Sep. 2006

The **Mayor´s Office of Long Term Planning and Sustainability** (OLTPS) is announced as the central city agency for conzeptualizing and managing a sustainable city development and coordinating 25 agencies and over 70 stakeholder groups.

Apr.2007

„**PlaNYC 2030**" is released as the first comprehensive masterplan for the future development and the ambitious target to create a „greener, greater New York."

Apr. 2008

The 2nd annual **progress report** is released with the first definition of **sustainability indicators** for monitoring and evaluating the performance of New York City.

Figure 17: Key steps towards a "greener, greater New York" during the Bloomberg administration (own graphic)

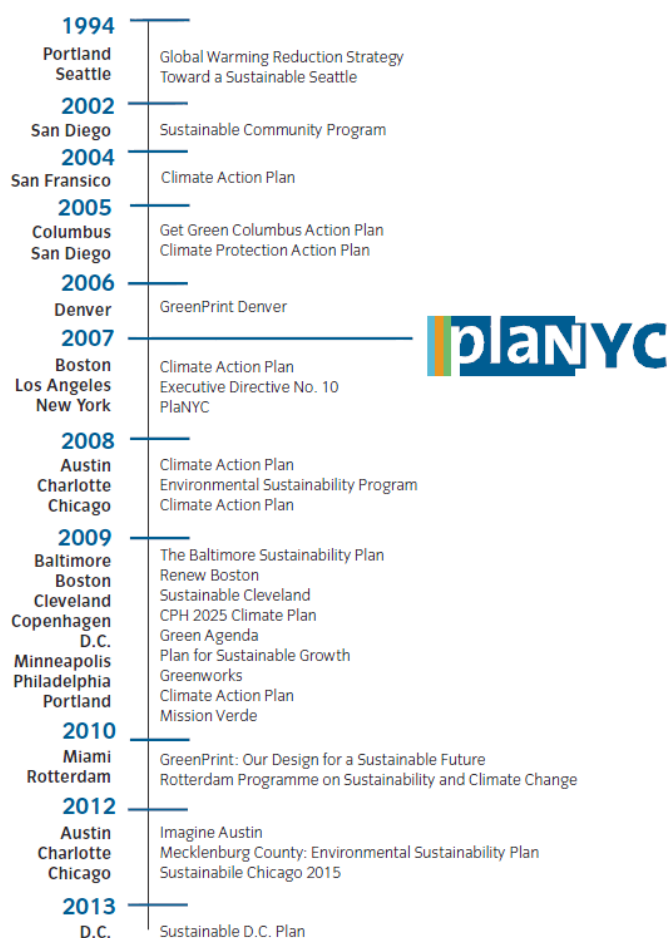|	
1994 Portland Seattle	Global Warming Reduction Strategy Toward a Sustainable Seattle
2002 San Diego	Sustainable Community Program
2004 San Fransico	Climate Action Plan
2005 Columbus San Diego	Get Green Columbus Action Plan Climate Protection Action Plan
2006 Denver	GreenPrint Denver
2007 Boston Los Angeles New York	Climate Action Plan Executive Directive No. 10 PlaNYC
2008 Austin Charlotte Chicago	Climate Action Plan Environmental Sustainability Program Climate Action Plan
2009 Baltimore Boston Cleveland Copenhagen D.C. Minneapolis Philadelphia Portland	The Baltimore Sustainability Plan Renew Boston Sustainable Cleveland CPH 2025 Climate Plan Green Agenda Plan for Sustainable Growth Greenworks Climate Action Plan Mission Verde
2010 Miami Rotterdam	GreenPrint: Our Design for a Sustainable Future Rotterdam Programme on Sustainability and Climate Change
2012 Austin Charlotte Chicago	Imagine Austin Mecklenburg County: Environmental Sustainability Plan Sustainabile Chicago 2015
2013 D.C.	Sustainable D.C. Plan

Figure 18: Timeline of municipal sustainability plans in the United Stated (The City of New York 2013m)

those goals" (The City of New York 2013f).

Only half a year after announcing the OLTPS, the first Pla-NYC was released on Earth Day (April 22, 2007) in order to meet the future challenges of the city (ICLEI 2010). With a tight timeframe for achieving the plan's ten overarching goals by 2030, and with 127 initiatives spread throughout ten fields of actions, PlaNYC represents the first comprehensive, long-term and action-oriented agenda for a sustainable city development of the City of New York.

3.3 KEY PILLARS OF NEW YORK´S STRATEGY FOR SUSTAINABILITY

3.3.1 Costs and Funding

At $50 billion, NYC has the largest municipal budget in the United States. Of this, $2 billion were allocated for a first period of ten years to PlaNYC (fiscal years 2008-2017) to fund the implementation of the 127 initiatives in the 10 fields of action (see Figure 15). During its first year, PlaNYC's running costs amounted to $245 million (The City of New York 2010a). While the Plan is primarily financed through

public funds (both city and state), partial funds are drawn from a combination of private budgets and revenues gene-rated by charging citizens congestion fees (Citizens Budget Commission 2007).

To provide an example, the bike-sharing project "Citibike", which consists of approximately 600 stations and 10,000 bikes, receives no public funding as it is sponsored by the fi-nancial institution Citibank and privately operated by Alta Bi-cycle Share. Any profits generated by "Citybike" are shared between the City of New York and Alta Bicycle Share (Alta Bicycle Share 2013). Other projects are financed through joint initiatives, such as the Sustainable Mobility and Regional Transportation Fund (SMART fund), of which 25% is financed by the city budget and 75% by the state budget (Citizens Bud-get Commission 2007). It is interesting to note that the city spends 10% of its annual energy budget (approx. $80 million) in measures targeting the reduction of energy consumption and aimed at achieving higher energy efficiency in govern-ment buildings (The City of New York 2013m).

3.3.2 Citizens' Participation

A government in touch with its people
The conception and implementation of PlaNYC´s strate-gic goals and initiatives is marked by an exceptionally high outreach effort to the public and strong community in-volvement. Thanks to the dedication of community boards members and civil society groups, the ideas of PlaNYC have been put into practice (ICLEI 2010). While the stra-tegic planners of PlaNYC were well aware of the challen-ges of civic engagement, they were also convinced that the plan's ambitious goals could not be achieved without the collaboration of the public and private sectors. Therefore, then Deputy Mayor, Dan Doctoroff, ensured that PlaNYC had a reader-friendly concept and design and was written in clear, simple language in an effort to make it accessible to as many New Yorkers as possible (ICLEI 2010). This was done with considerable success and today, seven years after the release of PlaNYC, posters concerning the overarching goals of the city´s vision and stickers with "Birdie", New York´s little mascot (The City of New York 2013f), continue to remind New Yorkers and visitors alike of sustainable be-havior initiatives all over the city. Bike to work, stop junk mail, bring your own shopping bag, switch off the lights or turn your thermostat down, are only a few of the small, but effective, tips Birdie reminds residents of throughout their day in New York.

311 Request Program
The city government of New York describes itself as an ad-ministration in touch with its people. Efforts to achieve this self-ascribed characteristic can be seen in initiatives such as nyc.gov and the 311.gov, direct and free-of-charge govern-ment links.

311 is New York´s service number for free information on

the city government and non-emergency services. With over 40 call centers, the concept of 311 follows a customer friendly one-stop-shop model. Rather than having to navigate a complex directory of city administrations, New Yorkers can find what they need via 311. The website provides access to the city's various agencies, public databases and information.

The service is complemented by the 311 Request Map, described as "probably the most aggressive" (e.Republic 2011) mapping system in the United States with a real-time service request page, citizens´ complaints site and public service delivery tracking system. 311 Request Map provides citizens with an easy way to communicate with their government and evaluate its service performance. Likewise, it equips the city government with a useful platform from which to react to public needs and provide good services. 311 Request Map not only identifies the exact location of complaints or requests but it also groups them into one of 15 overarching categories, allowing the responsible city agency to explore more target-oriented solutions and take action quickly.

"With nearly 30 million visits each year, nyc.gov has almost

as much traffic as Central Park, serving as a vital hub for information, engagement and constituent services" (The City of New York 2013n).

With an average of 60,000 calls and 8,000 website visits each day, of which approximately 20% result in service requests, the success of the 311 program is evident (e.Republic 2011).

"The more people that look at the data, the more likely they are to find some way that we can effectively resolve it", said Stephen Goldsmith, former Deputy Mayor for Operations (e.Republic 2011).

The 311 Request Map is the forerunner of the second version called "OpenData" which is analyzed as one of the practice examples.

Change by US
"Change by US" is another initiative aimed at involving citizens in the sustainable development of their neighborhoods. The online platform "Change by US" was launched in its beta-version in 2011 by the cooperation of non-profit organizations „Local Projects" and "CEOs for Cities" and

Figure 19: Birdie and social media for a greener, greater New York (Birdie NYC 2013)

run by the Mayor´s City Office of New York. According to Jake Barton, President of "Local Projects", the platform was initiated in 2010 and modeled after „Give a Minute", a successful online-service initiative which runs in both Chicago and Memphis. The site has been facilitating public participation since 2012.

"Change by US" is designed to facilitate citizens in starting up their own initiatives in their city and assuming responsibility for the direct environment and society in which they live. It provides a virtual space in which engaged residents can not only share ideas for a "greener, greater New York", but can also identify ongoing projects in their neighborhood and connect and collaborate with other community members to realize their ideas. By bringing together citizens and available resources throughout the city, initiatives for sustainable, small-scale civic solutions benefit from the local knowledge of other institutions and groups with similar objectives. Additionally, members can receive information about public and non-profit support options for their projects such as funding programs, legal advice services and public service agencies (The City of New York 2011a).

According to a staff member of the OLTPS, the project, which was funded by the Rockefeller and Knight Foundation (Rockefeller and Knight Foundation 2012) has provided a total funding budget of $50,350 to winning projects since it was launched.

3.3.3   Evaluation and Project Implementation

Driven by the success of his financial data and media company, Mayor Bloomberg implemented evidence-based planning as the overarching guideline for decision-making in the city government. In this way, he has steered his administration towards a "greener, greater New York" by using a set of sustainability indicators which are evaluated in annual progress reports and adopted in the update reports of PlaNYC every four years (The City of New York 2013m). As mandated by Local Law 55 of 2007, the city government must release an annual inventory on both citywide and city government GHG emissions (The City of New York 2010a). The goal of reducing NYC's GHG emissions by 30% by 2030 is well pursued, and citywide GHG-emissions have dropped 16% since the release of PlaNYC in 2007 (The City of New York 2013m) of which 68% can be understand as a result of New York´s efforts to reduce carbon intensity of the city´s electricity supply (The City of New York 2013f).

97% of the 132 PlaNYC initiatives had been launched by 2011, when the updated plan was released. The update of PlaNYC follows up on the city´s goals with 127 new initiatives, which should be implemented by the end of 2013. 2014 will see yet another update, this time under the administration of a new mayor. The Plan's annual progress reports and specific topic-related studies strive to ensure
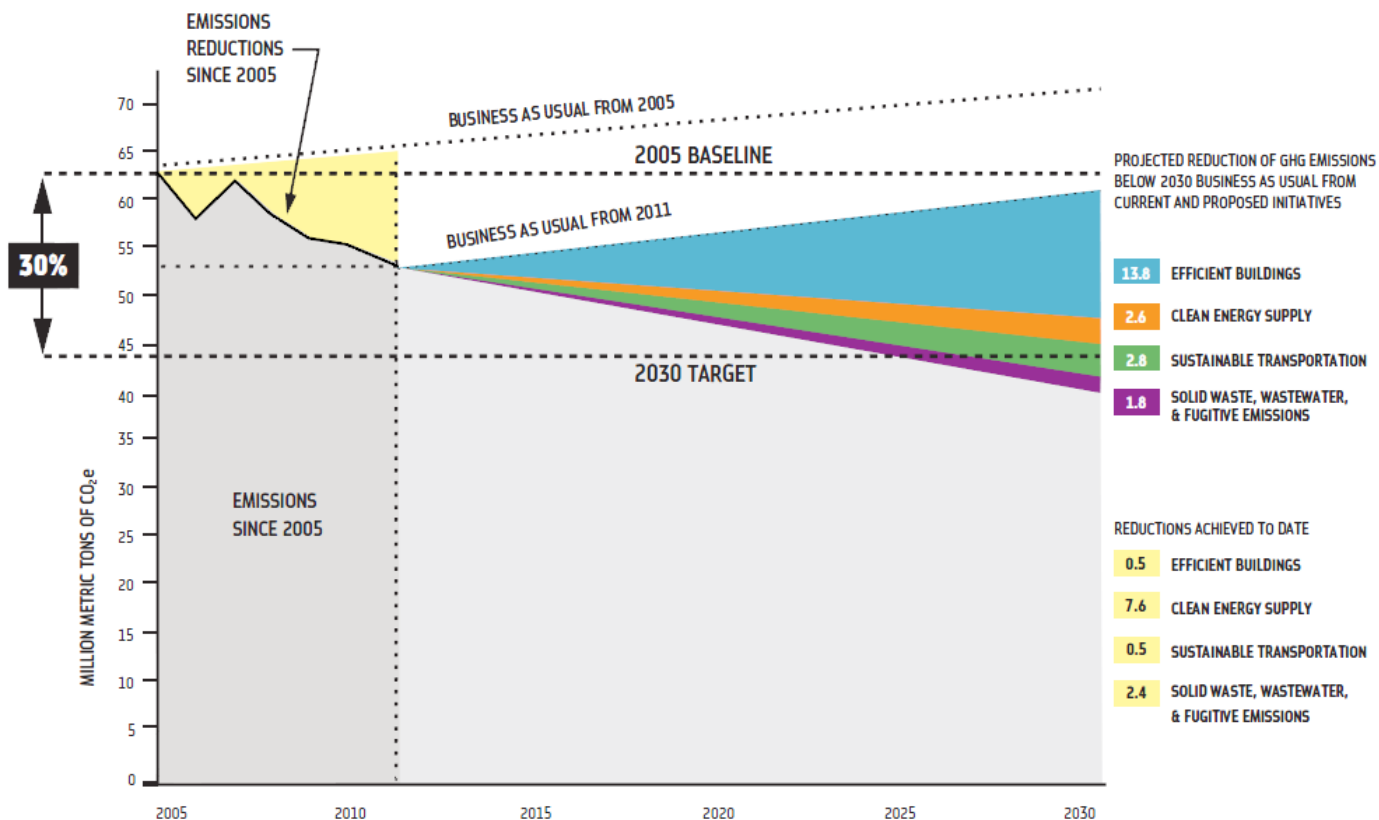

Figure 20: GHG emission scenarios for the city of New York (The City of New York 2013m)

transparency by tracking the city agencies´ performance, monitoring their actions and providing accountability (The City of New York 2013m).

The monitoring and evaluation process of PlaNYC is primarily based on a self-assessment conducted by the OLTPS. Aside from the support of the SAB, no external institution exists to provide oversight of New York´s activities in this field. However, the self-monitoring process is conducted in collaboration with local academic institutions, such as the Earth Institute at Columbia University. Much consideration is given to recent studies from various research institutions and large efforts are made to base the evaluation on the collected data (ICLEI 2010).

The update PlaNYC 2011 includes a set of 29 sustainability indicators (which were expanded to 30 in the 2012 progress report) set within the ten fields of action (see Figure 15). All the indicators are quantifiable and allow for the tracking of the city´s progress toward its overarching long-term goals.

A survey of more than 2,000 citizens analyzed the impact of PlaNYC on the behavior of New Yorkers. The survey asked what can be done in order to strengthen civic engagement in the transformation towards a 'greener, greater New York' and how the city government can increase its resident´s motivation to live sustainably. The key findings of the survey results were released in June 2013, highlighting the following points (The City of New York 2013f):

- New Yorkers understand the importance of environmental problems and believe in their own power to solve them.
- By engaging in the ten highest-impact actions, New Yorkers can reduce the city's carbon footprint by 7.5%, achieving one-quarter of the City's PlaNYC target.
- New Yorkers can improve environmental quality by reducing their use of fossil fuel-based transport,

switching to renewable energy and reducing and recycling waste.

- The prime motivator of sustainable behavior is the potential for cost savings. However, New Yorkers' motivations vary widely based on the type of action discussed.
- New York residents are a diverse set of individuals. The study classified New Yorkers into the following five categories based on their (The City of New York 2013f) varying attitudes toward environmental issues and the level of their inclination to engage:
  1. Inadvertent Greens (9% of interviewed New Yorkers) have the highest current environmental engagement but lowest intention for future engagement. They tend to be affluent and young or middle-aged.
  2. Pragmatic Homeowners (17% of interviewed New Yorkers) are average in current behavior and moderately willing to change. They tend to be older married homeowners in Queens and Staten Island.
  3. Young Urbanites (15% of interviewed New Yorkers) are average in current behavior and report a high willingness to change. They tend to be young apartment dwellers in Manhattan.
  4. Aspiring Greens (27% of interviewed New Yorkers) are average in current behavior, but report the highest willingness to change. They tend to be middle-aged and long-time New Yorkers.
  5. Skeptics (31% of interviewed New Yorkers) are the least environmentally active, with minimal intention to change. They tend to be younger and renters.

The survey identified cost savings as one of the main motivator for New Yorkers to change their everyday behaviours.

New Yorkers who are not already predominantly using energy efficient light bulbs to switch
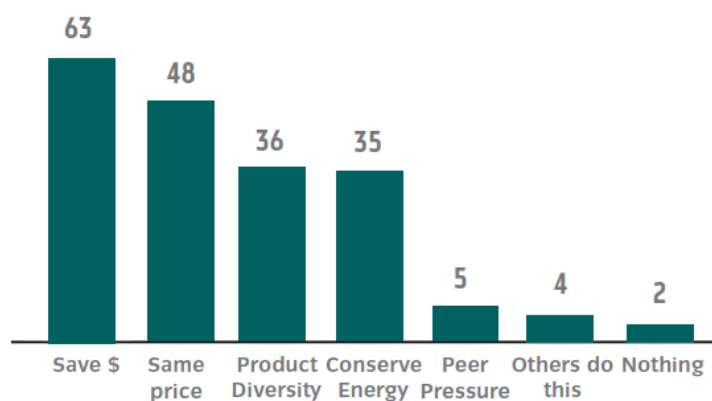
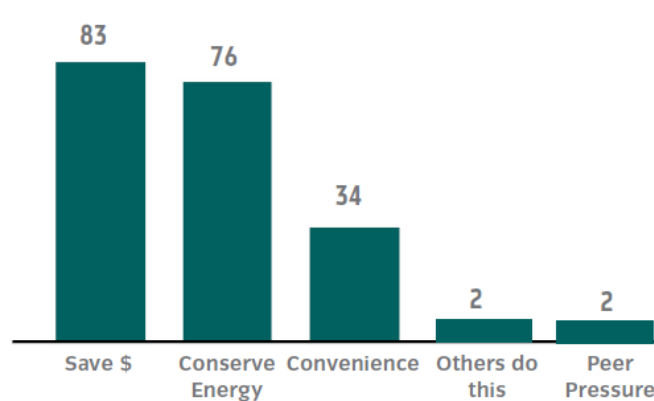**New Yorkers already engaged in high impact action**

Figure 21: Motivators for New Yorkers to begin using energy efficient light bulbs (The City of New York 2013f)
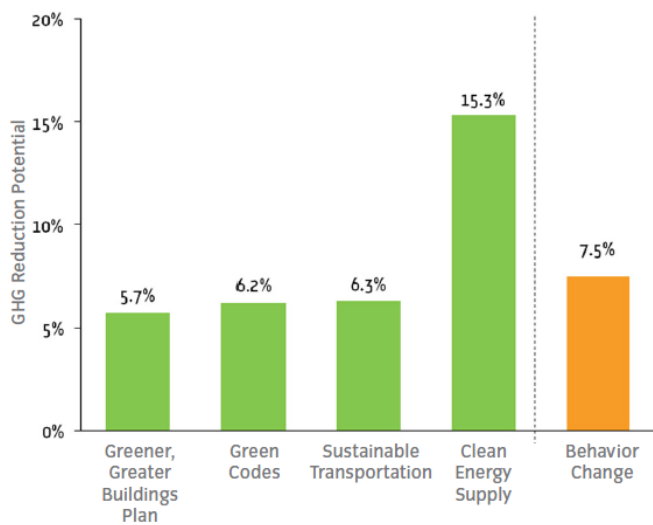
Figure 22: Top PlaNYC levers for reducing citywide GHG emissions (The City of New York 2013f)

This motivation is exemplified by the shift towards using energy efficient light bulbs as shown in figure 21 (The City of New York 2013f).

3.3.4   Successes and Success Criteria

Acting in concert
The conception of PlaNYC and the implementation of its numerous initiatives is the result of a joint effort on part of the city, state and federal governments, citizens, neighborhood groups, non-profit organizations, community boards, private companies as well as research institutions and universities. While McKinsey and Co. assisted in writing the plan, the OLTPS released the plan by coordinating the outreach to over 70 stakeholder groups with the help of nearly 75 local organizations. Support from the mayor and top administration officials has been fundamental for the successful and efficient implementation of PlaNYC (ICLEI 2010).

External expertise and assistance for evidence-based city planning
Aside from the SAB, described above (see chapter 3.2.2), Mayor Bloomberg launched the Climate Change Adaptation Task Force (CCATF) together with the New York City Panel on Climate Change (NYPCC) and the Climate Protection Act (CPA) in 2008. The objective, with the introduction of these three initiatives, was to analyze prospected climate change impacts on NYC and to provide data and development scenarios to the city government in order to support the evidence-based planning approach of the Bloomberg administration.

The interagency task force was the first realized initiative of PlaNYC (ICLEI 2010). It is built out of 38 city, state and federal agencies, regional authorities as well as local private infrastructure companies. In addition, a panel of experts from academic institutions and from the legal, engineering

and insurance industry advise the task force. Following the internationally highly recognized model of the Intergovernmental Panel on Climate Change (IPCC), the NPCC provides the task force with technical assistance and research results for evidence-based decision-making (ICLEI 2010).
"These groups will begin the process of creating a coordinated plan to adapt our roads, bridges, and tunnels; mass-transit network; water and sewer systems; electric, gas, and steam production and distribution systems; telecommunication networks; and other critical infrastructure. This effort is one of the most comprehensive and inclusive strategies ever launched to secure a City's critical infrastructure against the effects of climate change. The Rockefeller Foundation's Climate Change Resilience program has awarded a $350,000 grant to fund the work of the Panel on Climate Change" (The City of New York 2008).

In 2009, the NPCC released its first projection report concerning climate change impacts and risks for the city of New York. For example, the recent "Climate Risk Information" sheet, released in June 2013, highlights a temperature increase of 2.0°F to 3.0°F by the 2020s and a sea level rising of 11 to 24 inches by the 2050s (following the middle range of projections) for the coastally-located Big Apple. According to NPCC, over 800,000 New Yorkers will live in

Baseline Climate and Mean Annual Changes

Air temperature Baseline (1971 - 2000) 54°F	Low-estimate (10th percentile)
2020s	+ 1.5°F
2050s	+ 3.0°F
Middle range **(25th to 75th percentile)**	**High-estimate** **(90th percentile)**
+ 2.0°F to + 3.0°F	+ 3.0°F
+ 4.0°F to + 5.5°F	+ 6.5°F
Precipitation **Baseline (1971 - 2000) 50.1 inches**	**Low-estimate** **(10th percentile)**
2020s	-1 percent
2050s	1 percent
Middle range **(25th to 75th percentile)**	**High-estimate** **(90th percentile)**
0 to + 10 percent	+ 10 percent
+ 5 to + 10 percent	+ 15 percent
Sea level rise **Baseline (2000-2004) 0 inches**	**Low-estimate** **(10th percentile)**
2020s	2 inches
2050s	7 inches
Middle range **(25th to 75th percentile)**	**High-estimate** **(90th percentile)**
4 to 8 inches	11 inches
11 to 24 inches	31 inches

Figure 23: Climate change impacts for NYC - NPCC projections 2013 (The City of New York 2013k)

flood zones by 2025 (The City of New York 2013k).

*Bloomberg´s expertise in the private sector*
As Mayor of NYC, Michael Bloomberg's philosophy of opportunity for positive change within challenge and his pursuit of sustainable city development have been highly influenced by his personal experience in the private sector. His adoption of key private sector principles for the work of the city administration is exemplified in the long-term oriented PlaNYC as the pendant to a strategic business plan.

Mayor Bloomberg's expertise as a business magnate are highlighted not only by his hiring of top talents for a culture of innovation, conducting cost-benefit analyses on public investments – including variables such as quality of life – and implementing a continuous evaluation of the agencies´ progress in implementing PlaNYC, but also by him publicly tracking his own performance as the mayor of NYC (ICLEI 2010) His financial and political independence allows him to make decisions following the guiding principle of what is best for the city´s future and not what makes him popular among his electorate (ICLEI 2010).

Institutionalization of long-term thinking and sustainability in the city administration
Mayor Bloomberg is aware that the challenge of transforming the City of New York into a sustainable, livable and economically successful system cannot be achieved within his term in office but must be understood as a target overlapping several city mayors and generations of society. The city government of New York has kept in mind, from the very beginning of its work in developing a comprehensive strategy for NYC, that a "combination of long-term vision and short-term action [was] critical to [their] success" (The City of New York 2013m).

Therefore, the success of the city´s strategic plan is built on the following cornerstones, pursuing the long-term vision of PlaNYC while retaining its ability for short-term actions.
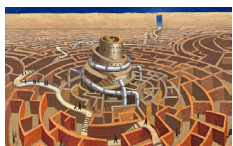
In its permanent efforts to pursue long-term planning within the city administration, the city government of New York has committed itself to the **Central Sustainability Office** (CSO) under local law 17 of 2008 (The City of New York 2010a).

The CSO is responsible for:
a) the oversight of the different initiatives for sustainability as well as the alignment of such initiatives with the overall master plan of city development;
b) the supervision of the different sustainability directors responsible for

coordinating with the city agencies;
c) reporting to the city mayor;
d) monitoring and evaluating the progress of sustainability initiatives; and
e) transferring the evaluation results into new/adapted indicators and goals for regular updates of the master plan (The City of New York 2013f).

Under the Bloomberg administration, this central institution is the OLTPS While the title may change under subsequent administrations, its functions will remain the same.

PlaNYC, as a comprehensive, action-oriented agenda includes:
a) overarching and long-term oriented goals for the development of the city;
b) initiatives that can be implemented within a defined period of time;
c) milestones that can lead the implementation of the initiatives and provide a short-term guideline for the pursuit of long-term, overarching goals; and
d) a set of sustainability indicators in order to monitor and evaluate the agencies´ progress concerning the implementation of the initiatives and the achievement of their milestones.
It is interesting to note that the city government can implement the vast majority of the plan´s initiatives itself without requiring state or federal approval (ICLEI 2010).

Local Law 17 of 2008 (The City of New York 2010a) requires that the city government of New York release an **update of PlaNYC** every four years in accordance with the mayor´s term in office. The CSO is in charge of these updates.

Local Law 17 of 2008 (The City of New York 2010a) requires **annual progress reports** – except in the year PlaNYC is being updated – in order to track the city´s performance by collecting data and providing transparency with regard to the sustainability indicators, which are also required by local law 17 of 2008 (ICLEI 2010).

The **SAB** consists of external experts in the different fields of action in accordance to the overarching goals of PlaNYC. The board assists and critiques the strategic work of the CSO, but does not have final decision-making power.
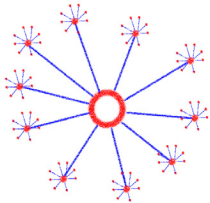
In addition to the CSO, every city agency has its own **sustainability director/coordinator** with the responsibility to pursue the citywide goals of sustainability within their particular sector. The director is required to report to, and cooperate with, the CSO for the successful coordination of actions. This mix of centralized and decentralized implementation of sustainability and long-term action planning in the city administrative structure can be understood as a key factor for PlaNYC´s success.

3.3.5   Challenges for NYC´s Sustainability Strategy

In spite of all the successfully implemented initiatives, the progress reports also mention that the city has "encountered obstacles to achieving some of the goals" (The City of New York 2011d). For example, the city´s efforts to maintain, improve and expand the transit network have been frustrated by a lack of stable, sufficient and rational fun-

ding sources. Furthermore, the global recession, which began shortly after the release of PlaNYC, has forced the city to reduce its capital budget. Thus, some of PlaNYC actions' start dates were delayed. Several initiatives were slowed down due to a lack of state or federal permission, action or funding. In addition to such limitations, the PlaNYC update highlights the challenge of reducing traffic congestion within the boundaries of the city of New York as one without appreciable progress (The City of New York 2011d).

Furthermore, the implementation of some initiatives from PlaNYC struggled due to dependence on federal or state laws. For example, NYC's effort to convert all taxi cabs to hybrid fuel models failed because the Federal Court decided that the law was "unconstitutional because cities don´t have the power to regulate emissions; that power lies with the federal government." In the same way, NYC needs the legislative approval of the State for the implementation of its congestion pricing initiative, which, to the present date, has not been granted according the OLTPS (ICLEI 2010).

Another issue, recently discussed due to the experience with Hurricane Sandy in 2012, is New York´s coastal location and the vulnerability of its infrastructure with regards to climate change impacts. In this discussion the islands off the coast play a specific role in finding future solutions for resilience. The city government of New York has given a lot of consideration to the question of how to deal with these challenges. It has concluded that these islands are home to many residents and that the city government should focus on a resilience-oriented development of these highly vulnerable areas instead of saving the budget for other activities, such as resettling its residents and abandoning the zones to nature.

The argument in favour of the latter option lies within the knowledge that the coastal zones could serve as a natural barrier against natural disasters, such as Hurricane Sandy, and therefore comprise a key element for increasing New York´s resilience as a whole. Hence, deciding what to do with these regions has become highly controversial, as the interests of local residents, the adequate usage of environmental resources and natural functions, and the protection of New York´s infrastructure and private sector often conflict with one another. The fact that Wall Street, home of the global financial sector, is located on the economically valuable Manhattan Island, only intensifies this debate.
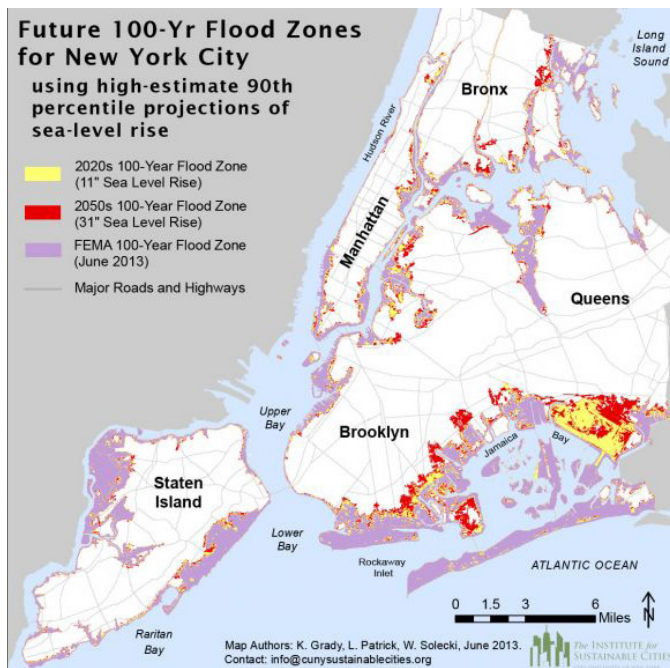

Figure 24: NPCC projections for vulnerable flood zones across New York´s Boroughs (The City of New York 2013k)

4 SELECTED BEST PRACTICES

4.1 GREENER GREATER BUILDINGS PLAN

The Greener Greater Buildings Plan (GGBP) is an internationally recognized and industry-transforming program, and the leading energy efficiency policy in the United States. With the NYC building sector accounting for 75% of the total GHG emissions, the GGBP was developed to ensure that energy information is provided to decision-makers and that the most cost-effective energy efficiency measures are pursued, thereby facilitating rapid and substantial citywide GHG emissions reductions from a single sector (OLTPS 2013).

The GGBP consists of four regulatory categories which are supported by exten¬sive job training and a financing entity called the NYCEEC. Only buildings exceeding 50,000 square feet are subject to the legislation; buildings of this size account for 2% of NYC's building stock but one-half of the city's total square footage in buildings and 45% of the building sector's total GHG emissions. Targeting this sector alone is expected to contribute to a more than 5% reduction in citywide GHG emissions by 2030, using 2009 emissions as a baseline, amounting to the prevention of nearly three million metric tons of carbon dioxide being released into the atmosphere.

4.1.1 Origin and Objectives

To enable the creation of PlaNYC, and the associated GGBP, Mayor Bloomberg created NYC's Office of Long Term Planning and Sustainability (OLTPS) in 2006.

Within the first two months of operation, the OLTPS created the SAB made up of seventeen external experts (The City of New York 2011c). The SAB helped to develop the goals of the GGBP, acted as a critical sounding board for initiatives under consideration, and supported the analysis of various strategies for achieving set goals.

The City spent 15 months researching and developing a package of energy efficiency initiatives, and on Earth Day of 2009, Mayor Bloomberg introduced the GGBP. It gained support through the remainder of the year, and the four regulatory laws were easily passed by the city council in December 2009. Full implementation of the GGBP is anticipated to reduce the city's total annual GHG emissions by 5%, return $7 billion annually in net-savings from reduced energy costs and create 17,800 construction-related jobs in energy auditing, retro-commissioning, upgrading lighting and maintaining equipment (OLTPS 2013). Ultimately, the combination of stakeholder engagement, extensive tech-

nical input, and strong leadership enabled NYC to put in place one of the most ambitious local government energy efficiency programs to date (The City of New York 2011c).

The GGBP's four regulatory categories are described as follows (OLTPS 2013):

- Energy and Water Benchmarking: A buildings' performance with respect to its energy and water consumption is assessed over time and by comparing it to similar buildings. This allows owners and operators to establish performance baselines, track performance, identify investments in energy efficiency and verify energy savings. The results are made available in a public database (Local Law 84).
- New York City Energy Conservation Code (NYCECC): All renovations, additions and new constructions must meet NYCECC code requirements (Local Law 85).
- Energy Audits and Retro-Commissioning: Once every ten years a building must undergo an energy audit. Energy audits are comprehensive assessments of a building's energy consumption including basic building systems such as Heating, Ventilaion and Air Conditioning (HVAC), electrical and lighting, domestic hot water, building envelop and conveying systems. The energy audit verifies that a building is in compliance with the NYCECC. Non-compliant buildings are required to undergo retro-commissioning to bring the building' up to code (Local Law 87).
- Lighting Upgrades and Sub-Metering (to be completed by January 2025): All non-residential spaces must be upgraded with lighting fixtures that comply with NYCECC at the time of the upgrade and all
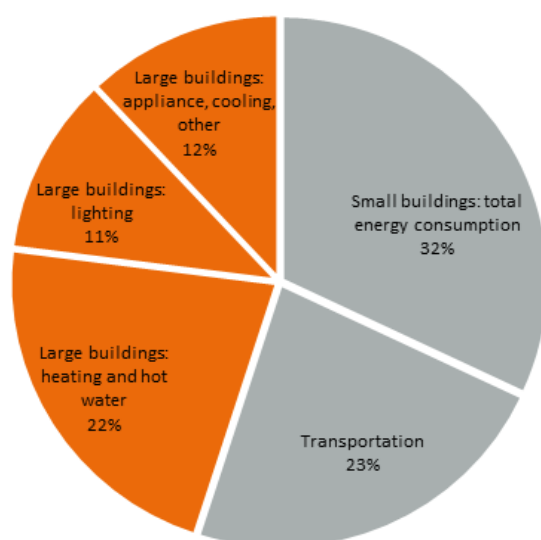

Figure 25: Breakdown of energy consumption citywide. Large buildings account for 45% of NYC's energy usage (OLTPS 2013)

floors and tenant spaces exceeding 10,000 square feet must be sub-metered and tenants be provided with copies of electricity bills (Local Law 88).

4.1.2   Green Building Financing

Acknowledging that some building owners may not be able to afford the costs of efficiency retro-commissioning, NYC formed the NYCEEC, a non-profit created as a partnership between the city and energy efficiency leaders from the private and non-profit sectors. The objective of the NYCEEC is to provide financing for energy efficiency projects and information about funding and tax incentives. Leveraging $37.5 million in US Department of Energy (DOE) Energy Efficiency and Conservation Block Grant funds, the NYCEEC anticipates financial support from private banks and philanthropists to increase this fund by four to 500% as NYCEEC absorbs all threat of loan default on energy efficiency projects (OLTPS 2012a). Currently, NYCEEC is developing new financial products and services to assist building owners and tenants, while incentivizing new lending practices that support efficiency and streamline access to information about energy efficiency opportunities and incentives (The City of New York 2011c).

The GGBP is also financially supported by the NYSERDA, which provides a program to assist buildings with funding for benchmarking, energy audits and retro-commissioning studies. Consolidated Edison, Inc. and National Grid, both utilities providers that service NYC, offer energy efficiency programs for their clients and provide funding for outreach programs for the real estate industry (OLTPS 2013).

4.1.3   Main Actors and Supporting Stakeholders

The strength of the GGBP comes from the NYC government's backing and full-time organization. However, the effectiveness of the GGBP comes from the strong incorporation of broad expertise from industry leaders across the board. Various stakeholders were engaged in different ways and in different phases of the GGBP, from planning to training and public outreach, and include industry experts in engineering, architecture, labor unions, environmentalist, tenant groups and the broader real estate community.

The NYC Mayor's Office, with consolidated dedication from the OLTPS and SAB, is the main actor in terms of creation and initiation of the GGBP. This plan would not have been possible without the prior guidance of PlaNYC and strong commitment to GHG reductions from the city's mayor. The city had the resources to write a law package to enable swift progress in the building sector without the need for government subsidies. However the city did not possess the resources or expertise to adapt the plan into a feasible and economically viable solution for the building sector. Training, outreach and resources were vital components to successful implementation. These were provided by private

institutions, non-profit organizations, and various governmental agencies as well as public universities from across the country (The City of New York 2011c).

4.1.4   Obstacles and Challenges

Implementation of the GGBP was an unusual political moment in NYC; there were very few obstacles to the plan. Michael Bloomberg, a powerful mayor, made the GGBP, energy efficiency and immediate GHG emissions reductions a citywide priority. Initially, the real estate industry posed the largest opposition to the plan with concerns that the regulations would impose financial burdens on building owners for efficiency retrofits, and then deliver the financial incentives of energy savings to the tenants, rather than returning the benefits to the owners. Addressing this concern, the city worked directly with the real estate industry to develop energy-aligned leases to enable both parties to share the benefits of energy efficiency (The City of New York 2011c).

The second greatest challenge to the GGBP was enforcement. Without clearly defined repercussions, building owners were uncertain about their obligations to comply. Even with a $500 fee issued every quarter to buildings that did not submit benchmarking data by the twice-extended deadline, some building owners responded to the penalties as more economically favorable than incurring the substantial upfront costs of initiating all retro-commissioning projects that were categorized as capable of a five to seven year return on investment as mandated by the new legislation (The City of New York 2011c). Greater accessibility to loans for energy efficiency projects with NYCEEC funding, free training programs and resource centers and ever-increasing stipulations for non-compliance are hoped to collectively combat non-compliance.

4.1.5   Impact Factors

Annual benchmarking enables building owners to compare year-to-year performance and assess which strategies are working. It also allows the city to track the impact of its policies and provide transparency. **Transparency** about energy use has been the driving force for energy efficiency retrofits and development. When building owners and potential tenants are able to see actual data on a building's energy performance compared to other similar buildings, the costs of efficiency retrofits become immediately desirable for highly inefficient buildings. Public disclosure ensures that energy efficiency joins other publicly available data regarding a building's management and finances, and should incentivize all building owners to consider the most cost effective improvements, such as operational efficiency.

The **highly competitive culture** of NYC has also been an active motivator in the rapid implementation of the GGBP. The NYC energy auditing program employees the USEPA Energy Star rating system, which clearly outlines its rating

criteria and awards energy efficiency values from 1-100. Transparency of building performance, backed with a new public understanding of what energy performance can be, encourages owners to voluntarily refurbish their buildings.

4.1.6 Achievements and Success Criteria

The NYC government decided to put the energy and water benchmarking legislation into practice through leading by example. After the law was passed in 2010, city-owned buildings were the only properties required to comply with the benchmarking in 2011. Since 2009, the NYC Department of Citywide Administrative Services (NYCDCAS) has worked with 28 agencies to benchmark almost 3,000 public buildings (The City of New York 2011c). Non-residential, private buildings were given until 2012 to comply; two-thirds of required building owners met this deadline.

4.1.7 GGBP and Sustainability

The GGBP promotes cost-effective steps to create significant social, economic and environmental impacts to guide NYC as a sustainable city of the future. Job creation is one of its social impacts. The GGBP will create 17,800 construction-related jobs in energy auditing, retro-commissioning, lighting upgrades and equipment maintenance. Some of these will be completely new jobs, while some will provide additional work for current workers skilled in these trades. The majority of efficiency improvements recommended by the GGBP are anticipated to return on investments in energy savings in less than seven years. Given the high energy costs New Yorkers are faced with, using less energy is critical to staying competitive and promises economic benefits across the city. Furthermore, building owners are being encouraged to comply in advance, thereby creating jobs and savings now. The GGBP is targeted to reduce the city's total fossil fuel requirement for electricity production and coinciding GHG emissions, this will amount to the prevention of nearly three million metric tons of carbon dioxide, which amounts to more than the entire carbon emissions of Oakland, California (OLTPS 2012a).

4.1.8 Transferability of the Practice Example

Two of the interviewed persons (Lance Jay Brown, architect and Professor at the City College of New York, and Russel Ungar, executive director of the Urban Green Council) were asked if the GGBP model could be transferred to other cities in the United States or worldwide, and the response was that this plan could be adapted to cities all over the world, given that retro-commissioning is a strategic investment which provides a large return on the initial investment.

NYC Mayor Bloomberg believes that cities around the world must take responsibility for the efficiency of the building sector in order to achieve quantifiable GHG emission reductions. In many regions, especially in the United States, city

governments are responsible for building regulations and are thoroughly equipped with the authority and resources to put similar plans into place.

In the United States, less than 5% of the national building stock is greater than 50,000 square feet, yet these buildings account for more than 50% of the nation's total GHG emission (NYCC 2009). Now that NYC has proven that a comprehensive approach is possible, other cities, such as the District of Columbia, San Francisco, Chicago and Philadelphia have begun reviewing their approaches and improve upon them (The City of New York 2011c). Lance Jay Brown believes that the programs and systems initiated in NYC are excellent and easily transferable to other city administrations. He also believes that NYC has many resources that can be put into practice in other cities to help resolve the global challenges of climate change.

4.2 VIA VERDE

Via Verde, located in the South Bronx borough of NYC, is a model for affordable housing intended to take sustainability and its impacts on the community to the next level. Mayor Bloomberg called the project "one the most environmentally advanced affordable housing developments in the nation." The South Bronx has been a site of intense development over the past two decades. In an effort to revitalize a borough that was devastated by building fires and abandonment in the 1970s. The development has consisted largely of new low- and middle-income housing projects.

The 222-unit Via Verde is the result of the 2006 "New Housing New York Legacy Project" (NHNY) competition. Co-sponsored by the American Institute of Architects (AIA) New York Chapter and the New York City Department of Housing Preservation and Development (HPD), the competition's explicit challenge was to create housing that would be "affordable, sustainable, and replicable." The winning team included the NYC architectural firms Dattner

Figure 26: 222-unit Via Verde (own photography by Elvira Ockel)

and Grimshaw, the for-profit affordable housing developer Jonathan Rose Companies, and NYC's oldest non-profit housing developer, Phipps Houses. The team combined standard construction methods with a sophisticated façade system, innovative apartment layouts, and extensive green elements, rising to the competition challenge (Kubey 2012).

4.2.1   Actors

Grimshaw Architects, Dattner Architects and development partners Phipps Houses and Jonathan Rose Companies won the $70 million Via Verde project. For their part, the architects say that designing and building Via Verde was a rewarding experience. Contractually, Dattner was the architect on record with Grimshaw as its consultant. However, "from the very beginning, we viewed the project as a full design partnership," says William Stein, principal of Dattner Architects. The project was the first juried competition for affordable and sustainable housing in the city's history.

Via Verde was initiated and organized by the NHNY Steering Committee, an independent group of architects, developers, and city representatives. NHNY was an open two-stage competition for architect-developer teams. 32 teams from around the world submitted responses to the first-phase request for qualifications, of which five were awarded stipends and invited to submit full design and development proposals. An independent jury used weighted evaluation criteria, with 30% each for 'innovative design' and 'economic feasibility,' 20% for 'green building,' and 10% each for 'replicability' and 'team experience'; placing a much higher value on design than typical in affordable housing projects (Kubey 2012).

"In NYC there are 10 different city agencies that work on this project", says Paul Freitag, perspective Director of Rose Development for Jonathan Rose Companies' in NYC. Each agency had an employee dedicated to this project. Freitag recalls the ribbon-cutting event as interesting, explaining that "they had a banner that was 20 feet long with the names of everybody that had worked on the project and there were hundreds of names written on it." The robust workforce made it possible to apply a holistic approach and focus on all of the various aspects of the project.

Other important stakeholders were the banks that invested in the project and community leaders who worked tirelessly to turn it into an inclusive neighborhood initiative by incorporating the community's input into the city's project. Many community organizations emerged promoting best practices and energy-free designs. One such special partner was a community gardening collective that promotes green markets in NYC. They entered the project to assist with the design and installation of the building's green roof and to teach its new tenants how to manage their community gardens, which are an anomaly in NYC. Having a rich pool of partners to collaborate with on innovative solutions is one of the prevailing NYC characteristics that has made this project a success.

The project was a public initiative calling for entries from the private sector creating what is known as a Public Private Partnership (PPP). PPPs are common structures for projects in large cities in the United States such as NYC, Boston and Chicago.

4.2.2   Procedures and Measures

Via Verde's dramatic step-shaped form, along with the sharp lines of its prefabricated façade, compliments the variety of building styles in the area. Rising south to north from three-story townhouses to a twenty-story tower, Via Verde wraps around the edges of its narrow, triangular site forming an intimate courtyard and maximizing sun exposure. The name Via Verde, or 'Green Way', refers to the project's system of over 40,000 square feet of planted roofs and garden space. Starting at the courtyard amphitheater, residents make their way to the various roofs by spiraling up through plantings of conifers, an orchard and resident gardening plots and finally arrive at a fitness roof with a covered terrace for exercise classes which leads to an indoor fitness center. Via Verde also incorporates a ground-floor health clinic and has become a test study for NYC's Active Design Guidelines, adopted in 2010, promoting healthy living through architectural features like inviting, accessible stairs as an alternative to taking the elevator. Via Verde's emphasis on healthy living captures the emerging definition of 'green building' that emphasizes the crucial relationship between sustainable design and healthy lifestyles.

The building's most innovative units are the two-story, two-bedroom units in the mid-rise section along Brook Avenue. Doubleloaded corridors, located on every other floor, provide access to the lower level of each unit. The upper level allows for cross-ventilation and incorporates side balconies facing the courtyard, which are rarely found in medium-income buildings. The building's southern section consists of two-story townhouses with private gardens and up to three one-story, floor-through apartments above, accessed by exterior stairways which are elevator-free. Ground floor live-work units line the Brook Avenue side of the building. The tower apartments range from studios to three-bedroom units oriented around a double-loaded corridor with every living room incorporating a corner window. All residents are able to access the building via the Brook Avenue entrance to the courtyard, creating a semi-public space (Kubey 2012).

The building incorporates various monitoring systems to monitor its energy and water performance over time. Via Verde's first residents began occupying the building in the summer of 2012. Therefore, at present, there is insufficient data on the building's actual performance.

Health is a very important factor in sustainable building.

NYC is conducting a study in which they are assessing the health of a group of Via Verde residents and comparing them to a similar group of individuals residing elsewhere. The study will track the health of these families over a five-year period to see if Via Verde offers healthier living. The study analyzes all types of families. According to Paul Freitag director of Rose Development for Jonathan Rose Companies' in New York, , "urban architecture and development needs to focus on health and efficiency. The Green Way is the way we need to build and live and it´s not a guess or trend anymore. It´s a fact." Mr. Freitag's team, in partnership with other private and not-for-profit developers, was recently awarded the Via Verde.

4.2.3   Financing the Project

Quality comes at a cost. The building's developers estimate that the $100 million project, at $236 per square foot ($2,600/m²), cost five percent more to construct than a typical affordable housing project would have. The cast-in-place tower construction and remediation of the brownfield site accounts for the majority of the additional expense. Still, with two-bedroom homes starting at $146,032, only 26 of the 71 co-op units remain on the market; some of those are due in a lottery and the rest is selling very quickly (Sheftell 2012).

Via Verde's architectural achievements were made possible by extensive governmental support not only with respect to funding, but also in terms of providing regulatory exceptions. For instance, a mayoral override exempted the project from having to provide car parking, which is typically a major expense in housing developments (Kubey 2012).

The key to Via Verde's success was a very mature system of PPPs in NYC. The public sector would not support a request for large subsides and investments from the private sector, and the private sector would not accept a project from the public sector that does not appear to be economically feasible. In other words, the trust between the public and private sector established through PPPs is crucial. Both sectors need to agree to work together and combine their resources to make a project happen. Both sectors must also be willing to advance the project based on mutual trust and respect for each other. This is particularly true in the United States context, which specializes in PPPs. Often, the reason public private relationships do not succeed is because they have tough and obligatory contracts. However, more commonly, they succeed when both sectors meet frequently to facilitate full collaboration by all project stakeholders.

4.2.4   Obstacles and Challenges

The Via Verde project exists because the city and the State of New York chose to subsidize it. They did so with the objective of providing green and accommodating homes to people who could otherwise not afford them. Such initiatives also exist in Europe, where there is a lot of social housing. In such projects, the public sector, in this case the city and state, tries to minimize the money they have to invest. Therefore, the private sector must apply their expertise to calculate, based on the funds available and an estimation of what people will be able to spend to purchase or rent the units, with which amount of subsidies the project will be feasible. The term 'closing the gap' refers to a case where, for instance, a 5 million dollar subsidy enables the implementation of a $50 million dollar project.

It is easier to construct a new affordable and energy efficient building than to operate an inefficient building for many years. Therefore, sustainable building is the most important factor in making buildings more affordable for the communities. Especially in affordable housing, it is important to make upfront investments to reduce long-term operating costs because higher energy costs cannot be compensated with raising the rent if energy prices rise. As such, whatever can be done at the onset to control future operating costs is very much worthwhile.

The economic downturn in 2008 made things more difficult for governance in NYC and was one of the greatest obstacles to the completion of Via Verde. Close to the completion of the project, the strength of the PPP was put to the test. Despite the general economic turmoil, the PPP stood by the project, and, despite serious economic difficulties, proved the strength of its partnership by completing the project.

4.2.5   Drivers and Framework Conditions

Team Player Mentality, PPP
The widespread use of PPPs in the United States is unique. In the United States, when the public sector has a piece of land that is afflicted with a problem such as a difficult to develop size or due to contamination from, for example, previous use as a sewage farm, the cost of restoration for redevelopment is too great for the government to bear alone. The Bronx is one such brown site area that has been polluted and contaminated. With the help of the private sector, the government can minimize their investment to limited subsidies, while the private sector can minimize their investment to a feasible term. PPPs started in the 1980s with programs for low-income tax credits. Over the past thirty-some years, these American PPPs have developed into robust partnerships, especially in the major cities. Via Verde demonstrates the size and scale such projects are capable of achieving through mature PPPs.

Fixed Rents
In NYC, the rental rates are typically fixed for 30 years. This structure is being applied to Via Verde. At the end of a 30-year contract, the building owner may apply to change the buildings status to no longer exclusively provide affordable

housing. However, this transition comes with a large fee. Therefore, most building owners refinance after 30 years and use the refinancing money to make upgrades to the building while still keeping the housing affordable.

Social Mix and Availability of Affordable Housing
One of the unique features of Via Verde is its cohabitation of an incredibly broad range of tenants with different incomes, some of whom rent while others own. Via Verde's residents range from formerly homeless individuals with very low incomes to people who, even though they have a limited income, are paying the equivalent of what they would pay for a similar apartment in the Bronx.

One of the goals of Via Verde is to create a small city community. For this reason, the gardens were planned and became a foundational element for residents living in the project.

Processes – Flexibility in the Field of Innovations in Sustainable Buildings
The process that produced the Via Verde project is just as important as the finished product. The NYC Department of HPD has not conducted another competition since Via Verde. They have, however, made changes to the way the HPD awards projects by building upon the Via Verde experience. For example, requests for proposals now clearly rank the selection criteria, such as design, sustainability, and financing, according to their relative importance. This new transparency allows applicants to make more informed design decisions and will lead to higher quality proposals (Gonchar 2013).

4.2.6   Successes and Success Criteria

A unique team of developers, architects and engineers has resulted in Via Verde, a structure that brings together a broad group of individuals. Both renters and homeowners, across a broad socio-economic spectrum, are using Via Verde's green space and gardens to create community. The success of Via Verde lies in the strength and diversity of the project's PPP. This project would not have happened without the commitment and intense support provided by both the public and private sectors.

Furthermore, the population density of Via Verde makes the project very NYC. There are 222 families living in Via Verde, amounting to over 400 people living on 2 acres, which is very much NYC's style. In addition to Via Verde's extraordinary design, the project boasts quantifiable benefits in affordability and sustainability. Prices for the project's 151 rental apartments are set for households making 30 to 60% of the Area Median Income (AMI), which is currently between $24,000 and $48,000 annually for a family of four. The monthly rent for a two-bedroom unit is $942. The 71 co-op units are priced for those making 70-100% of the AMI, with the purchase cost for a two-bedroom apartment beginning at $146,000. The design team estimates that the building will be over 30% more energy efficient than standard housing

developments. Via Verde's rental waitlist – 7,500 applicants for the 151 rental apartments – says more about the lack of affordable housing in New York, unfortunately, than it does about the specific project (Kubey 2012).

While, according to Freitag, many people profit from the project, it is the residents and the local neighbourhood that benefits most. People from all over the world come to the Bronx to see the building, which makes residents of the neighborhood feel like they live in a valuable neighborhood. This, in turn, indirectly benefits the city as a whole.

4.2.7   Via Verde and Sustainability

Via Verde marks a turning point in NYC housing. With the cost of living continuing to rise and once plentiful city-owned sites becoming increasingly rare, the need for well-designed housing is growing. Via Verde has achieved one of the most difficult feats in urban housing: to produce both a sense of community and access to open space at high density. The project sets a precedent for what is possible with investment in housing and design (Kubey 2012).

Via Verde is unique because it represents an approach of realizing how innovative buildings can have a positive impact on entire communities, as is the case in the Bronx. Developing in the Bronx was an insightful and clever plan that facilitated the improvement of public private relationships in the borough. This project was particularly uncommon because the city, after deciding to invest in improving the area, called out to the private sector for the best and most innovative designs through the opportunity and flexibility of a competition. The winning idea that emerged from the contest was a highly innovative financing structure, which incorporated banks, outside foundations, and public and private sector investments to complete the project. "This very intense PPP is a unique model", explains Freitag. In many other countries projects are either all public or all private, and you don't have the same comingling where you have the innovation and speed of the private sector combined with public sector goals and demonstration of best practices. The public sector is also setting new standards for what such modern housing should look like and promoting certain green technologies, so it becomes a real win-win situation for both sectors.

4.2.8   Learning from Via Verde

Can NHNY's results be replicated? Architect and competition co-organizer Lance Brown feels that "the question of replicability [of Via Verde] has been superseded by a visible change within HPD."

Paul Freitag explains that Via Verde is comprised of three building types; 2 and 3 story compact townhouses, a 6 to10 story midrise and a 20 story tower. Via Verde is actually three buildings in one and Freitag does not think that

Via Verde will be completely replicated anywhere in the world. However, he explains, if a city wants to plan a low-density housing project they can use the Via Verde townhouses as a prototype. Likewise, if they want to construct a green high-rise, they can build on the example set by the Via Verde tower model. In other words, parts of the project could be replicated elsewhere. While Via Verde is a diverse complex, a lot can be drawn from its individual parts, which potentially serve as stand-alone models.

The PPP model is also transferable. Paul Freitag states in the interview that his company has recently done some consulting work for the Brazilian city of Sao Paolo on how Sao Paolo can set up a structure of PPPs similar to those operating in NYC. Freitag also recently met with the deputy mayor of London and was asked the same question. England and Germany both have municipalities in which projects are either funded by the private or the public sector, lacking a combined structure such as that of the PPPs in the United States.

4.3 SUSTAINABLE CITY UNIVERSITY OF NEW YORK

As the largest urban university in the United States, the Sustainable City University of New York (CUNY) plays a transformative role in NYC's sustainable future. CUNY is dedicated to integrating sustainability into the university and the surrounding metropolitan area through its curriculum, policy work, research, capital projects, and workforce and economic development activities. CUNY is leading this transformation through the work of Sustainable CUNY, a broad program comprised of three key pillars: the CUNY Sustainability Project, citywide sustainable energy projects and CUNY Sustainable Works (U.S. Bureau of Labor Statistics 2013).

CUNY's collective of 23 institutions offer more than 100 continuing education classes covering numerous sustainability topics. The Green Energy Training program at the Center for Sustainable Energy has trained hundreds of students in solar system design and installation, home energy auditing and geothermal technologies. CUNY hosts three solar teaching labs across its campuses to ensure that CUNY graduates can meet the demand for green jobs and that clean technology is being piloted on its campuses. The CUNY Green Taskforce was established by the Office of the President in 2007 to guide the collective efforts of the university's campuses to transition to a more sustainable institution. The Green Taskforce consists of seven teams of students, faculty and staff who collaborate to monitor the areas of energy, water, transportation, recycling, procurement, nutrition and community outreach across all 23 CUNY campuses.

4.3.1 Origin and Purpose

In June 2007, CUNY chancellor, Goldstein, accepted Mayor Bloomberg's '30 in 10' University Challenge to reduce carbon emissions on its campuses by 30% by 2017. The CUNY Sustainability Project was established to respond to this challenge. A team was formed to help each of CUNY's 23 campuses create a ten-year sustainability plan. In 2008, CUNY elaborated its commitment to improved operations in response to Governor Paterson's New York State Executive Order Number 4, calling for state agencies to 'green' their procurement management, enhance recycling and waste management, and develop a sustainability plan. The project seeks to integrate sustainable practices into CUNY's operations, curriculum and research through partnerships with civic and business leaders with the objective of establishing CUNY as a pioneer in areas that fall under the rubric of sustainability. The campus sustainability plans identify over 800 actions to implement by 2017. At the end of 2011, CUNY had already reduced its emissions by 19%, more than half the plan's goal of 30% (U.S. Bureau of Labor Statistics 2013).

4.3.2 Project Implementation and Planned Steps

As mentioned above, many CUNY degree programs now include sustainability components, and more than 100 continuing education classes, covering various sustainability topics, are offered at the University. One such program is the Building Performance Lab (BPL). Since 2008, the CUNY Institute for Urban Systems' Building Performance Lab offers a nationally recognized Building Operator Certification Training Program to help prepare operating engineers to manage mechanical and electrical systems for energy efficiency. The certification is an industry standard and the skills are key to making significant improvements in a building's energy and systems performance. The BPL was created to support NYC's GGGBP and was developed within the framework of Greater NYC's green building initiatives.

In 2007, Sustainable CUNY was named the lead of the United States DOE's Solar America City Partnership for NYC. Partnering with the NYC Economic Development Corporation, the OLTPS, Con Edison and others. Sustainable CUNY is working to strengthen and enable the solar market by addressing the barriers to using solar energy and expanding workforce and economic development initiatives (U.S. Bureau of Labor Statistics 2013).

In June 2011, Sustainable CUNY launched the NYC Solar Map, the largest LiDAR-based map in the world. The map is an interactive online tool that displays the solar potential (along with the costs, incentives, and return on investment period) for each of the one million buildings in NYC. It is foundational for the city's new energy infrastructure and is being used as a platform for the development and placement of other clean technologies.

Tria Case, the University Director of Sustainability at CUNY, believes that the Solar Map is critical to NYC's low-carbon future because it enables building owners and the city government to know the true solar potential of every building in the city. NYC has a complicated infrastructure within a highly urban environment in which solar panels are very expensive, especially if the building owner is unsure of the roof's true solar potential. With the Solar Map, building owners know the average electricity output that they can expect from solar panels, and this information has been a powerful tool in encouraging solar installations in the city.

CUNY has looked beyond technological development to the economic constraints of implementation. Having successfully developed a collaborative process that enables the solar market, CUNY Sustainable Works is working to leverage that platform to enable the market for other cleantech innovations and processes utilizing CUNY's institutional strengths and partnerships. CUNY Sustainable Works first succeeded in developing a collaborative process for enabling the solar market. Now, the platform is being expanded to encompass other emerging cleantech projects through the following innovative programs:

- The Sustainable Business Leaders Advisory Board, established in 2010, incorporates the skill of over 30 city agencies, workforce development entities and academia and business leaders to grow the green economy.
- NYCleantech Collaborative (NYCC) was initiated in 2012 as a membership organization of leading industries dedicated to identifying flagship cleantech projects that can make a substantial difference to the city's sustainable future and collaborates on streamlining entry to the marketplace.
- CUNY Sustainable Works Commercialization Program works with NYCC in supporting emerging cleantech fields and provides pathways into the marketplace (U.S. Bureau of Labor Statistics 2013).

4.3.3 Financing the Project

PlaNYC, through the Department of Citywide Administrative Services (DCAS), reserved $30 million dollars for CUNY infrastructure projects, and was matched equally by the State of New York to be distributed by 2017. Additionally, the United States DOE awarded CUNY $727,000 on behalf of the national SunShot Initiative in 2011. CUNY Sustainable Works Commercialization Program received $1 million in investment funds from the private sector in collaboration with the NYCC. The University's Capital Program received $2.7 billion in New York State appropriations between fiscal year 2008-09 and fiscal year 2011-12 to address the infrastructure needs of all 300 buildings, accounting for 27 million square feet, on all 23 campuses (U.S. Bureau of Labor Statistics 2013).

4.3.4 Actors

The citywide success of CUNY's Sustainability Plan and related solar projects can be attributed to government support and impetus at the city, state and federal level. The passage of new legislation, such as the GGBP, and government sponsored initiatives and challenges, such as the Mayor's '30 in 10' Challenge and the DOE's SunShot Initiative, supported with financial assistance gave CUNY the necessary tools to get started. Additionally, substantial collaboration with the private sector has made otherwise unfeasible research projects, such as the NYC Solar Map, possible. CUNY has proven that collaboration between government finances and policy and research institutions' facilities and personnel, combined with the private sector's expertise and efficient implementation, can lead to a powerful consortium for the promotion of green technologies.

NYC Mayor Bloomberg was a particularly great motivator for the CUNY Sustainability Plan. The development of PlaNYC and the '30 in 10' Mayor's Challenge provided CUNY with impetus and institutional clarity in their mission to reduce their carbon footprint. This represents a great first step in getting universities across the city to start making sustainability commitments.

At the university level, Tria Case is a major leader in the promotion of clean energy. In her role as University Director, Ms. Case oversees the Sustainable CUNY Project and its Task Force on Sustainability and assists CUNY's 23 institutions of higher education in meeting their goal to reduce CUNY's carbon footprint by 30% in ten years. In addition, Ms. Case led the development of the NYC Solar Plan together with the OLTPS and the EDC.

4.3.5 Challenges for the Building Performance Lab and Solar Energy

One of the greatest obstacles in developing the BPL at CUNY was financing. The project was contingent upon the ability to raise money from outside sources for staffing and equipment. Another significant barrier was that the BPL's focus on existing buildings was ahead of the markets'; LEED and industry leaders were still focused on new buildings.

Implementing solar energy is still fairly complicated and takes a long time in NYC. From the time the building owner decides to install photovoltaic (PV) systems and the actual installation occurs, over a years' time could pass, given the stipulations associated with the various tax incentives that support solar technologies in the United States. The building owner must file an application, wait for approval, and then wait for inspection before the PV panels can be installed. This process would be simplified without the incentives, but building owners would be even less likely to invest in solar technologies without financial support.

4.3.6 Achievements and Success Criteria

CUNY periodically checks its progress towards achieving its energy goals by using a GHG emissions measurement tool, which was developed following the World Business Council for Sustainable Development (WBCSD), the World Resources Institute (WRI) and the International Council for Local Environmental Initiatives (ICLEI) GHG accounting protocols. The IPCC adopted these protocols for national-level GHG inventories. This measurement tool provides information on GHG emissions associated with mobile and stationary fuel sources, fugitive sources, process sources, purchased electricity and steam, as well as solid waste quantities, and GHGs generated by commuters (CCNY n. y.).

The Green Taskforce's first Sustainability Plan was developed in 2007 and outlined over 800 initiatives to be imple-

mented over CUNY's 23 campuses to achieve its carbon reduction goals by 2017. CUNY's 2012 Master Plan Progress Report outlines the key successes of the Sustainability Plan that have been completed as follows:

Energy goals: Inventory of GHG emissions was completed; building boilers were switched from fuel oil to natural gas; steam-traps were replaced to reduce heat loss and enhance cooling; upgrades were made to HVAC systems; high-efficiency light fixtures and switches were installed; energy-saving motion detection sensors were installed throughout 80% of the campuses; central chiller plant controls were upgraded; building envelopes were improved; campus-wide Direct Digital Control (DDC) Building Automation Systems were installed; and all vending machines were replaced with 'Energy Star' rated machines that power down when not in use.

ECM No.	Energy Conservation Measure Description	Annual Electrical Savings (kWh)	Annual Fossil Fuel Savings (MMBtu)	Annual Energy Cost Savings ($)	Capital Cost ($)	GHG Reduction (MT CO₂E)	Simple Payback (yr)
1*	Lighting Fixtures and Controls	2,300,000	0	$253,000	$3,000,000	856	11.9
2*	Energy Metering and Monitoring	0	0	$ --	$500,000	0	n/a
3*	Campus-wide DDC Building Automation System	2,400,000	37,500	$744,000	$7,000,000	3,115	9.4
4*	Re-commission Central Chiller Plant Controls	1,990,000	0	$219,000	$300,000	738	1.4
5*	HVAC System Retro-commissioning (Compton-Goethals and Baskerville Halls)	123,000	450	$19,000	$150,000	72	7.9
6*	Steam Trap Maintenance Program	0	17,000	$218,000	$150,000	1,008	0.7
7	Boiler Heat Recovery	0	1,600	$21,000	$250,000	95	12.1
8*	Data Center Energy Improvements (NAC and Marshak)	333,000	0	$37,000	$150,000	124	4.1
9	Building Envelope Improvements	580,658	9100	$180,280	$4,500,00	754	0
	Totals	7,146,000	56,550	$1,511,000	$11,500,000	6,008	7.6

Table Near-Term Actions (1 to 5 years) - Energy Conservation Measures (ECM)

MMBtu = 1,000,000 Btu
MTCO₂E = Metric tons of CO₂ equivalent emissions

Figure 27: Near-Term Actions and Energy Conservation Measures (CCNY n. y.)

Water goals: Hydration stations were installed to reduce bottled water consumption; low-flow toilets and faucet fixtures were installed; educational campaigns to prevent water waste and to minimize consumption were launched; and research projects on the reduction of storm water run-off were implemented.

Transportation goals: CUNY's vehicular fleet was switched from regular fuel to fuel-efficient, hybrid or electrical vehicles and a policy has been adopted that requires all new vehicles to be fuel-efficient or hybrid; bicycle racks and bicycle lanes were installed across campuses; reduced parking rates for hybrid vehicles were introduced; and the operational hours of shuttle busses to and from subway stations were extended to encourage the use of public transit (CCNY n.y.).

It is interesting to note that the latest additions to the CUNY vehicle fleet are "Blue Bird Vision" low-sulfur diesel fuel vehicles. Low-sulfur diesel fuel has a sulfur content of 15 parts per million, which makes it 97% cleaner than the standard highway-use diesel (U.S. Bureau of Labor Statistics 2013).

4.3.7 Sustainability

CUNY plays an integral role in educating students about sustainability, promoting responsible stewardship of the earth's resources and enabling students to participate in the protection of their environment (U.S. Census Bureau 2010). CUNY's mission statement details that the university will minimize its carbon footprint by reducing its GHG emissions and increasing its recycling and sustainable planting.

Likewise, the City College of New York (CCNY) is doing its part in promoting sustainability. In the words of Dr. Lisa S. Coico, President of the CCNY:

Our ongoing sustainability commitment extends our impact far beyond the borders of our campus. Through student activities, research and service learning courses, we are actively helping the surrounding community and other New York neighborhoods understand and meet their environmental challenges. Through our curriculum, research centers, key faculty and Master's degree in sustainability, we are preparing a new generation to address the challenges in a world where environmental concerns take on heightened importance (U.S. Bureau of Labor Statistics 2013).

4.3.8 Transferability of the Best Practice

CUNY's commitment to improving its operations, reducing its GHG emissions and fostering research and market implementation of renewable technologies, should be the guiding vision of all universities. Many of CUNY's achievements can be attributed to strong government support, both financially and in policy. For universities lacking such support, intermediate measures for improved efficiency

and GHG reductions can still be attainable through well-articulated and closely monitored sustainability plans. While the ability of universities to research, develop and test new renewable technologies varies across the world, all universities could be committed to preparing a workforce capable of contributing to current and emerging green professions.

4.4 ELECTRIC VEHICLE PILOT

The taxi company 'Yellow Cab' (Design Trust for Public Space und New York City Taxi & Limousine Commission 2007) fulfills an important role in NYC's mobility sector. Responsible for helping meet the ever-growing transportation demand of New York citizens and visitors alike, and available on a 24-hour basis, the taxi service, along with mass transit services, helps establish NYC as one of the world's most environmentally efficient major cities.

Licensed by TLC, taxis are operated by private companies or individuals, not the city government. Three main types of cabs operate in NYC: the yellow, the black and the livery cab. Only yellow medallion taxis, representing 90% of the total 54,000 TLC licensed vehicles in NYC, have the authority to respond to street hails (Design Trust for Public Space und New York City Taxi & Limousine Commission 2007). The NYC 'Yellow Cab' is not only seen as a valuable industry that serves the interests of the city, the owners, passengers and drivers, but also as an icon. The taxi's characteristic colour and style makes it easily distinguishable in the NYC landscape and public spaces. NYC's taxi services are an important asset and have the ability to contribute to efforts aimed at reducing GHG emissions. Representing billions of invested capital, generating annual revenue of over US$1.5 billion dollars and creating thousands of jobs, the taxi system is a vital component of NYC's urban transit network.

However, the 'Yellow Cab's' iconic value must not affect the development towards a sustainable taxi fleet. Mayor Bloomberg shared this view and first announced the Electric Vehicle Pilot (EVP) project in 2011. The main objective with this pilot project is to gain experience in integrating and operating electric vehicles in NYC's taxi fleet. Through

Figure 28: All electric Nissan LEAF taxi (New York Daily News 2013)

the collaborative efforts of the TLC and Nissan North America six all-electric Nissan LEAF vehicles were provided. The EVP is a milestone defined in PlaNYC and serves as a case study of the implications of broader adoption of electric vehicles in the Yellow Cab fleet.

4.4.1 The Genesis of the EVP

PlaNYC established ambitious goals to reduce 30% of the city's GHG emissions (from 2006 levels) by 2030. Because the transport sector contributes 22% of citywide total GHG emissions it plays a considerable role in the pursuit of emission reduction goals (The City of New York 2013m). Moreover, in the long-term, the goal is to increase the share of electric vehicles to make transportation clean and quiet. To this end, the Bloomberg Administration has set the goal of replacing 30% of NYC's taxi fleet with electric vehicles by 2020.

IIn 2007, prior to the EVP, a project called the Taxi of Tomorrow was designed with the aim of replacing the entire yellow taxi fleet with more fuel-efficient and enhanced models. The Nissan NV200 was announced the winning model of the call for proposal in 2011, establishing the Nissan car company as the sole manufacturer for future NYC taxis with a 10-year starting contract. Though Taxi of Tomorrow has not yet been phased in due, mainly, to litigation, Nissan simultaneously planned the EVP project in 2011. Although the NV200 model is neither fully electric nor hybrid, it represents the beginning of a shift in consciousness with respect to greening urban mobility.

With this, Mayor Bloomberg officially launched the one-year EVP on April 22, 2013 and the vehicles donated by Nissan joined the city's fleet of about 13,000 taxicabs. The objective of the EVP is to study electric taxis in typical day-to-day situations in order to determine how to best transition to electric taxis in NYC. For the period of one year, information about the technology itself, but also about

Figure 29: Fuel efficient Nissan NV200 (autoweek.com 2012)

its compatibility with the infrastructure, potential business models and interactions with drivers and customers, will be gathered. Data on advantages, disadvantages, benefits and challenges experienced by the drivers of the electric cab and their passengers will be collected and the environmental benefits of adopting electrical vehicles on a larger scale will be analyzed. There are no further steps planned until the results of the EVP project are evaluated. The procedure to achieve the ambitious objectives will be developed step-by-step as the project unfolds.

4.4.2 Financing of the Project

A call for participants was issued around October of 2012 to which two owner-drivers and two taxi fleets volunteered. Nissan provided the city with six Nissan LEAF vehicles and three quick chargers for the project. In addition, Nissan negotiated agreements with two private property owners. One quick charger was installed on city property where Nissan provided the charger and installation was funded by a grant from the NYSERDA. The standard level 2 chargers for homes and fleet garages of EVP participants were donated by the Federal DOE and installation paid for by Nissan. Electricity costs occurring while charging at these charging stations are paid for by the participants in regular electrical bills. For the duration of the project, additional costs, such as those associated with the new infrastructure, are distributed over various public institutions, private companies and the TLC.

4.4.3 Actors of the Project

PlaNYC encompasses a framework for the sustainable transition of taxis to electric vehicles which will play a significant role in improving the city's air quality. The OLTPS, which is part of the Mayor's Office, promotes sustainable growth and has been continually working with the TLC and Nissan to provide essential expertise throughout the pilot project. The EVP project was created as part of the Taxi of Tomorrow project, where TLC partnered with Nissan under the terms of a broader Taxi of Tomorrow contract. Though Nissan and TLC played leading roles in the implementation of the pilot, the entire process was enabled by the valuable collaboration between multiple stakeholders. Mainly the DOE is in charge of analyzing the data gathered from the pilot project.

Con Edison, one of the largest energy companies in the United States providing electricity, gas and steam service, has helped TLC and Nissan identify possible sites to host quick chargers based on their power usage profiles. City property hosts one quick charger and two private property owners, Related Management (a corporation dedicated to sustainable real estate development and operations) and Seward Park Cooperative (a complex of four 20-story apartment buildings) have agreed to each host one of the remaining two quick-chargers each. The DOT has provided technical support on the installation.
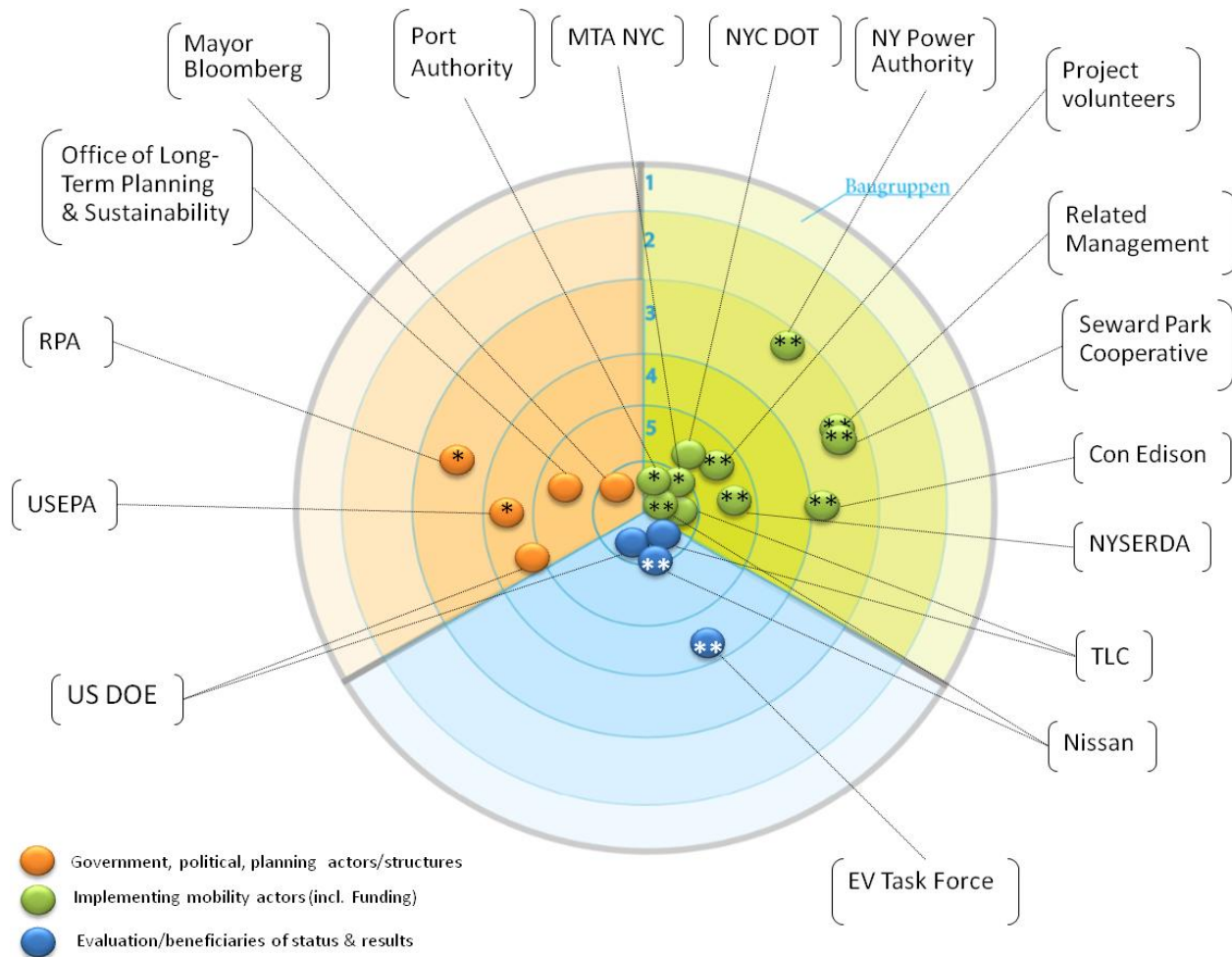
Figure 30: Actor onion including actors of the mobility sector. NYC and EVP partners marked with (*) are not involved in the EVP. Actors marked with (**) are not involved in mobility aside from the EVP (own graphic)

Mayor Bloomberg established a Long-Term Electric Taxi Task Force in January 2013. The Task Force is led by the TLC and will serve to provide relevant recommendations for the large-scale adoption of electric taxis in NYC. Comprised of important stakeholders within city agencies, industry and non-profit establishments, the task force relies on the expertise and collaboration of all participants on electromobility and the potential electric transformation of NYC's taxi fleet (The City of New York 2013c).

4.4.4 Barriers and Challenges: the Electric Vehicle as a Taxi

If the EVP provides successful results, the transition to electric vehicles could provide a great opportunity for NYC to reduce the serious environmental problems that it faces without losing its iconic taxi. The density of NYC, especially in Manhattan, is a significant challenge that slows infrastructural developments and can be blamed for the high

congestion of cars in the city center. On the other hand, NYC's density is responsible for many of the environmental advantages the city has over other cities in the United States. In high density neighbourhoods car ownership levels are lower than those of average American urban residents, the transit system is more developed and commonly used and popular destinations are within closer proximity to each other. As such, NYC does not face the same struggles many other cities face in moving people away from cars. NYC's challenge is more a question of how to improving the existing public transit systems.

An operational challenge during the project was the establishment of a quick-charging infrastructure. Land is a valuable asset and because site hosts were not offered any compensation, it was difficult to find suitable site hosts. A major structural challenge is identifying feasible business models for electric taxis, given the high investment costs and fees charged to users of quick-chargers. It is hoped that the EVP

will provide an answer to the question of whether it can become profitable for both the drivers as well as the owners of the quick-chargers. Should the EVP find there to be no private sector advantage to switching over to electric vehicles, government subsidy programs could be pursued to help jump-start the introduction of electric vehicles.

The high demand for taxi services and the company and driver's desire to earn as much as possible, poses another considerable challenge to the use of electric vehicles, which require charging, as do taxis in NYC. To provide some context, approximately 470,000 taxi trips are made each day, according to statistics gathered in 2006. Though the resulting 240 million passenger trips per year (with an average of 1.4 passengers per trip) represent only 11% of the approximate 2.2 billion subway and bus passenger trips made that same year, it is still an impressive figure. Of these trips, more than 170 million trips are paid Yellow Cab medallion trips. This figure has remained more or less consistence since 1995. According to the 2000 United States Census, 10% of all taxi trips are commuter trips and 85% of all trips either start or end in Manhattan. About 54,600 people (1.6% of the labor force) primarily use taxis and other for-hire vehicles to commute to and from work each day.

The majority of taxi drivers work 8 to 12 hour shifts, incorporating one or two short breaks amounting to a total of approximately 50 minutes. Cabs in New York are recognized as high-mileage cars. In 2005, the average cab travelled almost 104,000 km and the NYC taxi fleet mileage amounted to more than 1.3 billion km. However, mileage depends largely on the type of taxi-operator. It is interesting to note that although the average annual total taxi mileage is high, the average trip taken by New Yorkers is rather short. Over 50% of the trips taken by New Yorkers are less than two miles. In 1990, the majority of taxi-drivers travelled between 130 km and 240 km per shift and about 5% of the total mileage travelled included shifts covering more than 322 km. Driving speeds average approximately 63 km/h and drop to 56 km/h during peak-hours (Schaller Consulting 2006; TomTom International BV 2012).

4.4.5   Key Drivers and Framework Conditions

The following points have been identified as the key drivers of the implementation of the EVP:

- **Bloomberg as a political champion**: Mayor Bloomberg has been a strong advocate for the transformation of the taxi fleet. In PlaNYC the Mayor announced his goals of replacing 30% of the taxi fleet with electric vehicles by 2020 and has for several years continuously fought for the sustainable transformation of the city's taxi industry.
- **The presence of identified and fixed transportation aims**: Initiatives within PlaNYC to reduce transportation GHG emissions by 44% by 2030,

combined with Mayor Bloomberg's aim of replacing 30% of the taxi fleet with electric vehicles by 2020, has driven the EVP.
- **Fuel taxes**: NYC has one of the highest fuel taxes in the United States. In light of this, many taxi companies and owner-operators have opted to switch to hybrid taxis out of economic self-interest. Depending on the outcome of the pilot project, a similar result could occur with electric vehicles.
- **The taxi as a "moveable public space"**: Design Trust, a non-profit organization aimed at improving public space in New York, defined Yellow Cab as a movable public space. Yellow Cab is a dominant feature of NYC's streets and a strong link exists between taxis and mass transit services. Hence, this pilot project could potentially contribute greatly to the city's image and environmental quality.
- **Funding from the private sector**: Funding availability in NYC is very limited and this has taken a great toll on the quality of many services, including public transit. The MTA, for example, has been severely constrained due to a very limited budget and has not been able to pursue many of its goals. In fact, it has enforced a 50-cent tax on taxi fares. As such, Nissan, which provided the electric cars, two out of three quick chargers and paid for the installation of charging infratsructure, served as the backbone of the project.
- **New York City's geography**: NYC's geographic setting limits transportation to and from the island of Manhattan. Most of the taxi activity takes place in Manhattan, where private car ownership is the lowest in the United States, at 230 cars per 1000 residents, and use of public transit is high. The average distance a person travels per day is approximately 14.5km.

4.4.6   The Contribution of Electric Vehicles to Sustainability in NYC

By replacing its taxi fleet with fuel-efficient or electric models, NYC is transitioning towards a more sustainable transportation system. This transition has enormous potential in improving the city's environment, specifically air quality, and quality of life. Additionally, the transition will boost NYC's image as a green city due to the symbolic nature and dominating, as well as important, presence of its iconic Yellow Taxi. The main concern with this transition is the electric vehicle technology and its ability to stand up to the high demands the taxi services need to meet.

The technological transition towards electromobility is mainly driven by environmental concerns and public policy. However, socio-economic factors and technological developments are important pillars in promoting the use of EVs as well. Though EVs represent a great solution to many of the problems in today's road transportation systems, espe-

cially for growing urbanization challenges, the problems of traffic congestion and road accidents remain. Moreover, the sustainability of electromobility depends on many factors, including the resources employed in the technology and the energy sources utilized for producing fuel (or electricity). For instance, if the electricity is produced from oil, then EVs would no longer be greener than conventional cars, apart from eliminating tailpipe emissions. However, energy dependence would decrease, thereby enhanced energy security and greater stability. This rise in energy autonomy would mitigate conflict risks often associated with geopolitically sensitive resources, such as oil. As a whole, further developments in electromobility technologies are required in order for electric vehicles to contribute to a truly sustainable transportation system.

4.4.7 Transferability of the Practice Example

NYC is well suited for the implementation of electric vehicles as taxicabs given the city's high density which relatively short driving ranges as well as the city's high demand for taxi services. Consequently, the EVP project could be easily replicable in other densely populated urban areas and serve as a prototype for the widespread introduction of electric vehicles in large cities. The EVP project will collect data on trip profiles and charging times which will help other cities optimize the process of infrastructure construction and business model development. With further improvement in battery technology and the resulting driving range extension the project will also be relevant to more rural regions. The taxi trip profile is well suited for electric vehicles which can recover energy while braking and recharge between rides.

4.5 MASS TRANSIT SYSTEM

Between the 1960s and 1970s NYC´s subway system lacked a robust financial structure. Failing to be able to finance repair or replacements, the subways system quickly deteriorated and, much like in the case of the NYC taxis in the early 1900s, its image was damaged and trains were known to be unreliable and dangerous. Ridership decreased after the Second World War as people moved to the suburbs and acquired cars.

It was not until the early 1980s, as capital funding plans were introduced and financial resources became available, that the subway system benefitted from investments made in replacement, maintenance, security, etc. After two decades of heavy investment (about $75 billion dollars) and growth in the 1990s, today the mass transit system is widely used for both business and pleasure trips with the subway recording the highest passenger numbers in history. The NYC subway is the only subway in the United States that operates 24 hours a day, seven days a week. Approximately 140 million passengers ride the subway and 55 million passengers ride the bus every month.

Figure 31: Subway Line in New York City (E.S. Savas National Center for Policy Analysis 2012)

4.5.1 NYC Mass Transit Capital Programs

Today, efforts are primarily invested in the improvement, expansion, decongestion and upgrading of the signaling technology - such as the automation of the of the NYC mass transit system. Due to limited capacity and rising transit ridership, the city subway is congested. Several projects and proposals are being developed and implemented to expand the transit system. Examples of NYC mass transit projects include (MTA 2013a; MTA 2013b):

East Side Access: This $8.24 billion project is the largest transportation project in the United States and the first expansion of the Long Island Rail Road (LIRR) in over a decade. The aim is to reroute eight new LIRR tracks to Grand Central Station in an effort to reduce congestion at Penn Station (located in the western side of Manhattan). It has been observed that a large number of LIRR commuters travel to the east side of Manhattan and work within walking distance of the Grand Central Terminal. Hence, offering a direct east side access would reduce congestion at Penn Station, where many now transfer to connecting lines, and save overall travel time. The current date for service commencement is set for August 2019.

Second Avenue Subway: Costing approximately $4.45 billion, this new line is proposed to run parallel of the currently heavily congested Lexington Avenue Line running in eastern NYC. The project is divided into two phases. The first phase, which is an extension of the current Q line, will run parallel to the Lexington Avenue Line from 96th to 63rd street extending 2 miles along the length of Central Park. Project completion is planned for December 2016. It is hoped to alleviate the Lexington Avenue Line of 13% of its passengers.

No. 7 Train Extension: Another extension project, estimated to cost $2.4, is planned to extend the current 7 Line from Times Square (the current end-terminal) to the Far West Side (34th street and 11th Ave.). This subway exten-

sion of 1.5 miles should facilitate and promote urban development in this new neighborhood of Manhattan, starting service in June 2014.

Fulton St. Transit Center: The construction of a new 6,500 square meter transportation (and retail) center in lower Manhattan will connect 11 train lines and improve travel and access for about 300,000 riders. Having started in 2005, project completion for this $1.4 billion project is expected by June 2014.

The Automatic Block Signaling (ABS) currently used by the NYC subway system, largely installed between the 1930s and 1960s, is designed to control the distance kept between trains operating in the same direction by detecting occupied "blocks" or railway divisions (Wikipedia 2013a). The MTA plans to upgrade the current signaling system with Communication-Based Train Control (CBTC) technology. CBTC provides enhanced real-time information on train arrivals and delays thereby allowing trains to operate within closer distance to one another which results in a system capacity increase of approximately 10%. So far, CBTC has only been installed on the L-line.

4.5.2   Procedure and Measures

The expansion of the mass transit system in NYC, which is organized by the MTA, is a difficult task given the river crossings and the system's multiple steakholders. For example, the New York/New Jersey port and airport is controlled by the Port Authority and the local streets are within the ambit of the NYC DOT while the interstate highways and larger freeways are under control of the state DOT. Therefore the implementation of infrastructure projects in NYC is influenced by various interests, which have a strong impact on the planning procedure especially in the beginning when requirements must be developed.

4.5.3   Project Implementation and Planned Steps

Comprehensive and long-term planning of the subway system is only partially possible given the financial constraints and the different interests of the multiple stakeholders who are competing for limited space and funding. Furthermore, the fact that the subway system is in operation 24 hours a day seven days a week makes it difficult to find sufficient time periods to schedule construction work. Consequently, the expansion and improvement of the NYC subway system must follow a step by step approach consistsing of different projects which are sometimes divided into several phases, as in the case of the Second Avenue Subway project.

4.5.4   Financing of NYC Mass Transit Systems and Actors

NYC transit users pay the highest share of the operating costs of any subway system in the United States and pay almost twice as much as users in most other cities. Transit riders finance 50% to 60% of the operating costs for mass transit, specifically the NYC subway system. The remaining
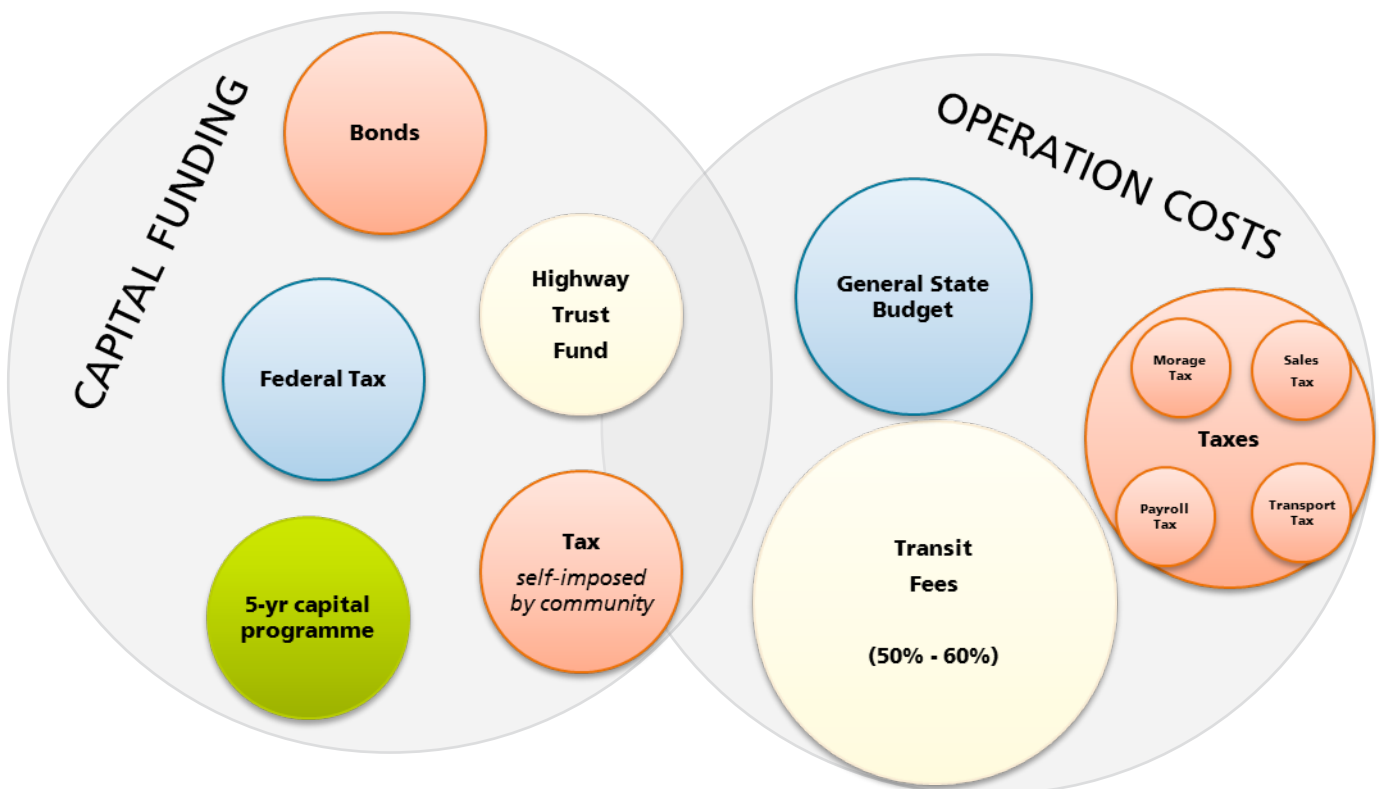

Figure 32: Financial sources of the NYC Subway System (own graphic)

40% to 50% operating costs are covered by the State of New York and typically raised from taxes collected by the state and dedicated to the MTA. These include mortgage, transport and payroll taxes as well as a sales tax imposed on the city's taxis. In addition, the State General Budget may also contribute and profits made in tolls collected from MTA bridges and tunnels are also used to pay operating costs.

NYC mass transit capital projects are financed through various different sources including funds collected through the federal gas tax and money from the State and Federal Government invested in so-called 'five-year capital funding plans'. Federal funds are generally known to be hard to come by. The Mass Transit Account of the USHTF is a source of capital funds, collected essentially off gasoline purchases. Another source is from bonds, based on the profits made from bridges and tunnels that are issued.

The Second Avenue subway project and the East Side Access project were both undertaken by the MTA in order to meet the growing capacity demand on mass transit in NYC. Further stakeholders are the DOT as well as construction and management companies. The MTA and its subcontractors meet on a regular basis with the Manhattan Community Board 8 Second Avenue Subway Task Force and Manhattan Community Board 11 to report on construction progress and to seek input from the community on the Second Avenue subway project.

4.5.5   Barriers and Challenges of Transit in NYC

The greatest challenges faced by the mass transit system of NYC are budget constraints, which have led to fare increases and service reductions, and the need for a more modern and expansive network. While the current subway system has not changed since the 1950s, several subway lines have reached their limits in terms of capacity. The urgent expansion required of the subway system is challenging and expensive due to several factors discussed below.

Strengths:
- Flexible system (double track lines)
- Good accesability (but not barrier-free)
- Strong alternative to individual motorised transport
- 24/7 serviced subway

Weaknesses:
- limited space
- high demand of underground
- over capacity
- budget constraints
- evasion of historical buildings
- ADA accessability
- expansive documentation
- multiple stakeholders

4.5.6   Key Drivers and Framework Conditions

Given the challenge of tight budget constraints, a key driver for the maintenance and expansion of the mass transit system in NYC is the MTA's five-year capital program. This plan is submitted every five years in order to get the capital budget, which pays for projects as well as major items like new trains and buses, approved by the state. The last plan was published in January 2012 and was estimated to cost between $25 and $30 billion, much of which was financed through bonds that the MTA will repay over many years to come.

4.5.7   Successes and Success Criteria

The success of the NYC mass transit system becomes evident when you look at its development over the past 100 years. In the 1900s the trains were known to be unreliable and dangerous. In contrast, the system serves the highest number of riders in history today and operates around the clock seven days a week. Although the price per ride ranks average within the world's metropolises, it covers up to 60% of the operating costs which suggests an effective mass transit operation system. However, the constant need for maintenance and construction, as well as changes in services and operations, makes this success fleeting and hard to maintain.

4.6   WORLD TRADE CENTER – SECURITY

The new World Trade Center (WTC) of NYC is located in Lower Manhattan. After its complete destruction due to the terrorist attacks of September 11, 2001 the new building complexes consist of five new skyscrapers (1, 2, 3, 4 and 5 WTC). The National September 11 Memorial & Museum, the WTC Transportation Hub PATH Station, 18,580 square meters of retail space as well as a performing arts center. With a height of 542.3 meters, the One World Trade Center (One WTC) Tower is NYC's tallest building. It consists of 792,480 square meters of office space, an observation deck, restaurants, and broadcast and antennae facilities. The new transportation hub, located between towers 2 and 3, is designed to serve as a traffic node for 250,000 pedestrians per day. Once complete, the transportation hub will consist of a retractable 45.7 meter high glass and steel construction that will allow sunlight to pass through to the rail platforms 18 meters below street level. The building includes a multi-story central transit hall, enhanced permanent PATH facilities and services, an integrated network of underground pedestrian connectors, as well as retail stores and restaurant facilities (Silverstein Properties, Inc 2013).

The new One WTC will operate elevators housed in a protected central building core. This core is supported by a pedestal with a footprint of 200-by-200 feet (61 meters) and a height of 70 feet (21.3 meters). The reinforced concrete installed above ground will protect the building from blast

Figure 33: View of One World Trade Center tower (April 19, 2013); construction elevator attached onto tower (right) (own photography Fraunhofer EMI)

threats in case of an explosion at street level. The structural integrity of building will also be enhanced through reinforced underground concrete structures.

Additionally, there will be protected designated emergency meeting points for each floor as well as separate staircases for civilians and relief forces. All stairwells will be extrawide pressurized staircases. Furthermore, the buildings will be equipped with concrete-protected sprinkler systems, emergency alarm systems and communication systems including enhanced emergency communication cabling, thus exceeding the safety requirements of the New York Building Code (PANYNJ 2013a).

4.6.1 Actors and Key Drivers

The WTC grounds are owned by the PANYNJ. The PANYNJ is a bi-state port district authority which oversees and owns most of the regional transportation infrastructure such as bridges, tunnels and air- and seaports within the ports of New York and New Jersey. As the owner of the WTC site, PANYNJ closely collaborates with the Lower Manhattan Development Corporation (LMDC) as well as Silverstein Properties.

As to its procurement in 2003, the LMDC, which was formed after the attacks of September 11 to plan the reconstruction of Lower Manhattan and was founded by then-Governor George Pataki and then-Mayor Rudolph Guiliani, decided to launch a competition for determining how to reconstruct the site. The LMDC is a joint state-city corporation managed by a 16-member Board of Directors, half of whom are appointed by the Governor of New York and half by the Mayor of NYC. LMDC's main task is to ensure the recovery and renewal of Lower Manhattan. It therefore cooperates with partners from public and private sectors in order to successfully reconstruct the WTC site. The LMDC coordinates long-term planning in addition to various short-term initiatives and closely collaborates with a large number of groups affected by the 9-11 attacks, such as victims' families, business owners and downtown residents. Furthermore, LMDC offers public hearings in order to ensure the participation of those affected by the attacks.

Several government bodies will be housed in the tower including the State of New York, the General Service Administration, and New York State's Office of General Services. The Chinese corporation Vantone Industrial Co. and the publishing corporation Condé Nast will become its commercial tenants.

Another important actor is leaseholder and developer Larry Silverstein of Silverstein Properties who retains control of building One WTC, architects David Childs and Daniel Libeskind, Dan Tishman who is the builder of One WTC and leads the construction management for Tishman Realty & Construction, as well as Douglas and Jody Durst, co-presidents of the Durst Corporation, which owns approximately 5% of One WTC.

4.6.2 The Vehicle Security Center

As a high-risk area, the One WTC site requires specific security measures. To comply with these enhanced security requirements, no vehicles will be permitted to enter the area at street level of the One WTC site. All vehicles carrying supplies and goods to the individual buildings, offices and retail areas as well as all private cars of people working in one of the buildings will undergo security scanning before entering the underground parkades. The Vehicle Security Center (VSC), located at the southwest corner of the redevelopment site, will be equipped with the latest technology systems such as vehicle scanning systems, vehicle arrest devices, control gates and closed-circuit television surveillance systems as well as security booths and an operations office to ensure that no potentially hazardous substances, such as chemical, biological, radiological, or nuclear explosive substances (sometime referred to by the acronym "CBRN", transported in vehicles can enter the WTC site. The VSC will serve as the major security screening checkpoint and it will extend five stories underground connected to several ramps that will lead to the parking and handling zones of the corresponding buildings. All vehicles must enter WTC through the entrance of the VSC where they will descend an underground helix pathway leading to the corresponding parking zones. All buildings except for the One WTC Tower will offer underground parking and loading zones. From street level, only the entrance to the VSC and the underground parking areas will be visible. On top of the underground facilities the St. Nicholas Greek Orthodox Church will be reconstructed next to its former location.

In 2009, the VSC construction was officially launched. Construction started with the excavation and securing of the south sub-grade against groundwater infiltration from

Figure 34: View on the Vehicle Security Center; entrance for vehicles on the right (own photography by Fraunhofer EMI)

Figure 35: Entrance to the VSC; helix pathway directing vehicles to the parking zones (own photography by Fraunhofer EMI)

adjoining areas. For this 29 interconnected concrete walls, three feet thick, were installed as slurry wall panels reinforced by high-strength tieback anchors which allowed for the soil excavation as well as the blasting and removal of rocks. Subsequently, the steel construction forming the roof and substructure of the VSC entrance was set up. After completion, 10,701 tons of steel will have been installed in the VSC (PANYNJ 2013b).

4.6.3 Construction of One WTC

The main objective of the new WTC is to develop a multifunctional infrastructure facility that serves as the city's core business center of the financial district as well as a major transportation hub and memorial for the destruction of the Twin Towers on September 11. In terms of security and resilience measures, the construction of One WTC as the tallest

building in NYC and the VSC as the central strategic supply management facilityare at the centre of attention. Both require specific construction methods as well as innovative building materials to ensure their resilience capabilities in case of a disaster.

NYC's highest building, the One WTC Tower, required specific construction methods. Generally, building provision for high-rise constructions foresee a compressive strength of 8,000 to 10,000 pounds per square inch (psi) corresponding to 55,158 kilopascal (kPa) and 68,947.5 kPa, respectively. The new tower, however, with a hight of 542.3 meters, requires a compressive strength of 14,000 psi, corresponding to 96,526.6 kPa, calling for specialized provisions (Margrill 2011). Overall, most of the concrete was poured into the One WTC's monolithic pedestal. With a footprint of 61 by 61 meters and a height of 21.3 meters, the reinforced underground structure is designed

Figure 36: Reinforced building pedestal of One World Trade Center (own photography by Fraunhofer EMI)

to protect the structural integrity of the entire tower from an explosive device even more powerful than the bomb which was detonated underground in the former WTC in 1993. At street level, One WTC is construed to withstand the blast of a vehicle bomb (Margrill 2011).

One WTC also features a secure, 1.8-meters reinforced concrete building core housing three stairwells and elevators for evacuation. Two of the evacuation stairwells are intended for evacuating people working in or visiting the One WTC. The third stairwell is reserved for fire-fighters and emergency responders. The width of the stairwells exceeds the common building code by 20% (Margrill 2011). In addition, the walls of the stairwells consist of fireproof concrete. All stairwells will be pressurized as to prevent smoke from entering the evacuation zones. This ventilation system will also feature a filtration system to protect the occupants from CBRN or other hazardous gaseous substances that may be used in the event of a terrorist attack (Margrill 2011).

4.6.4 Project Implementation and Planned Steps

Construction on transportation hub, 1, 2, 3 and 4 WTC as well as the memorial and the museum is still ongoing. The 104 stories of One WTC Tower are completed as well as 72 stories of 4 WTC. As of May 10, 2013, the spire on top of One WTC brings the building to its final height of 542.3 m.

The VSC completion status, according to the official WTC website as of June 2013, reads as follows (PANYNJ 2013b):

Overall Site:
- All excavation work has been completed, amounting to over 150,000 CY;

Western Portion of the Site:
- The foundation has been layed;
- Over 6,000 tons of steel has been erected;
- Concrete superstructure construction is ongoing.

Eastern Portion of the Site:
- Rock excavation has been completed, amounting to over 13,000 CY;
- Over 40 footings and foundational piers have been placed and slab on grade is near completion;
- Structural steel erection is underway.

The VSC is expected to be completed by mid-2015. However, the first construction vehicles to use the VSC are expected to enter the site through the VSC by the end of 2013.

4.6.5 Financing of the Project

The 2007 cost estimation for One WTC amounted to US$ 3 billion (US $ 12,380 per square meter). In 2012, the costs were adjusted upwards to US $3.8 billion (Brown 2012).. The costs for 2 WTC amount to $2.9 billion (Wikipedia 2013c)

and for 3 WTC to US $2.75 billion (Wikipedia 2013b). According to the PANYNJ (cf. 4.1.2), while the cost for the entire reconstruction of the WTC amounts to US $45 billion. However, this figure is expected to be adjusted upwards.

The LMDC, responsible for all reconstruction endeavors in Lower Manhattan after 9-11, was funded through the disbursement of Community Development Block Grants-amounting to US $2.783 billion (U.S. Department of Housing and Urban Development 2011) and approved by the Federal Government of the United States in the aftermath of the 9/11 attacks. The United States Department of Housing and Urban Development provides this grant.

In sum, the State of New York is providing US $250 million while the PANYNJ is providing US $1 billion through the sale of bonds for the construction of One WTC (Bagli 2007). In addition, the PANYNJ implemented a series of tunnel and bridge tolls, which ultimately were not exclusively used for WTC construction purposes.

4.6.6 Barriers and Challenges

One major challenge in the reconstruction of the WTC site is to provide for an integrated building complex allowing for convenience and visitor friendliness while at the same time ensuring that all security requirements are fulfilled. This involves innovative ways to manage traffic flows in Lower Manhattan and establish connectedness to neighbouring areas so as to prevent the WTC from being an isolated building complex. Thus, it will be particularly challenging to develop an integrated plan consistent with the wishes of all groups affected, including pedestrians, cyclists, vehicle drivers, professionals working at the WTC and visitors touring the site. To meet the interests of these varying groups, security bollards will be installed around the entire site to prevent vehicles from entering, in addition to NYPD security checkpoints that will be in place throughout the complex.

Additionally, the digital modeling of the new building complexes poses a significant challenge. Building Information Modeling (BIM) techniques are used to design the physical and functional characteristics of the WTC buildings and in order to create 3-D models of the corresponding building units. Unlike traditional building design techniques relying on two-dimensional construction plans, BIM provides a five-dimensional building model with time as the fourth dimension and cost as the fifth (Eastman et al. 2013). Thus, BIM incorporates spatial relationships, light analysis, geographic information as well as quantitative and qualitative information in order to create a holistically designed model of a building. Tishman Realty & Construction are using BIM for designing One WTC. As a relatively new design method, BIM poses various challenges in terms of implementation.

Figure 37: Security bollards are to be embedded around the WTC site to prevent vehicles from entering (own photography Fraunhofer EMI)

4.6.7   Transferability of the Practice Example

The reconstruction of the WTC is a highly unique construction endeavor. NYC and its Lower Manhattan district are not only densely populated, thereby posing various challenges for such a large-scale building effort, but the area also holds a very specific cultural and historical significance to its citizens as well as the country as a whole. Therefore, while specific building and construction methods and urban planning concepts may be transferrable to other construction projects, the sheer dimensions and proportionality of the applied security measures can only partially be transferred to similar projects in other cities.

4.7   NATIONAL URBAN SECURITY TECHNOLOGY LABORATORY – SECURITY

NYC has repeatedly been struck by natural as well as man-made disasters that have caused considerable damage and required the exceptional collaboration of relief forces on the one hand and comprehensive preparation strategies and concepts on the other. The National Urban Security Technology Laboratory (NUSTL) is part of the Science and Technology Directorate of the United Sstates Department of Homeland Security (DHS) and aims to bridge the gap between the operating relief agencies and the federal, state or communal authorities. Its main focus is on testing, evaluating and analysing technologies related to emergency response authorities on the communal, state and national level. NUSTL's current mission is designed for a broad assessment of threats. Essentially, NUSTL functions as a technical liaison between the DHS and the first responder community, thus addressing both end-user interests and homeland security capabilities. The laboratory focuses primarily is on the protection of urban environments (U.S. Department Homeland Security 2013).

NUSTL's main capabilities are:
- Test and evaluation: NUSTL provides a whole range of test planning, management, analysis, reporting and operational risk management for critical technology tests.
- First Responder Liaison: NUSTL collaborates closely with homeland security operational personnel in NYC and the tri-state area. These operational collaborations aim at understanding operating conditions, such as technical and resource limitations, as well as organizational and political challenges (NUSTL 2013).

NUSTL, as the interface between the DHS, first responders and crisis managers, views NYC as its test bed for applied research and engineering activities. According to its strategic plan for 2009-2013, its main goals are:

1.   to expand and strengthen customer and partner relationships within the homeland security community;
2.   to consistently deliver superior products and services to customers;
3.   to strengthen the Laboratory's workforce;
4.   to modernize and streamline the Laboratory's business support operations to maintain an effective organization.

Therefore, NUSTL constitutes the interface between DHS and the following bodies (Goodwin 2011):

- The New York Police Department
- The Fire Department of New York
- The Port Authority of New York & New Jersey
- The MTA
- The State of New Jersey: Office of Homeland Security and Emergency Preparedness

- The State of New York Office of Homeland Security
- The New York City Office of Emergency Management
- The Financial sector
- US Customs & Border Protection
- The US Coast Guard
- The DOE/NNSA/Emergency Response
- The Brookhaven National Laboratory
- The Remote Sensing Laboratory

4.7.1 Founding of NUSTL

In the 1940s, the Health and Safety Laboratory was founded, dedicated to pursuing research in the field of nuclear defense. When the project was moved to testing grounds in Nevada, the Health and Safety Labratory's new mission was to monitor the potential spread of radioactive fallout nationwide by collecting and measuring air samples throughout the country. In 1977, the DOE renamed the Lab the Environmental Measurements Laboratory (EML). EML was assigned various tasks, such as the assessment of radiation levels at a Pennsylvania nuclear plant after a meltdown in 1979, as well as research on the events of the Chernobyl nuclear accident in 1986. During the 1980s and 1990s, EML focused on investigating the measurement of radioactivity generated by radon, a natural gas occurring as a result of decaying uranium. After the attacks of September 11, all of the security- and disaster-related departments, agencies and institutions were consolidated in the new DHS. Located in NYC, EML was incorporated into DHS focussing particularly on terrorist threats targeting urban areas. In 2009, the Laboratory was renamed the NUSTL using NYC and the tri-state area as its test-bed. Its main task now consists of closely collaborating with first responder agencies both in terms of organizational aspects as well as technology based testing activities (Goodwin 2011).

4.7.2 Current Projects

Currently, NUSTL is conducting various testing and evaluation projects in order to improve the capabilities of NYC's disaster relief forces in terms of understanding and mitigating prevalent and future natural and man-made threats. Within these projects, NUSTL leads testing phases as well as field studies in close cooperation with the local emergency response community. This includes the System Assessment and Validation for Emergency Responders (SAVER) program as well as the Radiological Emergency Management System (REMS). Additionally, NUSTL hosts the New York Area Science and Technology Forum (NYAST), a consortium consisting of members from federal, state and local government authorities as well as certain private sector groups.

The SAVER Program
The SAVER program aims at supporting emergency responders in making procurement decisions for emergency response equipment. Following a market study, the equipment – although it is usually tested by the manufacturer also – is analyzed within the SAVER program according to the following criteria in order to provide the necessary information basis for the first responders:

- conduct impartial, practitioner-relevant, operationally oriented assessments and validations of emergency responder equipment;
- provide information that enables decision-makers and responders to better select, procure, use, and maintain emergency responder equipment (Carter 2012)..

New York Area Science & Technology
Local, state and federal government organizations, as well as private sector groups, regularly meet as a consortium to discuss progress in security technology applications. The topics addressed range from emergency management and first responder technologies to homeland security issues. NUSTL, as the host for these meetings, offers a platform for establishing contact, thoroughly exchange information and providing crucial field operations feedback (NUSTL 2011).

4.8 URBAN WATER SUPPLY INFRA-STRUCTURE: MODERNIZATION, INCREASING RESOURCE EFFICIENCY, INCREASING RESILIENCY

NYC has some of the best drinking water resources in the United States, exceeding federal and state water quality standards and thus allowing drinking water supply without the need for filtration units. However, the city's water supply relies mainly on water resources up to 250km away from the city. The water is transported via an aqueduct system that leads into two city water tunnels (NYC Water Tunnel No. 1 and No. 2). The first of these water tunnels was put into service in 1917 and the second in 1936 (The City of New York 2013q).

To assure future high quality water supply for an ever-growing population, three main measures are being implemented:

- Protection of the water resources outside of the city. In order to avoid costly filtration units, the city applied for waivers of the environmental protection agency (EPA) in the early 1990s. This set the framework for the ongoing Watershed Protection Program, and paved the road for the 1997 Watershed Memorandum of Agreement and the 2001 Long-Tem Watershed Protection Plan (Lloyd; Principe 2006);
- Constructing a third water tunnel. Stage 1 of NYC's Water Tunnel No. 3, which was started in 1970, came just in service. The last sections are projected to be completed by 2018. The total project cost is $5 billion (The City of New York 2013q).
- Implementation of a Water Conservation Program.

First initiatives started in 1985 by instaling water meters in residential buildings to enable the understanding of the actual consuptions. About 10 years later, according to NYC DEP, the world's largest toilet rabate program started, giving owner incentives to replace older toilets with more water efficient models. The program was relaunched in 2013 targeting a 7% reduction of the City's total water consumption by 2020. The Water Conservation Program of NYC DEP is also including additional specific water efficiency & reuse programs, education programs, and the generation and updates of relevant regulations and guidelines. The progress is documented in a yearly report and in a Five Year Update Document of NYC DEP.

All three measures are required for the successful protection of the city's future water supply. However, while both the Watershed Protection Program as well as the NYC Water Tunnel No. 3, are important initiatives with long histories, this report is mainly focused the current efforts of the Water Conservation Program, which targets a broader, non-technological, approach to water stewardship.

4.8.1 Development and Objectives

With the city's population expected to rise to 9.1 million by 2030, water conservation will continue to have an important role in meeting demands for water (Strickland et al. 2011). While in the 1980s water use and wastewater production increased, water meters were being installed by the mid 1980s on residential properties leading to a fundamental shift in awareness of the water consumption in the city. This became especially true once hydro bills based on water consumption were introduced. Increased demand, combined with periods of drought, lead the city to repeatedly exceed the safe yields of the water-supply facilities resulting in the occurance of more than two water rate increases within a decade.

According to Strickland et al. (2011), current levels of water consumption have reached historic lows. This trend needs to be maintained for the following reasons:

- The need for a shut down of the Delaware Aqueduct in order to make necessary repairs;
- The need to be able to respond to increased volatility that may occur due to climate change;
- The need to be able to create additional storage capacity in the sewer system for storm water.

The following supply-demand gap is emerging: while NYC's population is expected to continue to grow, the city's water supply and wastewater disposal capacities are approaching their limits.

4.8.2 Procedure and Measures

NYC's efforts for increasing water conservation were do-

cumented in the city's Water Conservation Program, first issued in 2006. The most recent update, made in 2011, contains six major components required for achieving the program's prescribed goals, namely (Strickland et al. 2011):

- Water efficiency programs, to promote efficient water use and minimize water loss through actions such as leak detection, fixing faulty components and developing recommendations on how to make buildings more water efficient.
- Water reuse programs to provide discounted water and sewer rates for properties in NYC that have implemented water reuse systems, including the recognition of the requirements of Local Law 86 (LL86), the 2005 NYC green building law, and LEED Water Efficiency credits.
- Automated Meter Reading: The installation of a citywide fixed-network of Automated Meter Reading devices and Meter Transmission Units were starte to be implemented in 2008 as part of NYC Department of Information, Technology and Telecommunication's citywide wireless system, known as NYCWiN, which covers all of the city's boroughs, customers and supply networks.
- The enforcement of water use and water supply rules, which address water quality and leak prevention issues found in "Rules of the City of New York" (RCNY) under "Rules Governing the Supply and Use of Water" in Chapter 20, Title 15 of the 2009 edition.
- Education and public outreach programs on water and water efficiency. Initiatives include school and university programs, public events and seminars for building managers, online courses and education materials and written publications such as the city's water conservation manual "Water Matters: A Design Manual for Water Conservation in Buildings".
- The continued tracking and projecting of water demands for the analysis of current and past water trends.

Additionally, regulations were updated to target new billing methods and initiatives to enhance public outreach and education with the objective of encouraging voluntary water reduction during periods of shortage (NYC DEP (2012) Water conservation report, annual update) (Strickland 2012).

4.8.3 Relevant Stakeholders

The New York City Department of Environmental Protection (NYC DEP) is responsible for water conservation and efficiency for urban use water supply systems.

4.8.4 Key Drivers and Framework Conditions

The main driver for the initiatives was the above mentioned supply-demand gap that has been apparent since the 1980s. The need to repair a leaking section of one of

the aqueducts, which will require the acuaduct to be shut down for the duration of repair work scheduled for 2020, provides a serious challenge. During this time approximately 50% of NYC's water supply will be potentially suspended.

Several factors have influenced the water conservation program within the modernization of the urban water and wastewater infrastructure.

Direct impact factors include:
- Mayor Michael Bloomberg;
- Public Education.

Pressures from population growth;
- Long-term thinking by decision makers;
- Continued dependency on drinking water sources located outside the city;
- A decentralized pursuit of sustainability within the city administration;
- Aging infrastructure
- The Office of Sustainability Management;
- Continuity and long-term objectives of sustainability-promoting activities;
- Demographic change.

Indirect impact factors include:
- Financial resources (public funding);
- Cost savings for private households;
- Position as a role model and as a leader of city networks
- Centralized supervisory institutions within the city's administration;
- Ecological awareness and open-mindeness of the citizens for a sustainable development policy;
- Municipal employees motivation to work for sustainability projects;
- Marketing strategies, public relations and the overall image of the city;
- The city's economic development strategy.

4.8.5   Successes and Success Criteria

The progress of the different initiatives, projects, and programs of the NYC water conservation program are constantly monitored and results are published in an annual report by the NYC DEP.

Data from a 2002 study provides a look at the amount of water that could be saved with more efficient water conservation measures (Hsu 2006). The data was collected from a number of water conservation programs conducted throughout the United States. According to this compilation, NYC conserved the following amounts of water by implementing the following systems and programs in the 1990s:

- 115,000-150,000 m³ of water per day were saved by the leakage detection program;
- 760,000 m³ of water per day were saved by instal-

lation of water meters;
- 15,000 m³ of water per day were saved by water savings from homeowner inspections;
- 265,000-300,000 m³ of water per day were saved within 3 years by water savings from the replacement of about 1.3 million inefficient toilets within the toilet replacement program.

4.8.6   Transferability of the Practice Example

The idea of implementing water efficiency and water conservation aspects in the process of modernization of a city's aging water infrastructure is in principal transferable to any city, as water is a vital resource everywhere and the measures taken can be integrated into the strategic planning of any city to obtain more sustainable development.

In regions where high quality water resources are not limited, water efficiency and water conservation projects can reduce pressure placed on the existing infrastructure thereby allowing for more flexible and sustainable modernization. Additionally, adopting such measures can reduce the energy demand for treatment and transportation of water and wastewater. In regions with high population growth or severe water scarcity, the topic of water efficiency and water conservation is even more urgent and needs to be implemented to allow for the sustainable development of the city.

4.9   DECENTRALIZED WATER TREATMENT AND REUSE IN BATTERY PARK CITY - EXEMPLARY WATER EFFICIENT BUILDINGS

The planned community of BPC at the southwestern tip of Lower Manhattan is home to about 17,000 residents and several museums and memorials, amongst other buildings, and serves as a blueprint for urban development.

Several green residential high-rise buildings located in Battery Park City (BPC) incorporate advanced technologies to achieve water recycling and reuse within the building. The buildings with LEED Gold and even LEED Platinum certification respond with their water efficiency systems to the ever-increasing need for action, identified by Mayor Bloomberg in the PlaNYC Progress Report as a critical issue (Shields 2011).

4.9.1   Relevant Stakeholders and Project Site

The regulation framework that lead to the implementation of several green buildings in BPC were initiated by the Battery Park City Authority (BPCA) a public-benefit corporation that was created in 1968 by the State of NewYork under Governor Nelson Rockefeller and under the authority of the Urban Development Corporation.

The aim of the BPCA was to redevelop BPC which, at the time, consisted of outdated and deteriorating piers and

landfill sites from the construction of the NYC Water Tunnels, the WTC, and other construction projects within NYC. The land in this area was reclaimed by sand dredging from New York Harbor off Staten Island.

BPCA formed a PPP to replan the area and facilitate new construction of a mixed commercial and residential community to create housing without displacing existing communities. The master plan was built on earlier plans focused on integrating society and technology. Design guidelines were created especially for BPC and for each new development area to provide for a variety of building types and designs common to older neighborhoods in NYC but including features that go beyond the city's design guidelines. Additionally BPCA published the Residential Environmental Guidelines in 2000 "to establish a process for the creation of environmentally responsible residential buildings, appreciably ahead of current standards and practices for development" (Battery Park City Authority 2013). Other guidelines, such as the "Commercial / Institutional Environmental Guidelines" and the "Residential Environmental Guidelines", followed to provide direction and measures for design strategies which resulted in outstanding buildings which have influenced the real estate market and construction industry of the city as a whole. BPCA reviews and monitors all planning and implementation processes (Battery Park City Authority 2013).

The Albanese Organization (Garden City, NY) was involved in the development, construction, management and marketing of several properties in BPC including, amongst others, The Solaire, the first sustainable residential high-rise in the United States and The Visionaire, one of the most advanced green buildings in the country.

American Water's Applied Water Management Group worked with several developers at different locations in BPC to design and manage the construction and operation of a state-of-the-art water recycling systems within green buildings. Projects include The Solaire, Tribeca Green, Millennium Towers, The Visionaire and Riverhouse.

4.9.2   Creation and Objectives

Initiation of the green building projects in BPC were mainly due to the regulative framework of the BPCA whose project guidelines mandate a minimum LEED Gold certification for its new buildings.

Construction on the first green building in BPC started in 2003. Since new buildings were subsequently added to the project following the same guidelines, the project's completion timeline has been extended and construction is still ongoing.

4.9.3   Technological and Organizational Measures

In The Visionaire, as well as in other buildings in BPC, stormwater and wastewater is collected and treated on-site in or-

der to reuse it for flushing toilets, irrigating rooftop gardens and adjacent parks, and cooling towers. For wastewater treatment several steps including biological treatment, microfiltration membranes and UV-radiation are used to comply with NYC's direct reuse standards.

The treatment and recycling processes are highly automated, and the operation and monitoring of the system is conducted online. However, an operator is always on call in case of a disruption (Shields 2011).

In addition to using the recycled wastewater to supply water to toilets, cooling towers and green roofs, the systems reduce rainwater runoff and utilize harvested rainwater for irrigation.

A number of other energy efficient technologies are implemented in the green buildings in BPC including air purification systems, natural gas cooling-and-heating systems, solar panels, and regenerative brakes on elevators. Micro-turbines are installed in some buildings to generate a portion of the building's electricity and others utilize energy recovered from combustion heat to heat domestic hot water.

4.9.4   Project Implementation and Planned Steps

Step by step, several green buildings have been implemented in BPC and across the United States. Learning from precedent-setting projects such as The Solaire and implementing the BPC's guidelines has allowed for improvements and the generation of increased efficiency in operation and maintenance by using similar technologies in several buildings in the neighborhood, and an increased safety due to back-up systems close by.

4.9.5   Financial Issues

The total capital cost of the water reuse system of The Solaire building, serving a population of 560 people, was $560,000 (Don Shields n.y. a).

Similarly, the capital cost of the water reuse system of The Visionaire, serving a population of 778 people, was $600,000 (Don Shields n.y. b).

Due to the water saving initiative of NYC DEP, incentives such as the Comprehensive Water Reuse Program (CWRP) offered by the Water Board of NYC (see Part VI Section 10 for the NYC Water Board's Water and Wastewater Rate Schedule) – are available for reducing potable water demand and improving the profitability of water reuse systems for developers. Since the green buildings of BPC are not completely reliant on the city's water supply and wastewater disposal systems, credits are given on its water and sewage bills. From the view point of the city, buildings with water treatment and reuse systems help ease the burden on the existing infrastructure and water supply demands (Shields 2011).

Particularly in the beginning, public funding support through grants and incentives were available to the BPC projects. Moreover, increased buildings costs resulting from the water reuse system and additional sustainable technologies leading to LEED Gold and LEED Platinum certification are offset by reduced energy and water bills, and the high real estate prices. Real estate rates in this district are high due to the attractiveness of the district which is ideally located in Lower Manhattan between the financial district and the Hudson River, with a view of the Statue of Liberty. The green reputation of the district and its buildings is an additional factor that increases the areas' attractiveness, making certain individuals willing to pay the price. Green buildings offer a healthier environment, for which people are willing to pay. This causes the cost differential to be ameliorated. As such, it can be expected that with a growing number of similar projects, costs will decrease and more and more buildings will become green (Gill; Carey 2008).

4.9.6 Challenges and Solutions

A lack of established water reuse regulations, permitting issues, constrained space, and public education were the main challenges for the planning and implementation of green building initiatives such as The Solaire, especially during the early phases (Don Shields n. y. a). At the time, in order to gain approval for green building projects, permits had to be organized with the help of the responsible regulators and were based on negotiations between the BPCA developers and responsible city departments such as the NYC Building Department and the NYC Health Department. In the meantime, the NYC Building Department itself is able to provide permits for water reuse systems and statewide standards and protocols for water reuse have been put into place for developers.

Building designs, particularly in the city's first green buildings, did not always match the technological needs of the water reuse system of which an important part is located in the buildings' basement. Instead, technologies were designed to overcome exhisting spacial challenges (Don Shields n. y. a).

Given that the sustainable development concept implemented in BPC's high-rise buildings, particularly the blackwater treatment and water reuse systems, were new at the time the first green buildings in BPC were implemented in 2000, public education and public involvement played a key role in the positive acceptance of the project by the city, the regulators, the developers, the construction contractors and the residents. With this end in mind, the new green building guidelines were reviewed by external public organizations and city agencies and the BPCA provided extensive public outreach programs at a very early stage of development. Due to these efforts, the BPC Environmental Guidelines, as well as innovative approaches such as the blackwater treatment and water reuse system, were well received and given the opportunity to prove theselves successful (Shields n. y. b).

4.9.7 Impact Factors

Key factors for the successful implementation of water treatment and reuse in high-rise buildings include amongst others (Shields n. y. a&b):

- The regulatory mandate for sustainable development by the BPCA;
- public support through grants and incentives;
- the utilization of emerging technologies; and, most importantly,
- a team of individuals, including the building administrations and the management of the involved companies, who were open-minded to applying new technologies to meet innovation in green building development.

Additionally, the following general impact factors influenced the implementation of a decentralized water treatment system in BPC:

Direct impact factors include:
- The regulative framework of local public-benefit corporations and authorities;
- The legal framework and regulative power of the BPCA;
- Long-term thinking of decision makers;
- The ability to be receptive and adapt where required to allow for innovation in sustainability;
- The BPC's position as a role model in the market for building water treatment in densely populated areas;
- The ecological awareness and open-mindedness of the BPC's citizens for a sustainable development policy;
- A general openness, acceptance and adaptability to innovation in sustainability;
- Commitment and motivation for the use of certification systems;
- Professional competence and the professional knowledge of the participating actors.

Indirect impact factors include:
- NYC Mayor Michael Bloomberg;
- Public education and public awareness with respect to environmental issues such as the value of water;
- Socio-economic population gaps;
- Awareness of health and a healthy environment within themodern city lifestyle;
- Dependency on drinking water sources outside the city;
- Trust in economy and technologies;
- Sustainability as one of the city administration's main objectives;
- A deep understanding of market mechanisms as a competence of the city government;
- Availability of affordable housing;

- Increased district attractiveness;
- The neighbourhoods' 'green' image
- NYC as an island with limited space and also an ideologic island;
- BPC as an even more restricted space;
- Individual ideals of engaged stakeholders;
- Availability of technology;
- Diverse society.

4.9.8 Sustainability

In 2003, The Solaire, the nation's first sustainable high-rise residential building opened in BPC. Environmentally engineered to consume 65% less energy during peak demand hours, 35% less energy overall and 50% less potable water (which is more or less equivalent to 100% use of recycling water) than similar apartment buildings, The Solaire has established itself as the benchmark for sustainable residential development worldwide and in 2004 was awarded the United States Environmental Protection Agency's highest recognition of public works award for protecting and enhancing environmental quality (Battery Park City Authority 2013).

BPC's high-rise buildings, The Solaire, Tribeca Green, Millennium Towers and Riverhouse, are each certified LEED gold from the UnitedStates Green Building Council, while The Visionaire was the first LEED Platinum residential building in BPC, saving approximately 55 % of water compared to a typical building and more than 35 % of energy.

In these buildings, recycled water is used for toilet flushing, irrigation, cooling and even for the common laundry facilities. On average, the buildings save about 38,000 cbm of potable water per building and year. In addition to the water savings, the buildings consume less energy overall, particularly during peak demand hours, compared to typical buildings of similar size (Shields n. y. a&b).

The general socio-economic benefit of decentralized water treatment and reuse systems is that they reduce the need for water supply and wastewater treatment, by deferring investments to improve water and wastewater infrastructure from the centralized public to a more decentralized private organization. Consequently, the city is able to maintain the existing infrastructure without needing to upgrade even while the population continues to grow (Shields 2011).

4.9.9 Transferability

The idea of decentralized water treatment systems applied in water efficient buildings, examplified by The Visionaire in BPC, is in principal transferable to any other city, as water and energy are vital resources everywhere and the measures taken are based on well-known technologies. Also, organization and financing of such projects is feasible, depending on the framework conditions, as shown in the practice example.

Compared to Germany, where the average water consumption is 120 l/cap/d, NYC and the United States in general have a rather high water demand per capita (about 295 l/cap/d) which increases the need for similar projects, especially when considering the pressure to act given the limited availability of potable water resources.

In regions where high quality water resources are not limited, water efficient technologies can reduce at least the energy demand, treatment and transportation of water and wastewater. In regions with high water scarcity the topic of water efficiency and water conservation is often even more urgent than the need for energy conservation.

4.10 SUSTAINABLE STORMWATER MANAGEMENT

Rather than being absorbed into the ground, much of the stormwater in NYC flows over impervious surfaces such as roof drains or catch basins in the streets, and from there into the sewers, as in many cities worldwide. About 70% of the cities stormwater is transported within a combined sewer system. During heavy rains, the combined wastewater (about 100 Mio. m³ per year) can be discharged at nearly 500 permitted CSO into the City's waterways (NYCDEP 2013. Consequentially the city's surface waters are not safe for recreation after heavy rainfalls due to periodically high levels of coliform bacteria, nuisance levels of floatables, depressed dissolved oxygen, sediment mounds, and unpleasant odors, resulting from the CSO.
Therefore, a strategic plan was derived to realize extensive implementation of green infrastructure and source controls in order to detain and retain stormwater runoff through capture and controlled release, infiltration into the ground, vegetative uptake and evapotranspiration.

Important steps of the Sustainable Stormwater Management Plan include:

- increase of the amount of permeable surfaces by installing Greenstreets (conversation of unused concrete "islands" formed by the city's intersecting streets into leafy, 'pint-sized' parks).
- expanding the Bluebelt system (structural and nonstructural stormwater management control measures to mitigate both quantity and quality of runoff).
- continuation of implementation of the MillionTreesNYC initiative .
- creation of pilot projects to better understand the installation costs, maintenance requirements, and overall performance of promising technologies.
- efforts to study the feasibility of implementing source controls on a grand scale.

4.10.1 Creation and Objectives

The objective of the Sustainable Stormwater Management Plan are an extensive implementation of green infrastructure and source controls in order to detain and retain stormwater runoff through capture and controlled release, infiltration into the ground, vegetative uptake and evapotranspiration. Objected consequences are

- decreased amount of stormwater entering the city's sewer system
- reduced need for end-of-pipe stormwater storage and treatment
- lower volumes of CSOs and other untreated discharges
- improving NYC's water quality
- improving public access to the city's tributaries
- Creating a livable and sustainable NYC

The efforts should be established by collaborative relationships between City agencies to facilitate the planning, design, and installation of green infrastructure, to allow an implementation of the most cost-effective and feasible stormwater source controls.

Side-benefits of the source control strategies should result in cooler streets, cleaner air, carbon sequestration, reduced energy use, flood mitigation, and improved public health.

4.10.2 Procedure and Measures

The City has taken the many actions to increase the use of green infrastructure to manage stormwater. The most important ones are in the following list:

- Realization of the NYC Green Infrastructure Plan, an ambitious strategy to better manage stormwater from 10% of impervious surfaces by 2030. This investment in a mix of green infrastructure, cost-effective grey infrastructure, system-wide optimization, and conservation is supposed to reduce Combined Sewer Overflows (CSOs) by more than 45 million cubic meters per year.
- The launch of over 30 demonstration projects to test performance and costs of green infrastructure over time in order to determine how to best encourage widespread adoption.
- Creation of proposed performance standard for new development and expansions of existing development to require a stricter stormwater runoff release rate into the sewer system.
- Over 379,000 trees, including 63,600 street trees under MillionTreesNYC.
- Secured Federal stimulus funding through the American Recovery and Reinvestment Act (ARRA) to install Greenstreets.
- Adopted the Green Roof Tax Abatement, providing

o New Yorkers with the opportunity to receive tax incentives for installing eligible green roofs.
- Expanded the Bluebelt system on Staten Island.
- Released a Street Design Manual and a Sustainable Urban Site Design Manual to provide guidance for how to design right of way infrastructure and facilities more effectively.
- Replacement of notification signs adjacent to CSO outfalls and creation of an online water body advisory page that allows the public to see where CSOs are likely, based on recent rainfall activity.
- Water rate study that evaluated expenditures, revenue sources, and alterna¬tive water, wastewater, and stormwater rate structures.
- Approval of a sewer charge for stormwater at parking lots which have not previously paid any sewer charges in order to assess these properties for the runoff generated by their impervious surface area.
- Pilot projects and modeling of CSO reductions through green infrastructure investments.
- Guidelines for the design and construction of approvable stormwater management systems to assist in the development of several different onsite stormwater controls for new development and expansions of existing development.
- Creation of an impervious surface mapping using detailed o satellite infrared imaging for the entire city.

4.10.3 Project Implementation and Planned Steps

New York has been made great progress to a livable and sustainable city by using green infrastructure to sustainably manage stormwater. Nevertheless, much work still remains. An important step was the approval for the implementation of the NYC Green Infrastructure Plan. Further feedback on the proposed stormwater performance standard from the environmental, business, and real estate communities will have to be sought and considered.

4.10.4 Actors

Initiator of the Sustainable Stormwater Management Plan is the Mayor's Office of Long-Term Planning and Sustainability initiated by Mayor Bloomberg. Leading agencies in the development and the monitoring of measures based on the strategic planing processes of the city are the NYC DEP, the New York State Department of Environmental Conservation, and the Departments of Parks & Recreation and Transportation.

Many of the projects within the Sustainable Stormwater Management Plan require approval of the NYC DEP to assure that requirements of the NYC Watershed Regulations are fulfilled. NYC DEP also published Guidelines for the Design and Construction of Stormwater Management Systems.

An additional important actor is the SWIM coalition (the acronym stands for Stormwater Infrastructure Matters),

which is made up of around 50 groups including the Bronx River Alliance, Cook and Fox Architects, Durst Organization, New York Public Interest Research Group (NYPIRG), Natural Resources Defense Council (NRDC), Riverkeeper, South Bronx Economic Development Corporation, Sustainable South Bronx and many others.

4.10.5 Key Drivers and Framework Conditions

The key drivers and framework conditions are discussed above. The following list summarizes the most important direct and indirect impact factors.

Direct impact factors:
- NYC Mayor Michael Bloomberg
- Legal Framework & regulative Power of NYC
- Climate Change
- Long-term thinking of decision makers
- Decentralized pursuing of sustainability within the city administration
- Office of Sustainability Management
- Continuity and long-term direction of sustainability-promoting activities
- Geographical conditions

Indirect impact factors:
- Education
- Hurricane Sandy as a „wake-up call"
- Social-Economic Gap/Segregation
- Harbor as an important part of NYC´s economy and a vulnerable part with regard to climate change
- position as a role model and as a leader of city networks
- centralized supervisor institution within the city administration
- Regulative framework of local (New York state) public-benefit corporations / authorities
- Aging infrastructure
- Engagement of citizenship in district and thematic interest groups
- Motivation of the municipal employees to work for sustainability projects
- Presence of leaders and role models, who can drive projects and processes and motivate other actors
- Marketing strategy, public relations and image of the city
- Demographic change

4.10.6 Transferability of the Practice Example

This practice example is in principal transferable to any other city, with the need for measures to control and manage stormwater. However, due to the interference with other sectors such as the ofices for city planing, and the need for a large variety of different small and larger measures, most of them implemented on a decentralized level, a strategic planning process on city level is mandatory. For the implementation of measures funding and incentives need to be provided and the implementation process needs to be monitored and documented.

The efforts NYC has undertaken in this and in other fields depend to a large extend on a well organized administration, the active engagement of the authorities, on the awareness of the population and last but not least on the technological progress, which still has not come to an end.

By interlinking goals of different sectors, such as stormwater management and increasing the city's attractiveness by green spaces, multiple benefits can be generated which are relativizing costs for single measures.

4.11 OPEN (GOVERNMENTAL) DATA INITIATIVE

After the economic recession at the beginning of the last century, the United States government provided various different services within cities, such as social services. Unfortunately, because of poor management (Desai et al. 2012; Axinn, Stern 2011; Marx 2003; Reid 1995), these services often failed. Therefore, people asked for freedom and independence from these services. With the introduction of digital technology, managing the information flow became possible and the quality of adjustability of governmental scaling as the economy continued to grow increased, said Noel Hidalgo, an open data advokat from Code for America. Partly in answer to the socialist movements in the last century, the USA has had a tendency towards more conservative, smaller government as well as more agile and profitable businesses. Following a path focusing on lean government and information flow technology, American people recognized that if the technology to manage very large-scale production of social services through data or information is in place, this increases the quality of governmental services. As Hidalgo points out, the concept of 'open government' is an extension in many ways to this idea. Open government is a very conservative approach to governance, with the central aim being the creation of a leaner, more agile and more effective government. It is possible to have a leaner government if the information about the production of services is available.

4.11.1 History

To achieve the above mentioned goal, open data enables the citizens to understand what is going on within a system, like the governmental system, and how this system could be improved. From a governmental perspective it is also important to realize that, on a national scale, one has to deal with so much information that affects so many lives. Therefore it is essential to understand the information that is available and being produced by the system, not only for management reasons but also for ethical ones.

The interested citizen in America saw the effectiveness in the private sector and came to the conclusion that the methods that were used in the private sector could also be

used in the governmental sector. Open government enables, through the acrruing transparencey, the citizens to be the checks and balances of the governmental operations. This is the fundament of every democratic system, but in the United States ties in with a common mistrust of governmental operations in general.

The information provided through an open governmental approach enables the citizens to, for example in case of a non-functional government, find the cause and how to deal with it. While some people would argue to stop non working policies, like the disasterous start of the Health Care Bill in the U.S., one could use available data to analyze and fix the problem. The second approach is then a more evicence-based one then the first.

New York has about 10 million residents and grows to about 15 million people during a normal workday and even more for occasional events like the New York Marathon (NYC OpenData 2013). The people expect, rightly, according to Michael Flowers, who is the director of the Office of Policy and Strategic Planning, that the city of New York provides the services and operations (like public transportation, security, energy, etc.) for all, not just for their residents, as they are paid for by tax revenues and therefore by all.

For decades, political activist groups were looking at the performance of the different agencies. Their argument, as Noel Hidalgo says, was that they wanted to know what is going on within the city. From an accountability perspective, they wanted to know how public transportation is operating, how effective the public, social and healthcare infrastructure is, and how the schools were operating. They especially wanted to know how the tax money is deployed to finance the streets, police and fire departments, in order to be able to hold them accountable.

Mayor Bloomberg sees himself as a technologist. He started a technological company that makes profits with media, data and information analysis. According to several people (The New York Times 2013b), he was the one who brought the accountability practice into the municipal system to the disappointment of the unions said Flowers. He implemented this approach at first in his own office, but successively in many others. If we want to improve the governmental services, we need to know what is performing and what is underperforming, as Christopher Corcoran, who is Michael Flowers assistant, says. The foundation of such an approach is to have an analytically driven government and therefore data that can be analyzed. One can recognize the importance of Mayor Bloomberg's approach by looking at the city's organigram. The 2009 founded analytical task force, led by Michael Flowers, is directly attached to the mayor's office.

However, the open data initiative existed long before Bloomberg. The basis of the open data initiative is the city charter, which is the city's constitution. This charter is re-written every ten years. In 1989 there were already forward-thinking advocates that saw that the idea of an open government requires open data. Thus, they lobbied for the inclusion of a paragraph into the city charter that required the government to create a data catalogue of all data sets that were available in the municipality. This data catalogue was to be maintained by a public advocacy office.

In 1989 the technology was not available to manage the large data volumes. The advocacy office, and an understanding of how this data could be used, were not yet developed. As the technology became available and less expensive to deploy, things started to change in the technological industry. In 2009 the city realized that the idea of an open data catalogue was enshrined in the constitution, but hadn't been acted upon. By 2013, according to Noel Hidalgo, all three necessary components were available: there is an active community of activists, citizens, and businesses, the technology is affordable for almost everybody and the political understanding and awareness to make this open government are working together.

Thus, the open data initiative is based on an initiative that started decades ago, but through Obama's open government initiative on the federal level, New York was able to take these arguments and apply them to the city level. An interesting side note is that quite a few authors of the federal open government initiative came from New York with a deep knowledge of how the city is functioning. So, one can assume that NYC is one of the cores of the open government movement in the United States.

By Bloomberg's 3rd term as New York's mayor, after being successful in many other areas on his agenda, Bloomberg was able to say there was enough constituency, enough consumers and people advocating for the concept of open data, that he initiated a collaboration between the mayor's office, the city council and the good government groups to pass the so-called 'local law 11' legislation said Hidalgo. This bill framed and enshrined the previous activities that were going on. Now, finally, the technology, the community and the awareness were at the same level of maturity.

4.11.2 Approach

One example of how governmental decision-making affects a great number of people is transportation policy, said Hidalgo. It affects everybody regardless of their life circumstance: whether people have children or not, whether they are married or not, whether they are gay or straight, or black or white. The public streets, the sidewalks, etc. are fundamental for urban living, but NYC does not have a DOT that has the ability to collect all the data across the city to manage transportation policies based on the actual needs of the people. The expertise is not evenly distributed within the districts of the city, but based on, for example, the financial potential of

the district. The open data approach can help to bridge this gap by providing data from other parts of the urban system to fill the gaps and build a data-driven information system to inform policy makers and provide a more analytical view of how to approach urban planning.

Michael Flowers and Christopher Corcoran explained that the key for this approach is to use data in an applied way. All data in an urban system has a frame of reference into which the data belongs. The frame of reference is not the same for all datasets, but because there is an ontological structure in geospatial data, it is possible to map more specific geolocations to more general ones. One of the most important geospatial keys is the Building Identification Number (BIN), which belongs to a block. However, as Flowers stated, big data is useless unless it is used for a real world problem.

A good example is the increase in efficiency of NYC's tax controllers. The city has a several million businesses but only a few tax controllers. If these few controllers engage only in random checks to ensure businesses are paying the correct amount of tax, their efficiency is not very high. It would be better to send them to only the most likely perpetrators; but the question was how to find them. The Flowers' data task force set out to develop a system for identifying tax evaders. What they came up with is very simply but effective. They developed an indicator of business activity and concluded that wherever a business is, there is waste (garbage, wastewater, etc.). This data is available per BIN and can be matched with tax data. If there is a lot of waste but no tax income, this represents an anomaly. Although it alone is not proof that someone is engaged in tax fraud, it is more likely that this person or business is attempting tax fraud than someone whose tax and waste values match. This indicator can be used to select which businesses the controllers should be sent to check on. With this basic system the controllers' success rate was improved from about 10% to almost 90%. One of the central points is that this does not have much influence on the controller. They do the same work, but are provided with a weighted list instead of a random list. This also makes the approach more successful because, as Flowers claims, the controllers were not forced to change their work habits. It is important to keep in mind that Flowers' department is focused on the correlation, not the causality, between indicators. The analysis doesn't need to be perfect, it simply needs to be good enough to be used, and this means better than before without analysis.

The main objective, as Nate Silver, statistician and editor-in-chief of ESPN's FiveThirtyEight blog, said, is that data analysis follows the Pareto principle of prediction. This means that with 20% effort you gain about 80% accuracy. Therefore the "20% often begins with having the right data, the right technology, and the right incentives. You need to have some information – more of it rather than less, ideally – and you need to make sure that it is quality-controlled. You

need to have some familiarity with the tools of your trade – having top-shelf technology is nice, but it's more important that you know how to use what you have. You need to care about accuracy - about getting at the objective truth – rather than about making the most pleasing or convenient prediction" (Silver 2012). This is exactly what Flowers' team did. They started with what they had and used it very wisely – they started with Excel sheets.

The question is how the available data is used. Hidalgo said that the government know there are digital divides across socio-economic variables within the city, but that they believe technology can be used to bridge these types of divides. The question is how to implement this in the urban planning process. How should the technology be applied in order to bridge that divide? Open data will lead urban agencies and operators from a trial and error principle to more scientific and empirically driven decision-making. This may reduce the number of wrong decisions made by these agencies.

Hackathons, an event in which computer programmers and others involved in software development, and other such events are a central element of the success of the open data initiative and are, according to Nathanael Bassett, a media researcher at The New Scool conducting research about open data activists, based on the old idea of hack labs, a community-operated workspace where people with common interests in computers, technology, digital art or electronic art, can meet, socialize and collaborate. The participating people who invest their free time to analyze the data to identify possibilities for improvement in the city. The participants are volunteers like other volunteers as well, just with a different focus. The participants in such events are surprisingly not just young people or males; it is a very mixed subculture that based on equality. Hackathons are about learning to solve problems, learning APIs (application programming interface), networking and having a good time. Differing from occupy events, which are goal oriented, a hackathon is more about the social gathering like at a LAN party, a temporary gathering of people with computers, between which they establish a local area network (LAN), primarily for the purpose of playing multiplayer video games. Sometimes, however, the results of such an event even become the foundation of a business. Since hackathons are often about data and analysis, data that is needed is not always available. In such cases the data is sometimes created by crowd-sourcing, a practice of obtaining needed services, ideas, or content by soliciting contributions from a large group of people, and especially from an online community, or is put together from different sources like the ones that can be found under NYC's open data portal (NYC OpenData 2013).

Even if urban planning uses an evidence-based approach, the community will always be within their own self-interest. There will always be members of this community who have more political power and are able to organize and express

themselves in a more concrete and vocal way, and therefore disproportionately represent themselves as the voice of the community. Open data will leverage the differences provided that they have the education to understand the data. Now we are starting to use data to combat some of these traditional perspectives, but they will always exist. This makes education a central element for the future.

4.11.3 Players

The open data initiative is not a specific project, but a strategy and procedure. Therefore, it is very difficult to determine the key players within it. One person that was mentioned almost every interview is Michael R. Bloomberg, mayor of NYC from 2002 and 2013 and founder of the Bloomberg Empire. His tech company is about media and data and analyzing information. He has brought these accountability practices into NYC's municipal infrastructure. This cuts through all the different departments like performance-based operations. In order to hold people accountable based on their performance, it is necessary to have an analytically driven government. If the goal is to improve governmental services, it is important to know what is performing and what is under-performing, and hold people accountable to that.

Hidalgo said that the mayor's management report, that include governmental key performance indicators (KPIs) had already been a part of the city's architecture long before Bloomberg become mayor. He just continued that in different aspects of the city municipal operations. He was able to do this because he doesn't need to report this to any union or investors. As the 13th richest man in the world, according to Forbes (Forbes 2013b), and an independent politician, he is not accountable to unions or political parties. His political power comes from the fact that he is financially and politically independent. He doesn't need to placate any political interest of other groups for re-election.

Within the NYC government, Gale Arnot Brewer, a city council member for the 6th district, was one of the main characters who re-wrote the city charter and integrated the open data initiative in the charter. Another key actor is Beth Novak, who served as United States Deputy Chief Technology Officer for open government and led President Obama's Open Government Initiative. For Local Law 11, Philip Ashlock was one of the persons who analyzed all the legislative options for this bill. The open data initiative would probably not exist if public interest groups had not been advocating for it for decades. Two central individuals in this group are John Keny from OpenPlans and Jean Grashnow from NeighborWorks. Another very important actor in NYC who is also well connected is Noel Hidalgo, a founding member of the New York City Transparency Working Group (nycTWG), a network of NYC civic groups who advocate for greater transparency in city government. In 2012, nycTWG lobbied for the passing of NYC Local Law 11 of 2012, then America's premier municipal Open Data law. He also works for Code for America as NYC program manager.

In the applied data analysis sector of the city is the office of Policy and Strategic Planning, lead by Mike Flowers. This is often also called the Mayor's Geek Squad. This department serves as a service provider for data analysis problems for all city departments. In the security sector the key person is Raymond Kelly. He introduced COMSTAT and laid the foundation for the Smart Public Safety approach for the New York Police Department (see Smart Public Safety). In the health sector, one of the most important actors, when it comes to data driven approaches in public health, is Dr. Thomas Farley, who was appointed NYC Health Commissioner in May 2009. He is the person behind innovative initiatives such as the comprehensive tobacco control program, the elimination of trans fats in restaurant food, a requirement for chain restaurants to post calorie information on menu boards, and development of an electronic health record.

4.11.4 Challenges

Over all, Corcoran sees challenges in four main areas: politics, cultur, law and technology. Because of the NYC's administrative structure, only the mayor's office can merge offices and data. Bloomberg's philosophy is "if you can't measure it, it doesn't exist", but a different mayor may think differently. If the mayor's office does not support this strategy, evidence-based urban planning becomes very difficult or even impossible. Even if the mayor's office supports this approach, the involved agencies need to do so as well, if it is to be successful. This is because the data is produced implemented and used on the agency level. One needs to understand the agencies in order to understand what to expect from the data. However, the available data cannot always be used as a result of legal restrictions. One example is tax data. In Germany, it is not permisable for the city to use tax data for urban planning purposes. This data is purpose-only data, which means that it cannot be used for purposes other than what the data is compiled for.

The smallest problem is the technology. Sometimes all the available data is accessible, but the amount of data is so big that the city does not have the computing power or the human resources to compute meaningful results. Nowadays, at least the computing part becomes, thanks to Moore's law, a minor one. As Aaron Ogle and Noel Hidalgo pointed out, educated people that can deal with the data and have an understanding of it as well as an active community to use the advantages of open data are key components in such an initiative. Not everybody is thrilled about this development, as it results in holding people accountable for their performance. Especially within the unions and city departments there are groups fighting against these approaches. One of the reasons, according to the unions, is that this strategy puts, too much pressure on the employees. Their fear is that these strategies will be used to reduce the number of jobs and increase the workload of those remaining.

The open data initiative can have a positive effect on start ups which are able to use the available data and create something new with it, but it can also have some negative effects on existing companies, especially those who rely on an information advantage. For example, back when the Catholic Church had the power to decide who was taught to read and who was not, and only permited members of the clergy to acquire this ability, the invention of mass-produced reading material undermined the power of the church. This eventually led to the point where everybody was allowed to learn to read, however, this came at a price: the church lost part of its power (Buttler 2007; Dewar 1998).

It is often said that there is need for more data; that we need to collect everything that is possible. This is actually not true. At the moment, there is a large amount of data out there to be analyzed. The main problem, according to Steve Koonin, director of the Center for Urban Science and Progress at New York University, is that the information is not used, as yet. Another point is that Smart Cities need to focus on the people and therefore policies need to be problem-driven. For Susan Christopherson, professor at Cornell University, this means that the following questions must be asked: What do we need to solve the challanges? Do we have the data needed, or the structures to solve these issues, or do we need new create new structures and data?

4.11.5 Impact Factors

As described earlier, the availability of data itself is not a guarantee that the data will be used or that the usage is beneficial for the city. The main success factor is the engagement of educated people who understand the possible impact using this data would have for the city. These individuals need to be capable of understanding and analyzing available data. Therefore, it is necessary to have an open-minded culture which is enthusiastic about data and an environment that supports this culture. Events, such as hackathons, can be a part of it, but are not the 'holy grail' for creating this type of environment. Brad Feld, an early stage investor and entrepreneur since 1987, said that the most important point is that someone starts (Feld 2012). Investors or municipalities cannot do this because the people need to start themselves. A city can only support them by, for example, providing shared workspace.

4.11.6 Criteria for Success

The success criteria depend on the sector that is using the data. One can think of measuring the download rates of data files as a criteria to measure the success of open data usage, but this may not be the best indicator. A better approach is to evaluate whether the usage of data in a certain sector is successful. One can, for example, measure the cost reduction by weather depending delivering (so-

mething that is quite important in the US) of supply chain company's who using services that are based on available open weather data and compare the results with companies who don't use such services or with the prior costs. The success criteria could then be the duration of deliverables, average cost for a delivering, etc., as a result of improved supply chain delivery through data analysis.

However, open data doesn't necessarily mean digital data. Open data can also be data that is presented to the public in order to make better decisions. A very good example is the public health sector. The local government inspects restaurants within a city. This data can be presented to the customers. Studies on this topic suggest that doing so will most likely decrease food-borne illnesses by 20 to 30% (Irwin et al. 1998; Jones et al. 2004; Simon et al. 2005). In this case one could measure the success of open data by measuring the ICD-10 (the International Statistical Classification of Diseases and Related Health Problems) cases related to foodborne illnesses.

The mayor's office defined such indicators for NYC in its annual report and the PlaNYC. Mayor Bloomberg also started to manage the city like a company. Dennis Smith described it this way: "Basically they [a manager of a company ed.] can convert the performance of different parts of the business into profit. I think with cities it is a lot harder because there really are sanitation outcomes, there are health outcomes, there are safety outcomes. [...] This management report last September 2012, for the first time the mayor's management report has about ten pages with indicators that are not agency specific. The things that citizens in New York expect this city to do for them and how we do it. I really want to think about what are the things, the performance that they are expecting of the city. And then figure how we are going to measure whether we are getting those results, those outcomes. And then what back-warding a logic model would help all the different things and what the citizens have to do."
One can summarize the key success criteria for the open data initiative as an evidence based approach to managing the city.

4.12 SMART PUBLIC SAFETY

Rudolph Giuliani, who became mayor of NYC in 1993, and William Bratton, the New York Police Department (NYPD) Commissioner, jointly revolutionized policing in New York. Their approach was based on actively preventing crimes, rather than reacting to criminal activity. The model they implemented, CompStat (COMPuter STATistics or COMParative STATistics), strategically uses data to fight against crime. By implementing this approach, the yearly crime rate was reduced from 700,000 complaints in 1994 to only 100,000 complaints in 2013. Thus, the New York model is analyzed as a best practice example for the field of smart public safety. The implementation, approach and successes

of CompStat were discussed in a group setting, as well as in a subsequent interview with Dennis Smith. Smith is a professor of public policy at New York University, and together with William Bratton, he published an analysis of CompStat in 2001 (Police Executive Research Forum 2013).

4.12.1 History

Systematic data collection began long ago in NYC. In the 1970's, the first Mayor's Management Report had already been published. This report collects and distributes statistics about all public offices in New York twice a year, in order to measure and understand their performance. However, the fact that these values were not, or not sufficiently, analyzed and that no corresponding strategies for improvement were developed, continued to be a problem. Additionally, there were very few, if any, results-oriented indicators. For example, the central values of New York's police department were based on reactions to crime: how quick was the response to calls, was an arrest made, how many officers are on patrol each day etc.

Before William Bratton introduced CompStat in New York in 1994, the general belief was that the police is unable, or barely able, to exert any influence on the magnitude of crime within a city. Correspondingly, the reduction of crime was not seen to be the responsibility of the police. Instead, the police's main task was considered to consist of reacting to crimes when they occurred and, most importantly, reacting fast.

Since the 1970s, when radio communication and 911 systems were implemented in the United States, 911 calls had been distributed to patrol cars in a random manner, in such a way that they could be responded to as quickly as possible. This is known as the Random Patrol model. This approach was based on the assumption that citizens, when they are threatened or involved in a crime, will call the police and that the police will then arrive on the scene as soon as possible, and – ideally – arrest the perpetrator. However, studies conducted during 1979 and 1980 showed that Random Patrol had no significant effect on either the reduction of criminal activities or on the feelings of safety amongst the population.

Progress was first initiated by David Dinkins, NYC's mayor before Giuliani, through the introduction of a new concept: Community Policing. Policing was re-thought in such a way that police officers now entered the districts and came into direct contact with the residents living there. This allowed the crime rate, which had been continually increasing until then, to be halted.

These developments were further developed once, in 1994, William Bratton was given the position of Commissioner of the NYPD by the mayor of the time, Rudolph Giuliani, and the two jointly implemented CompStat. Their goal was to use this approach to increase the city's safety. During a press conference they announced that a 10% reduction in crime was expected in New York, and by the end of 1994, crime had already decreased by 13%. In the following year, a decrease of 17% was achieved.

4.12.2 Approach

The CompStat approach is about a change in how police work is managed. This includes the following central elements:

- Decentralized commands
- Results-oriented activities and
- A focus on the reduction of crime.

Thus, a shift from reactive policing to a focus on the reduction of crime ensued. In order to achieve the goal of preventing criminal activity, the following methods were used in New York: Evidence-based Policing, Hot Spot Policing und Community Policing.

4.12.3 Evidence-Based Policing

The central aspects of evidence-based policing include the use of available data in order to develop an effective strategy and continual follow-up and evaluation.

Yearly, approximately five million radio announcements were made and followed up on by the police. It was only upon the introduction of CompStat that patterns were able to be identified and it was observed that 40% of these calls came, repeatedly, from the same addresses. This meant that a police patrol would be sent to an address to which officers had already been sent several hours, or days, earlier. In doing so, none of the information generated during the previous visit was passed on to the officers now going to the same address. Thus, police were sent to this address, but the problems there were not being solved. One reason for this was that the pressure to respond to calls quickly can lead to officers concluding visits as fast as possible in order to be available for the next call. The new approach change this by trying to assign not different police officers to the area but if possible the same.

Hot Spot Policing
Bratton used the large volumes of available data in order to analyse where crimes occur and where criminal activities are most concentrated. Corresponding to the results, police were stationed in higher numbers in these areas. There was no concern that, in doing so, criminality would be pushed from one location to another. Smith explains this by pointing out that one cannot assume that individuals who commit crimes are inherently criminal. When people are provided with different ways of earning money, they will choose the best option. Through the NYPD's new approach, the risks associated with illegal businesses increased dramatically, and thus, this line of business was simply no longer

worth pursuing. Therefore, Hot Spot Policing works with the premise that by focusing police presence in certain areas in which criminal activities are taking place, the rate of crime within the entire city will be reduced. The key point is stationing officers where crimes are occurring.

Community Policing

Community Policing began in 1989 while David Dinkin was mayor of NYC. The police went into the districts and approached residents in order to speak with them and to obtain information on crime within their neighbourhood. The residents of a district often notice conflicts, crime, and especially the potential for crime, before the police ever would. Therefore, the idea was to begin working together with residents. Smith makes reference to a case in which an older lady would no longer go into the park with her grandchild, because drugs were being sold there. From her window, she was able to see where the drugs and the money were hidden, and passed this information on to the local police. This was possible because the local police made regular contact with residents of the district a foundational part of their work. Therefore, the police was able to find both the money and the drugs. If this starts occurring regularly, the drug dealer will most likely choose to end his activities in this area.

Project Implementation

Before 1994, all the of the NYPD's information management was centrally visualized and it took three months to process the data accrued during one month. Bratton began his mission to reduce the crime rate by providing each police station with a computer. Each station assigned one individual who was then responsible for entering and analyzing data concerning all crimes and reports. Thus, for the first time, police commanders played an important role in the fight against crime. Additionally, weekly CompStat meetings were held in which crime patterns, strategies to fight against these patterns within the different police districts and evaluations of these strategies were discussed.

Starting in 1994, a strong focus was initially placed on the reduction of drug-related crimes. Smith told about one CompStat meeting in which Jack Maple, the Deputy Police Commissioner for strategies to fight against crime, asked the police commanders when drug-related crimes tend to occur most. The officers answered that this type of crime usually occurs in the evening, on the weekends and in clubs. Maple then informed them that narcotics officers work between nine and five from Monday to Friday, and asked: shouldn't we be deploying officers to where and when crimes are happening? The key CompStat element is about deploying police to places where crime is happening. This concept was already applied within Hot Spot Policing. An additional field of application is in the localization and mapping of data. Based on this, 4000 additional police officers were deployed to Brooklyn-North, as this was the area characterized by the highest concentration of drug-related crimes.

Another example for the strategic application of CompStat was within efforts to reduce car theft, which was one of the biggest criminal businesses in New York. The strategy did not focus on predicting individual crimes, but rather on understanding the system as a whole. In order to increase profits, the stolen cars were taken to so-called Chop Shops, where they are taken apart into pieces and then re-sold. Therefore the police looked for and then shut down the Chop Shops, and arrested their owners. Another possibility for turning stolen cars over for a good profit was to ship these vehicles elsewhere. The Piers from which this was possible were also closed down. As a result, car theft was no longer profitable, and since 1990 it has therefore been reduced by 94% in New York.

Funding & Partners

Giuliani, NYC's mayor, and Bratton, Commissioner of the NYPD, worked together very closely during the introduction of CompStat, and together, they implemented the strategy to fight against crime. After CompStat's introduction, cooperation between these two positions continued to be important for the success of the approach.

Another key factor is the collaboration between different city offices. The city's mayor should therefore set related priorities and goals, and, based upon these, decide which offices and departments must work together towards achieving the objectives.

One example that illustrates the importance of these types of collaborations is the construction of social housing. Smith spoke of a police commander who had explained that before the apartments could be moved into, building inspectors and fire inspectors had to check and approve the building. In contrast, these residential locations are never inspected by a police or security officer. Correspondingly, problems relating to crime are often one of the first things to show up. In order to prevent this, a police representative could evaluate the building from the perspective of public safety, and identify danger areas that could then be avoided.

Challenges

Smith calls one of the challenges presented by the CompStat approach to data analysis the problem of 'what gets counted counts'. Those factors which are measured and observed will have the greatest impact on the management approach that results from this analysis. Therefore, the danger exists that only some of the key factors are analyzed and other very important factors are not taken into consideration. Thus, many factors must be studied, and there must be constant feedback on whether changes in management actually have a positive effect. Before CompStat, this was the case, since the focus was placed primarily on the minimization of response times and the number of arrests. It is therefore necessary to implement a process of continual learning, such as, for example, the implementation of the weekly CompStat strategy meetings.

An additional measurement problem results from the fact that it is difficult to find an opportunity to measure crime prevention – to determine a value that depicts how many crimes it was possible to prevent.

In order to achieve the goal of preventing crimes in New York before they occur, people who behave in any way that seems at all suspicious are stopped by the police and questioned. Since the people who are questioned are consciously selected, this leads to the challenge that these individuals may get the feeling they are being unjustly suspected.

In this context, a major area of criticism in New York is concerned with the fact that an over-proportional number of African Americans, as well as people from Latin-American descent, are stopped for questioning. 88% of all victims and 90% of perpetrators in New York are either African-American or of Latin-American descent and the districts in which a large number of these population groups live have the highest crime rates in NYC. By using the approach of deploying police officers to those areas in which crime occurs, the majority of the 'stops' take place in these districts. Correspondingly, a small proportion of New York's population, living in certain districts, receives the majority of the police presence and has the highest number of interactions with the police.

This leads to the danger of the relationship between the citizens in these areas and the police becoming fraught with negativity. Thus, the challenge is to increase the citizen's awareness that the police are there to protect them, and it becomes particularly important that during direct interactions the police behave with the utmost professionalism. In addition, technologies which may assist in improving this process would be very useful. For example, detectors can be used during searches conducted on passers-by, in order to prevent unnecessary physical contact. Additionally, the police's interactions with the citizens must be able to be scrutinized, which can be accomplished through the increased use of video recordings and careful note-taking during questioning.

Impact Factors
The city does not stand on its own, and during the development of strategies the environment – and the context in which these strategies will be applied – must also be considered. The key factor for successfully reducing crime is not being able to predict individual criminal activities. Rather, it is about understanding the thing as a whole, such as for example car theft, and developing strategies that effectively interfere with this business, such as closing down the Chop Shops. Through the analysis of data, the idea is to identify which tactics are effective in different contexts.

An additional important factor is the collaboration between different public offices. These must share their experiences with one another, and in particular, should check on the interplay of different sectors and their effects on specific strategies. The citizens of the city should also be included in such processes.

4.12.4 Key Success Criteria

The foundational idea behind CompStat is to change the management of police work from reactive to preventive. Important features of this type of management are decentralized leadership, focusing on results and the goal of reducing the crime rate. A critical factor in doing so is that data are not only collected, but also utilized and analyzed. They should be used to develop strategies and also to monitor whether these strategies are, in fact, contributing to the achievement of set objectives. Therefore, it is important that this approach is conducted as a continual process of learning. Of additional importance is the mapping of data and the use of these to fine-tune strategies accordingly.

4.12.5 Transferability

In order to transfer the evidence-based approach used in New York to other cities, the first step would be determine what data is available. Each city's police department collects certain data during their daily operations, which could be used within this approach. If this is not already available, initial data should be collected in order to determine in which areas an over-proportional number of crimes tend to occur. The strategies of the local police must be adapted to correspond to this data.

One example of the successful transfer of this approach to another city is the case of Los Angeles, where William Bratton, after leaving NYC, became Chief of Police. Once again, Bratton was able to dramatically reduce the rate of car theft; however, he accomplished this using an entirely different strategy than what he had used in New York. The key to successfully transferring CompStat is the identification of the problem as a whole and the development of a corresponding strategy which is appropriate for solving the problem. Continually testing, evaluating and adapting the strategy is also a critical component of its success.

Dennis Smith talked about a Crime Strategy Meeting held by Bratton during the early part of his work in Los Angeles and during which different categories of crime were discussed – amongst these was car theft, since this represented a major problem within the city. Around 11:30 in the morning, Bratton asked 'so, where are your Chop Shops?' and his employees thought he was announcing the lunch break, since, in the South of the United States the term 'Chop Shop' refers to a store in which items such as steaks can be purchased. Following this, Bratton explained how car theft was organized in New York, and that Chop Shops functioned as an essential part of the system, used to take apart cars and re-sell their individual parts. His police officers answered: 'here in Los Angeles we get the cars back; they are not taken apart. We have a terrible public transit

system here in New York, and when young people go out in Los Angeles, and then need to get home, they break into a car and use it to drive themselves home. They are often drunk and crash into things or are involved in accidents, but we get the car back.' Thus, Bratton was not able to apply the same strategy he had used in New York, and was forced to develop an adapted approach. The method used in Los Angeles was composed of analyzing where and when certain types of cars were stolen. Then, the police placed 'bait cars' of the particular make at the appropriate locations and observed these closely. With a high certainty, young people would come up to the cars and attempt to steal them, at which time it was possible to arrest them. Soon, it was known all over Los Angeles that the police were cracking down on car theft, and the rate of these types of crimes was reduced considerably.

Therefore, a generalizable strategy can be formulated which states that the problem must be understood as a whole, and aspects must be identified through which patterns can be disrupted.

5

5 RESULTS OF THE CITY RESEARCH

5.1 RESEARCH CONCEPT

During their two-week research stay in New York City (NYC) the researchers had the opportunity to speak to a wide variety of individuals who shared their unique insights on the cities' initiatives and structures. However, it was not possible to conduct a detailed analysis of all urban structures in a city as large as NYC within such a limited timeframe. Thus, the m:ci researchers chose to focus on selected practice examples, thereby capturing only a fraction of the city as a whole. Nevertheless, due to the selection process of the practice examples that were analyzed, it is hoped that the analyzed projects and structures provide the essential pieces of the puzzle that has allowed NYC to become a sustainable city. However, this report in no way claims to be a comprehensive study of all sustainability initiatives and structures in NYC.

5.2 ACTORS WITHIN THE CITY

Based on the practice examples in chapter 4, some important actors involved in the analyzed sectors are found in the list provided below. This list serves as a preliminary guide for who may be an important actor in NYC. This table does not provide a full picture of all of the important actors, however, as this would be a complex and nearly impossible task to fulfill within the short research visit to NYC.

Partner	Sector
Code for America	💬
Stevens Institute of Technology	💬
Center for Urban Science + Progress at New York University	💬 💧 👥 🏢 🚗
Stern at New York University	💬
Polytechnic Institute of New York University	💬
Department of City Planning at New York City	💬
Data Kind	💬
Open Plans	💬
Open Geo	💬
Cornell University	💬 💧
CUNY Institute for Sustainable Cities	💬 💧 👥
Center for Coastal Preparedness	💬 🏠 💧

Organization	Icons
Wagner School at New York University	💬 🏠
Applied Water Management Group	💧
NYC Environmental Protection Bureau of Environment	💧 👥
CUNY	💧 🏢 👥
Department of City Planning	💧
Via Verde Rental Associates, LP; Phipps Houses Services, Inc./Managing Agent	🏢
City College of New York	🏢 👥
Coggan & Crawford Architecture + Design	🏢
Dattner Architects	🏢
Jonathan Rose Companies	🏢
CUNY Institute for Urban Systems	🏢 👥
German American Chamber of Commerce	💬 🏢 👥
NYC Accelerator for a Clean and Renewable Economy	🏢 👥
Urban Green Council	🏢 👥
Center for Economic Transformation at NYC Economic Development Corporation	🏢 👥
CUNY School of Professional Studies	🏢 👥
Mayor´s Office of Long-Term Planning and Sustainability	🏢 👥
Hunter College	👥
Institute for Market Transformation	👥

Mayor´s Office of Environmental Remediation	
Mayor´s Office of Operation	
New York Conflicts of Interest Board	
Center for Economic Transformation at NYC Economic Development Corporation	
Mayor´s Office of Long-Term Planning and Sustainability	
New York City Department of City Planning	
New York City Office of the Mayor	
Regional Plan Association	
National Urban Technology Laboratory	
Structural Technologies	
UNISDR	
World Trade Center	

NYC's sustainability actors can be characterized as follows:

- The city has a wide range of scientific institutions conducting research in the field of sustainability;
- The city's staff are, in many cases, also involved in private sustainability projects and policy-making;
- The city has an open-minded and civically engaged population;
- The city has a strong and independent Mayor who initiates and support new ideas;
- The city has an active start-up sector that uses the available data to develop and implement added value initiatives;
- The city has an active council which continuously tracks sustainability issues and pays close attention and an administration that has set high sustainability goals for itself.

5.3 ANALYSIS OF PROJECTS, PROCESSES, OBJECTIVES AND DECISIONS

ICT

The cooperation between NYC's mayor and police chief has been a significant structural effect factor. The implementation of CompStat and the resulting revolutionized police work in NYC was possible thanks to former NYC mayor Rudolph W. Giuliani and former chief of police Bratton who jointly developed a strategy to improve safety in the city back in 1994. The mayor of a city has the ability to set comprehensive priorities and involve other relevant public authorities in the process; because of that, interdependencies with other sectors can be exanimated and modified if needed.

Local differences in a city, and the corresponding adjustments required to adapt to individual circumstances and conditions in the various districts, pose another important factor for success. For example, in NYC local representatives are involved in the strategy formulation process for

the city's police. An important part of the development of strategies and the implementation of locally adapted approaches in NYC are the CompStat meetings in which police chiefs meet with their key employees once a week to exchange knowledge on successful factors, identify existing barriers and discuss how to resolve these barriers in order to improve the city's overall anti-crime strategy. It must be ensured that such a strategy is continuously evolving and adapting in order to ensure that crucial exchange and learning is an ongoing process.

Data analysis is central to the fight against crime in NYC. A continuous review of strategies and the results of procedures contribute to the ongoing evaluation of data. Information gathered on the location, time, and specifics of a crime, combined with details gathered on the offender(s), is evaluated to optimize the fight against crime. Timely evaluation is essential and effective evaluation can, for example, lead to more focused policing of certain identified areas and enhance adaptation to local conditions.

Another important factor is to gain the support and involvement of the population in order to obtain information about crime in different neighborhoods. This has been achieved through community policing initiatives, which can also help to improve the relationship between the public and the police.

NYC's outcome-oriented approach has been a central factor contributing to the city's continued and dramatic reduction in crime rates. The focus here has not been on predicting individual crimes but on uncovering general patterns. This approach was successfully implemented to reduce auto theft in NYC.

Security
Overall, NYC is promoting three key strategic security missions: catastrophe and disaster management, big data and infrastructure protection. In the wake of Hurricane Sandy, NYC has undergone vital measures to better prepare for and respond to natural disasters and the short and long-term consequences thereof. Based on the successful implementation of PlaNYC, A stronger and More Resilient New York, a nearly US $20 billion resiliency plan, was implemented. This plan is a comprehensive endeavor to unite and concentrate the city's core capabilities in the field of sustainability with the aim of incorporating infrastructure and activities related to the built environment-, such as coastal protection, insurance, utility supply, healthcare, water and transportation with specific community rebuilding efforts and resilience planning. The plan foresees the participation of not only official and professional bodies but also New Yorkers themselves and therefore works to keep residents thoroughly informed on the various initiatives and projects announced in the plan. Hurricane Sandy hit NYC and the surrounding urban areas with such unexpected intensity that experts agree that the city and its neighbors have begun to reconsider the city's close proximity to the ocean and the threats that may occur due to its specific location.

Thus, the NYC Office of Emergency Management (OEM) is revising all flood and security-related maps to better prepare for both natural disasters and man-made catastrophes.

Big data systems are at the forefront of NYC's security strategy. The city's surveillance system, known as the Domain Awareness System (DAS), which was launched by the NYPD, provides an example of the city's interconnected big data systems. The DAS combines CCTV camera footage, reports from over 3,000 radiation sensors, license plate detectors and public data streams for the identification of threats on the streets. NYC has made it a priority to support crime prevention as well as crisis management operations using existing as well as new sensor and data systems which are based on the sharing of extremely large amounts of data. Such interoperable information gathering systems have become crucial to the work of all security-related authorities. Systems such as NYPD's DAS are designed to be transferable to other metropolitan areas which are equally densely populated and have a similar urban infrastructure. However, the cultural context in which such systems are placed is crucial for their implementation since they may interfere with civil and privacy rights causing controversies and a lack of acceptance among citizens.

As a third fundamental security mission, NYC is on the forefront of critical infrastructure and building protection. The city is still deeply stricken by the very recent consequences of Hurricane Sandy and the events of September 11 have left the city deeply scarred. The reconstruction of the World Trade Center as a key business district is strongly grounded in developing technological and emergency response-related security measures. In particular, site access control systems, above all the Vehicle Security Center, show that preparation for a possible terrorist attack is a core motivator of the overall security planning and implementation measures taken for both individual building complexes as well as surrounding interconnected infrastructure complexes in the corresponding city districts.

Water
NYC's inspiring efforts and practices in the water sector are mainly driven by the different citywide strategy processes for sustainable urban development, which resulted 2007 in the overall PlaNYC, framing a variety of different actions in its different target areas. However, many of the strategic actions in water sector, such as the efforts for water conservation, started already decades ago, when the reliability on the water resources outside of the City, the problem of an aging infrastructure and the growing population as well as the vulnerability of the City due to the water supply system was recognized.

Efforts in improving stormwater management were due to external events such as frequent and more and more severe flooding of an ever broader range of communities, while at the same time the value of open water bodies and green

spaces for the City's attractiveness was realized by the people and the government. Therefore, the awareness of the population towards healthy lifestyle, environmental issues and the demand for an attractive surrounding met the awareness of the City towards effects of climate change. The City also became member of C40, the Cities Climate Leadership Group, which is a network of the world's megacities committed to addressing climate change, allowing the members to learn from experiences of each other.

In one particular district, the Battery Park City (BPC), the local authorities recognized the potential of its prominent and exclusive location, motivating them to apply the highest standards, required for new buildings. This was leading to most innovative solutions in terms of water reuse and efficiency, decentralized wastewater treatment, and energy efficiency within buildings. The practice examples of BPC are impressive showcases, presenting the water reuse and efficiency potential in combination with a high level of living quality in nowadays buildings within densely populated areas of a city.

In the end, the different strategic processes of the City, targeting many small and larger technological and organizational measures, and its consequent implementation with a documentation of its progress allowed the City to excel at the water sector as well as in other areas. However, the strategic processes depend highly on the impressive active engagement of the authorities, on individuals within the government and the administration, on the awareness of the population regarding a healthy lifestyle and environment, and last but not least on the technological progress, which will go on and allow also in the future impressive practices.

Buildings
The strongest factor in recent developments in NYC is the governmental support of building innovation, energy efficiency and sustainable city planning. A clear guideline for all decision makers and offices is manifested in PlaNYC. This helps provide transparency and facilitates faster processing and decision-making.

The energy efficiency regulations have a strong influence on building development, both for new buildings under constructions and old buildings required to undergo retro-commissioning. As part of the Greener Greater Buildings Plan (GGBP) local laws were implemented to insure energy audits of larger buildings. Such laws create new understanding and demonstrate that economic incentives for improvements and innovation pay off in the long term. It is important to remember that while sustainability is the goal, sustainable development is only achievable if it is proven financially viable. Therefore, investments into green building practices and retro-commissioning must be able to prove themselves economically beneficial in order to succeed and become widely adopted.

Another way of creating better understanding of critical environmental issues is through education on sustainability. CUNY, a 'green university', provides an excellent case in point. The university is collaborating with the local government on a project that will, in time, help shape public opinion and make developers and residents aware of the need for sustainable buildings, thereby turning sustainability features into something people will value and want in a building. CUNY's green campuses set a positive example of green development and exemplify values of sustainability in a public space thus creating curiosity and admiration. The education and programs provided by the university produces future experts in sustainable technologies and trades. Additionally, program graduates have practical experience from contributing to their universities' green development initiatives. A green university is the ideal place to conduct research on developing new methods and concepts for sustainable buildings and cities.

Another strong concept to create economic benefit from sustainable buildings is the public-private-partnership (PPP). By entrusting project with valuable goals and clear guidelines to a private partner, to implement and treat it as a normal source of income, the government can reduce its financial investment. On the other hand, the private partner is provided with a profitable project that would not have been available to them without the incentives provided by the government. In this way, innovative projects can be realized much faster and with more security for both parties involved.

Mobility
NYC ranks first in the nation in terms of passenger miles flown, transit passenger miles travelled and truck freight volume. In the year 2006, transit alone accounted for 1.8 billion passenger trips carrying 8 million passengers per day (almost 70% in subways). New Yorkers are heavily dependent on public transportation and have a much lower car ownership rate (23%) than any other major city in the country (78% average). Moreover, NYC is the only city in the United States where more than half of the households do not own a car. Were the city to follow general car ownership patterns, the city would have an additional 4.5 million cars on its streets. The transport sector emitted 11.4 million tons of CO_2 in 2010 (69% from passenger cars) and is the second largest CO_2 emitting sector after electricity generation. Due to low private car use, about 48 billion miles (approx. 77 billion km) of travel are avoided yearly, saving the city 23 million tons of transport-related CO_2 emissions.

Governance
In 2007 the master plan for New York City, the 'PlaNYC 2030' has been released and attracted attention as a global example of sustainable community and economic development.

Three main challenges functioned as key drivers for the de-

velopment of a comprehensive, strategic plan for NYC's development: the expansion of population, the city's aging infrastructure and the impacts of climate change on NYC. Moreover, the 9/11 events have raised awareness that a city must not only provide public services, but also create a safe space in which the future-oriented economic, social and environmental needs of a diverse and prosperous city can be met. Furthermore, projections for climate change impacts on the Big Apple highlighted the need for NYC to take action by, preparing for inevitably negative impacts while striving to minimize its own impact on global warming. Thus, the concepts of sustainability and resilience became central guidelines for the future development of NYC.

PlaNYC is an ambitious agenda aimed at creating a 'greener, greater New York' even as the city's population continues to grow towards a projected nine million residents by 2030. The ten fields of action which are part of the city's sustainability strategy include: Parks and Public Space, Energy, Brownfield, Air Quality, Waterways, Solid Waste, Climate Change, Water Supply. Additionally, PlaNYC presents seven topics, which are cross-sectoral: Public Health, Food, Natural Systems, Green Building, Waterfront, Economic Opportunity, and Public Engagement.

The conception of PlaNYC and the implementation of its numerous initiatives is the result of a joint effort on part of the city, state and federal governments, citizens, neigh-

borhood groups, non-profit organizations, community boards, private companies, as well as research institutions and universities. While McKinsey and Company assisted in writing the plan, the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) released the plan. Support from the mayor and top administration officials has been fundamental for the successful and efficient implementation of PlaNYC.

5.4 PROJECTS AND PROCESSES

Project typology NYC
The description of structures within a city must always be understood as a still-life, capturing a specific moment in time. The transformation of a city towards a sustainable state requires the transformation of these structures, which is why the analysis of projects and processes – taking into account their time-related dimensions – are of central importance in this research project. The key question is: What is required in order to shape these transformational processes successfully in each individual project? In order to identify the causes underlying the successful implementation of projects, it is helpful to divide the processes into project phases, as shown in Figure 38. Each project phase depicts a different structure of actors involved.

A project tends to be successful only when the implementation of all phases is successful. If, for example, a projects
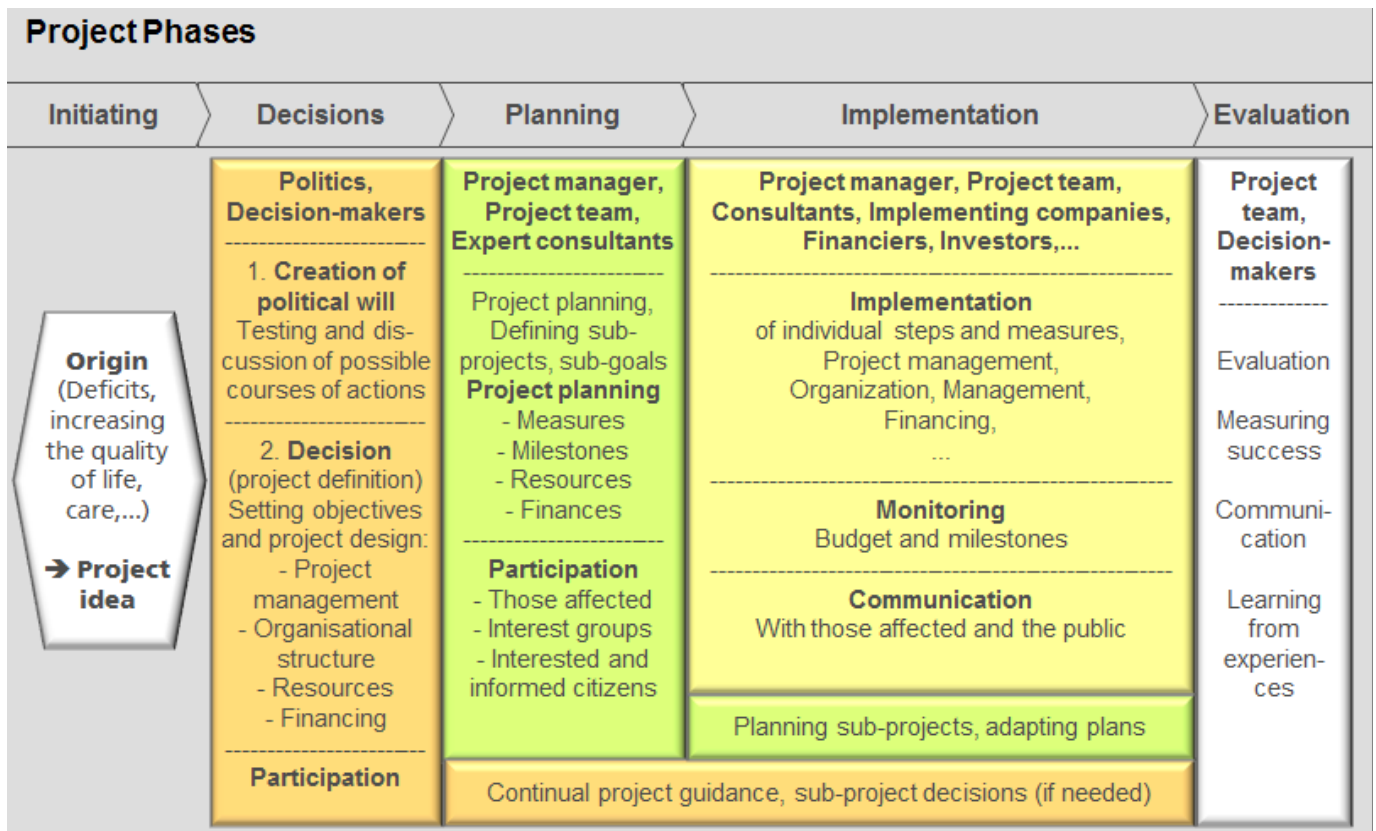
Figure 38: Typical project phases in a transformation process (own graphic)

Table 2: Insights in New York City

Project Phase	Insights
Initiation	• Drivers for the initiation of projects can be found in various groups of actors. NYC is unique in that it has a very engaged population and a wide range of interest groups who are active in various fields and initiate projects such as data analysis tools for available open data systems. NYC's administration is also continually working on topics relating to sustainability and has a long-term vision. Mayor Bloomberg's ideas on sustainability have significantly influenced the city. • The main underlying project, 'Open Data Initiative' and the associated evidence-based policy approach, have a long history. Based on the continual advocacy of data activists, the administration was forced to publish the data that was available. The evidence-based policy approach dates back to the 1970s. At this time, the approach was not widely recognized and first only applied to the police sector. Once the government saw the positive results the NYPD achieved with this method and the technological advancements, the approach was adapted in more and more sectors – a process that is still ongoing.
Decision	• Unlike most projects in European cities, many projects in NYC are initiated by the private sector and therefore the decisions made with respect to such projects are made primarily by private companies. However, the government supports most of these projects and is, therefore, also involved. • The government most often sets the framework for the direction of new initiatives, and then hands over the responsibility of implementation of the established projects to private companies.
Planning	• Planning for Sustainability in NYC is cross-sectoral, high-ranking and city-led. The Mayor's Office of Long-Term Planning and Sustainability (OLTPS), is not only responsible for the conception of PlaNYC, it also defines indicators for achieving the self-imposed objectives as well as it evaluates the progress of the 25 city agencies in pursuing the plan´s targets by covering the respective indicators and steers the agencies´ activities by realigning indicators and strategic measures. With this, NYC manages to keep planning for sustainability centralized at the highest level (high priority) and steer operations in all agencies at the same time.
Implementation	• Implementation of the numerous initiatives that relate to PlaNYC is a common effort by the governments on city, state and federal level, the citizens and neighborhoods, non-profit organizations and community boards, private companies as well as research institutions and universities. The "Sustainability Advisory Board" assures that the right priorities are set and the best methods are chosen to achieve the goals. The sustainability directors /coordinators in each city agency link the executive forces with the strategic planning office. • This mix of centralized and decentralized implementation of sustainability and long-term thinking in the city administration structure can be understood as a key factor for PlaNYC´s success.
Evaluation	• The core idea of evidence-based policy is that every initiative and every dollar spent on a project will be evaluated. It is Mayor Bloomberg's belief that anything that cannot be measured does not exist. • For the sustainability-related aspects, indicators are defined in PlaNYC and the mayors performance report. • Annual Progress reports and updates to the plan (every four years) have become mandatory by law. This makes PlaNYC not only a Masterplan for greening New York City, but also a suitable management tool for steering this process. • If a project does not reach the key performance indicators (KPI's) or cannot prove the benefit it brings, adjustments will be made or the entire program will be dropped.

goals are not clearly enough defined, or, if at the end of the project the resources available are not sufficient or the responsibilities have not been laid out clearly enough, optimal project implementation will not be achievable. The approach of dividing the process into project phases can be applied to individual projects, long-term accompanying processes (such as, for example, the Sustainability Council) as well as the entire transformational process towards a more and more sustainable future as a whole. Important insights relating to such projects, taken from researchers' analysis of the practice examples studied in NYC, are shown in Table 1.

5.5   KEY SUCCESS FACTORS

Successful implementation of a project depends on solid planning. However, exter¬nal drivers exert pressure on projects, which influences successful implementation. Some of these factors and their effects are known at the beginning of the project. These will exert influence throughout the durati¬on of the project and are already taken into consideration during the planning phase. Other factors only become significant during the course of the project, and may require adaptation of the project. Both types of factors – and the boundary between the two is fluid – can prove to be either beneficial or damaging to the project. This research has the goal of identifying the most important drivers within a city, in order to understand the reasons behind the courses the projects take and to gain insight into the transferability of the practice examples analyzed. This is valuable information, since it can be assumed that transferability is a given, provided the most important factors (in this case success factors) within the city studied are also present in the city the project is being transferred to.

In NYC's practice examples, 36 factors were identified, with varying effects on the successful implementation of the practice examples. The factors were assigned to one of twelve categories, which lead to an average of 3.61 factors per category. The combination of the categories and factors are shown in Figure 39.

Reciprocity of factors
Figure 40 visualizes the reciprocity of the factors. The placement of the factors was selected using the Kamadakawai-algorithm, which choses the position based on the centrality index of the corresponding node. We can see, that even though Mayor Bloomberg has a higher number of nominations, the three factors, 'public available data', 'open mind' and 'evidence-based policing', have a more central position in the NYC urban system, at least in the investigated projects. Of these factors 'open mind' is in a prominent position. This becomes obvious when we take a look at the out degrees. The open-minded population of NYC is a central factor in the success of the city's project implementation and is one of the main cultural foundations of this city. Residents' open-mindedness has allowed the city to forge new

paths without meeting resistance. A good example of this is the availability of venture capital for start-ups. Where in Germany a start-up needs to prove a concept by referring to the successful implementation of other projects and processes, start-ups in the United States and especially in NYC have easier access to venture capital because even if there is no proof of concept, the start-up can acquire capital if it can convince the stakeholders that their idea is innovative. This fundamental cultural characteristic opens the door to trying out new concepts that are unthinkable in German cities. However, this advantage comes with a price. On the one hand, actors in NYC can test innovations which elsewhere would be smothered in the early discussion stage. On the other hand, they run the risk that the project develops in a way that could negatively impact the population. An example is the data-driven society. The open data initiative has huge advantages in the blending of different entities or in a better understanding of social systems. The drawback, however, is that such systems can easily jeopardize citizen's security and privacy.

Impact factors by type of effect
As one can see in Figure 41, the most influential impact categories are the urban resources and political actors. The most influential political actor is, as already mentioned above, Mayor Bloomberg, who needs to step down this year as Mayor after 12 years in office. It is not possible to estimate what future impact his successor Bill de Blasio will have on NYC. Aside from the mayor there are also other political actors who are important for the described projects. For instance, in the case of the Open Data Initiative, Gale Arnot Brewer is of particular importance.

5.6   LEARNING FROM NEW YORK CITY

One of the central elements in NYC is the usage of data and IT. However the usage of data and IT is not an end in itself. The process started with the citizens' request for an overview of the city's data in order to make the government accountable and to increase transparency. The citizens wanted to know what their tax money was being used for. United States residents, particularly New Yorkers, realized that economic market principles could also be used in governmental and political processes. Therefore, under the leadership of Mayor Bloomberg, the NYC administration implemented an assessment system that sets verifiable goals and measures their status with defined indicators, which were enshrined in PlaNYC, before applying policies as well as during the implementation process. Only if a policy is successful will the government continue the program without making adaptations. If a policy is not successful, the initiatives are either adjusted or stopped. In NYC this evidence-based governance is highly IT and data driven. For this reason, Mayor Bloomberg created the Office of Policy and Strategic Planning, a group of civic-minded number crunchers, lead by Michael Flowers, who work directly with

Figure 39: Practice examples and the corresponding factors (own graphic)

the mayors office. Flowers, while not connected to New York's political system, was an external person with a good idea – using predictive informational techniques - that he presented to John Feinblatt, the Mayors chief policy adviser. Flowers, however, is not the only external person who has been brought on board by the city's administration. The Bloomberg administration is known for seeking out expert knowledge when necessary to become more objective and evidence-based. As a result, the solution for a lot of things are not only based on ideology but more and more on the question of 'does it work? Does it have a measurable benefit?'.

Applying this approach to the studied practice examples give a diverse answer to questions about the projects' benefits and adaptability. If we look at a project that has a comparatively low density, such as 'Via Verde', we need to conclude, according to Edward Glaser, that from the perspective of sustainability this is not beneficial, however, it is from a community perspective. Based on this information,

we now can decide which we consider more important. In other words, a decision must still be made, however, the decision is now based on a more objective analysis. To provide another example, we can also conclude that the 'Electric Vehicle Pilot' project works in NYC because of the city's population density. We know that such a project can be adapted by cities with a similar density but should question whether it would also be successful in a low-density area.

The IT and data approach, and the resulting increase in transparency, is not only useful for holding the government accountable but also for monitoring and assessing individual decisions and gives consumers a basis for their decisions so that they can make informed choices. The Solar Map initiative, for example, enables citizens to calculate the return on investment of the installation of a solar panel in any given location. Likewise, the LEED certificate provides information on building construction and retro-commissioning and provides estimates in regards to estimated costs.
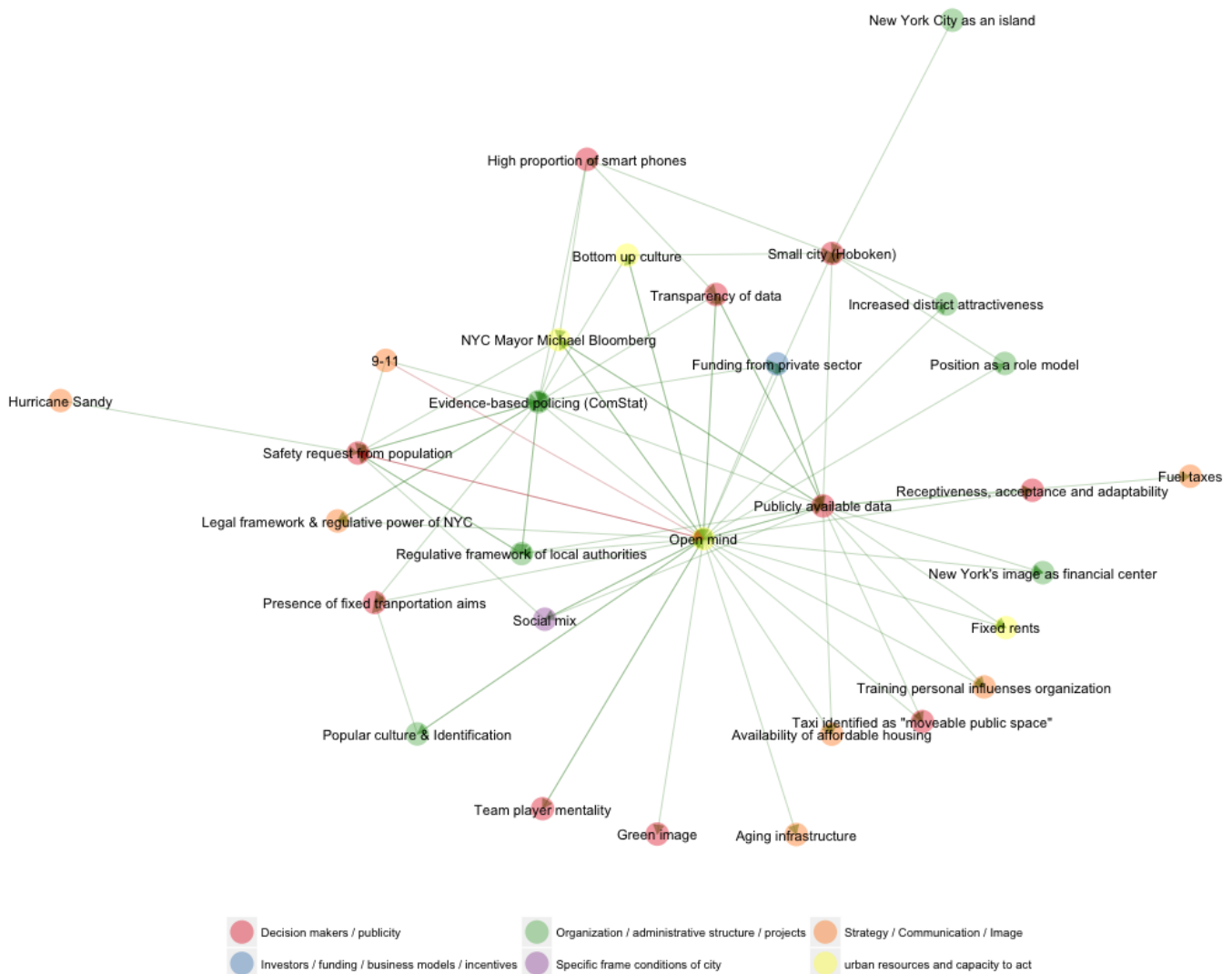
Figure 40: Representation of the reciprocity of the factors. Positive interactions are coded in green, negative interactions in red

Over all, data and ICT plays a central role in NYC. We can say that NYC is the most ICT-based city of all cities studied in this project. It is important to note that the IT systems used enable the information usage and increase the accessibility to such information (i.e. publish data, analyze data etc.). They are not sustainable by themselves, but can be used as a tool for sustainability. ICT is also used to automate a lot of processes like water treatment, quality measurement and security surveillance.

The positive effects of this approach come at a cost. To get a benefit out of the data one needs to be able to analyze it and understand the implications of the results found. This requires a high level of education, and computer science and statistics are becoming increasingly fundamental abilities, similar to reading and writing. Those who are unable to understand this cultural techniques are more likely to be over proportional disadvantaged. Knowing this, NYC tries to enhance the public school system and improve its universities as well as found new ones. Such initiatives are economically beneficial as they attract knowledge-based companies. Likewise, existing universities adjust their programs accordingly and offer more data driven degrees and degree programs while also focusing more on sustainability aspects, like CUNY is doing. Overall, we can summarize the

process as the transformation from an economic system to a knowledge-based system. We can see that Berlin is on a very similar path. It is approximately at the position that NYC was in about ten years ago. If Berlin continues down this path, similar approaches and results may be seen in Berlin in the future as were observed in NYC.

In addition to being related to ICT, the success of NYC is also rooted in its cultural setting. The United States in general, and NYC in particular, has a very strong grass roots movement, which originates in strong community (not necessary neighborhood) relationships. This leads to a 'team player' mentality that is dominant in almost all studied projects. The citizens are also very open-minded and willing to try out new approaches and methods. The benefits of evidence-based policy (e.g. a tremendous reduction of crime within the city limits) strengthen this effect additionally because the policies can be seen to have a direct benefit.

In addition to its cultural characteristics, it is interesting to see that New York City – under Bloomberg – had a very central style of planning. This is physically expressed in the arrangement of the mayor's office: his desk is in the middle of an open office surrounded by his employees. He is responsible for the data driven approach, the PlaNYC, OLT-
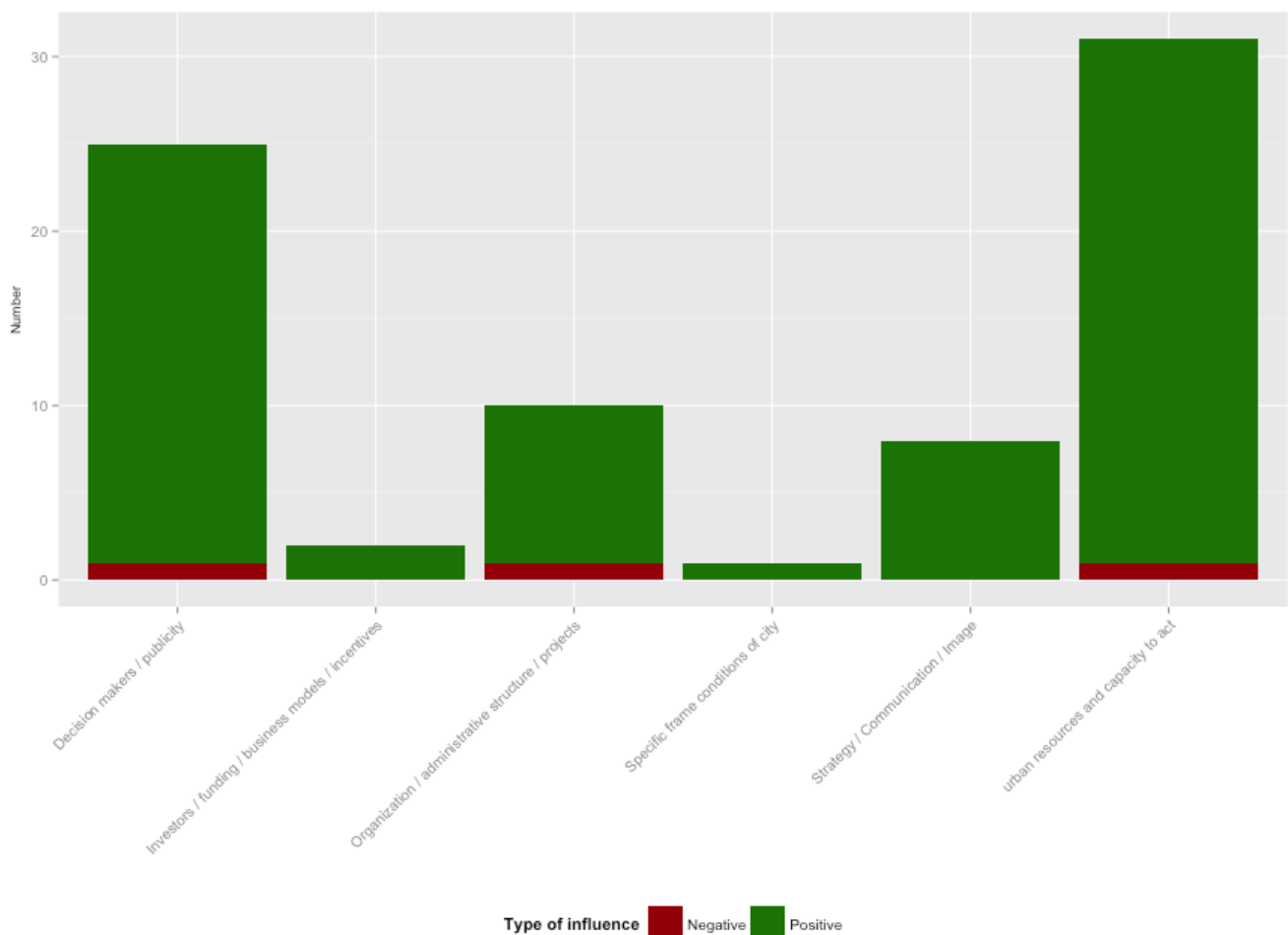
Figure 41: Success factor categories according to whether they have a positive or negative influence (own graphic)

PS and other similar initiatives. Central support increases a project's weight and reputation. However the city government, for the most part, functions as a framework that sets project boundaries while the actual implementation is often realized in a Public-Private-Partnership. The sustainability efforts must also be understood under this maxim. The government sets the goal for the city to become more sustainable, but the approaches need to have a positive measureable outcome for the city.

Based on the culturally-founded subsidiarity principle, Mayor Bloomberg, like the intellectual urbanists Benjamin Barber (Barber 2013) or Edward Glaeser (Glaeser 2012), see the city as being responsible the problems and able to provide the solutions for the challenges in sustainability.

5.7 RECOMMENDATIONS

Recommendations for Municipalities

Based on the knowledge gained in NYC, the following list is composed of recommendations for ensuring the successful implementation of projects aimed at increasing sustainability:

- Appropriate positioning of the 'sustainability' topic within the administration
- Setting goals that are specific, measureable, assignable, realistic and time-related
- Evaluating the goals regularly, basing this evaluation on data
- Making Evaluation, progress reports and updates a mandatory process (by local law) helps cities push the sustainability process independent from legislation periods etc.
- Sustainability needs central planning – but also a counterpart within the individual agencies who can transfer the plans into on-the-ground project implementation.
- Creating goals in such a way that they have an immediate positive effect in order to ensure the population's support of the project
- Publishing all governmental data under an open source license

Recommendations for Industry

Long-term cooperation between the city administration and civil society. The implementation of new and innovative solutions takes a long time. The support of discussion processes and highlighting technological solutions through industry can be very helpful.

Innovative solutions should be implemented together with researchers and innovators. Many innovative concepts and products were made possible in NYC through a combination of engaged experts and the city's high density of

research institutions. Such innovative structures should be used in order to realize pilot projects.

Provide data-driven government solutions. The more the governmental processes evolve towards an evidence-based system, the more the cities need knowledge and experts that can provide data driven and analytical solutions. NYC's success in this field is largely based on Public-Private-Partnerships, such as within IBM solutions for smart cities, especially the predictive crime analysis solutions.

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7   APPENDIX

A1: Interviews conducted during the research stay in New York

Name	Institution	Function	Date
Adam Hutter	National Urban Technology Laboratory	Director	4/19/2013
Prof. Alan Feigenberg	City College of NY	Professor Architecture	4/15/2013
Alice J. Hong	National Urban Technology Laboratory	Deputy Director	4/19/2013
Alison Conway	City College of New York	Assistant Professor, Department of Civil Engineering	4/17/2013
Ari Kahn	NYC Office of the Mayor	Policy Advisor for Electric Vehicles; Long-Term Planning and Sustainability	4/18/2013
Ph.D. Aristides A. N Patrinos	Center for Urban Science and Progress	Deputy Director	4/15/2013
Caleb Crawford	Coggan & Crawford Architecture + Design		4/12/2013
David Gilford	Center for Economic Transformation @ NYC Economic Development Corporation	Assistant Director	4/18/2013
Dawn Miller	Taxi and Limousine Commission TLC	Director of Research and Evaluation Deputy	4/22/2013
Don Shields	Applied Water Management Group	Engineering Director	4/22/2013
Donna U. Hope	Institute for Market Transformation	Policy Analyst & Consultant for NYC Mayor´s Office of Long-Term Planning and Sustainability	4/18/2013
Emily Wheeler	NYC Accelerator for a Clean and Renewable Economy	Deputy Director	4/19/2013
Prof. Dr. Hillary Brown	City College of New York	Professor at School of Architecture, urban Design and Landscape Architecture	4/17/2013
Howard Slatkin	NY Department of City Planning	Director of Sustainability	4/18/2013
Jack Dean	Metropolitan Transportation Authority MTA	Planning	4/17/2013
Jason Chin-Fatt	NYPIRG's Straphangers Campaign	Field Organizer	4/18/2013
Prof. Dr. Jill Simone Gross	CUNY School of Professional Studies	government/governance expert at CISC	4/20/2013
Jochen Albrecht	CUNY Institute for Sustainable Cities	GIS-expert at CISC	4/23/2013
Judy McClain	New York City Transit	Senior Director of Service Planning	4/14/2013
Prof. Lance Jay Browm	City College of NY	Professor, Bernard&Anne Spitzer School of Architecture	4/17/2013
Prof. Dr. Laxmi Ramasubramanian	Hunter College	Professor of Planning and Design at Hunter College and expert for participatory planning	4/23/2013
Luke Clause	Center for Economic Transformation @ NYC Economic Development Corporation	Project Manager	4/18/2013
Maria Hasan	UNISDR	Associate Expert	4/17/2013

Name	Institution	Function	Date
Mark Davies	NY Conflicts of Interest Board	Executive Director	4/15/2013
Matthew Allen	German American Chamber of Commerce	Director	4/9/2013
Max Ruperti	Via Verde Renatal Associates, LP; Phipps Houses Services, Inc./Managing Agent	Property Manager	4/11/2013
Michael Bobker	CUNY Institute for Urban Systems	Project Director	5/7/2013
Ph. D. Miachel Holland	Center for Urban Science and Progress	Chief of Staff	4/15/2013
Ph. D.Mohammad Karamouz	Center for Coastal Preparedness	Director	4/15/2013
Patrick Dail	CUNY School of Professional Studies	Project Director	4/18/2013
Paul Freitag	Jonathan Rose Companies	Managing Director	4/23/2013
Prof. Dr. Peter Marcotullio	CUNY Institute for Sustainable Cities	Co-Deputy Director	4/19/2013
Phillip Hofmann	Structural Technologies	President	4/17/2013
Prof. Rae Zimmerman	NYU Wagner	Professor of Planning and Public Administration	4/18/2013
Richard E. Barone	Regional Plan Association	Director of Transportation Programs	4/11/2013
Dr. Richard Hanley	CUNY Institute for Sustainable Cities	Director of the Brooklyn Waterfront Research Center	4/21/2013
Richard Reiss	CUNY Institute for Sustainable Cities	Creative Director of City Atlas	4/22/2013
Rusell Unger	Urban Green Council	Executive Director	4/23/2013
Sandy Hornick	NY Department of City Planning	Principal at Hornick Consulting, Inc. (former Deputy Executive Director Strategic Planning at Dep't of City Planning)	4/18/2013
Sarah M. Kaufmann	NYU Rudin Center for Transportation, NYU Wagner School	Research Associate & Assistant Adjunct Professor of Planning	4/15/2013
Stacey Lee	Mayor´s Office of Long-Term Planning and Sustainability	Policy Analyst	4/18/2013
Stephen A. Eisner	Mayor´s Office of Operation	Director	4/23/2013
Ph.D. Steven E. Koonin	Center for Urban Science and Progress	Director	4/15/2013
Steven Goldfinch	UNISDR	Programme Officer	4/17/2013
Prof. Susan Christopherson	Cornell University, Department of City and Regional Planning	Professor	4/18/2013
Prof. Dr. Tria Case	CUNY	University Director of Sustainability for CUNY	4/10/2013
Vlada Kenniff	NYC Environmental Protection Bureau of Environmental Planning & Analysis	Managing Director	4/16/2013
Wayne G. Hawley	NY Conflicts of Interest Board	General Counsel	4/15/2013
William Stein	Dattner Architects	Principal	4/11/2013
Zacharia Schreiber	Mayor´s Office of Environmental Remediation	Chief - Sustainability and Grants	4/23/2013

A2: Collected Indicators for the City of New York

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
general data	Inhabitants in City			8,244,910	Year 2011	http://quickfacts.census.gov/qfd/states/36/3651000.html
	Inhabitants in year 2002			8,084,316		http://www.health.ny.gov/statistics/vital_statistics/2002/table02.htm
	Inhabitants in year 2007			8,175,133	Year 2010	
	Inhabitants greater metropolitan region			19,501,616		
	Size city		km²	784,77		
	Size greater metropolitan region		km²	47,126	Square miles	http://www.rockinst.org/nys_statistics/2010/1-88.pdf
	Increase of population (city)		annual%	0.9		
	Population density (city)		inhab./km²	10.506		
	Population growth per year (over last 10 years)					
spatial data	residential	percentage of total area	%	42.5		http://www.nyc.gov/html/dcp/pdf/landusefacts/landuse_tables.pdf
	industrial	percentage of total area	%	3.6		
	traffic infrastructure	percentage of total area	%	7.1		
	green areas/parks	percentage of total area	%	27		
	Protected area (% of city area)	percentage of total area	%			
	water bodies	percentage of total area	%			
social data	Persons per Household			2.61		http://quickfacts.census.gov/qfd/states/36/3651000.html
	living space per Person		m²			
	House ownership (%)			32.6%		
	Average distance to work					
	Immigration rate (annual)			36.8%		
	Average Age			35.9		
	Average life expectancy at birth					
	Average days of illness		days/year			
	Inhabitants per 1 doctor					
	Suicide rate					
	Birth rate			13.1	Year 2007	http://www.rockinst.org/nys_statistics/2010/1-88.pdf
	Share of employment primary sector					
	Share of employment secondary sector					
	Share of employment tertiary sector					
	Mobile phones per 1,000 residents			900	USA, 2010	
	Internet connection per 1,000 inhab.			742	USA, 2010	
	Share of public spendings for Education		%GDP			

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
Social data	Share of public spendings for Health (%GDP)		%			
	Gini-Index Country / City		%	45	USA, 2007	
	HDI Country (Human Development Index)			0.910	USA, 2011	
	GDI Country (Gender Development Index)			0.927		
Environmental data	Total energy demand		MWh/a	212,476,526	Year 2010	plaNYC, 2010, S.54
	Energy demand private households		MWh/a			
	Energy demand industry		MWh/a			
	Energy demand transport sector		MWh/a			
	Energy demand for public transport (as part of transport)		MWh/a			
	Total electricity demand		MWh/a	Nur Pro-Kopf-Angaben…	2010	CGI, 2012, S.7
	Electricity demand by private sector		MWh/a	Nur Pro-Kopf-Angaben…	2010	CGI, 2012, S.7
	Electricity demand by industry sector		MWh/a			
	Electricity demand by transport sector		MWh/a			
	Electricity demand for street lightning (as part of public energy demand)		MWh/a			
	Total heating demand		MWh/a			
	Gas					
	wind					
	hydro					
	CHP					
	PV					
	Share of electricity demand produced within the city		%			
	Share of electricity demand produced by renewables		%			
	Level of ICT solutions installed in the energy supply system		1 (very high) - 6 (very low)			
	Average price for fuel in the transport sector		€ct/liter	50	2010	NYSERDA, 2012
	Number of electricity suppliers with customers in the city			Con Edison, National Grid, Central Hudson, NYSEG, New York Power Authority, Long Island Power Authority		
	Number of Distribution System Operator (DSO)					
	CO_2-emissions generated by the energy sector		tons CO_2/a	49,300,000	2009	CGI, S. 6

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
Environmental data	Renewable energy targets existing		yes/no	yes	seit 2007	plaNYC web, 2012
	Renewable energy development plan existing		yes/no			
	Subsidies given for the energy sector		Mio €/a	80,000,000	2011	planNYC 2012, S.18
	Ownership share of the city on the local utility		%			
	NO2		µg/m³	29.52		
	PM10		µg/m³	20		
	Amount of waste		1,000 t	13,213		
	% Recycling		%	15		
	CO_2 emissions overall		1,000 t	58,300		
	CO_2 emissions per cap.		t	7.1	2005	
	Water price		US$/liter	3.39 100 cf	Cubic feet	
	Water use per cap.		l/day	476.2		
	Ecological footprint of city		gha/cap	7.2 gah/cap	USA, 2008	
Governance	Tax revenue Total					
	Loan programs			1	that helps micro and small businesses experiencing difficulty accessing conventional bank loans and lines of credit	http://www.osc.state.ny.us/pension/instate/index.htm
	City has the right to define and change laws that regulate important infrastructures in the m:ci sectors			yes		http://www.nyc.gov/html/ops/nyc-stim/html/home/home.shtml
	Nr of parties in city council / parliament			2		http://en.wikipedia.org/wiki/New_York_City_Council
	Public confidence in government		%	83		http://www.oecdbetterlifeindex.org/countries/united-states/
	Voter participation in last elections		%	90		http://www.oecdbetterlifeindex.org/countries/united-states/
	Transparency of city budgeting			3		http://www.nyc.gov/html/ops/nyc-stim/html/home/home.shtml
	number of districts (decentral)			5		http://en.wikipedia.org/wiki/New_York_City
	Quality of masterplan			4		Strategy 2011-2014 (Department of environmental protection)
	Content of masterplan regarding Morgenstadt			4		Strategy 2011-2014 (Department of environmental protection)
	characteristic e-government			4		http://www.nyc.gov/html/dep/html/home/home.shtml
	rent index		€/m²	22.12 €/m²		
	GDP per capita		US$	75,469.755		
	GDP total			1,113 Mrd.$		
	Growth rate		%			
	Debt per capita		% of GDP	16,157 US-$		
	Tax revenues (in 1000)		% of GDP			

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
Economical	Public expenditures per year on city administration (without firefighters, police, schools, hospitals)					
	Rate of unemployment		%	9,6		
ICT	Municipal ICT investments					
	Total annual expenses for ICT/inhabitant		US$	26,082		http://www.thecrystal.org/_download/ICT-for-City-Management.pdf
	eGovernment implementation status	The indicators focuses on the quality of self-services provided for citizens and businesses by the city administration as well as on integrated e-service delivery.		2		New York state eGovernment report http://www.its.ny.gov/assets/documents/EGovReport.pdf US eGovernment-Strategie 2012 http://www.whitehouse.gov/sites/default/files/omb/egov/digital-government/digital-government-strategy.pdf http://www.govtech.com/public-safety/New-York-City-Shows-New-Law-Enforcement-Technology.html
	Use and Transparency of municipal data	The indicator focuses on digital provision of municipal data in a machine readable format (XML, rdf) for developing smart applications on the basis of public / basic data.		3		NYC Open Data https://nycopen-data.socrata.com/ NYC Big Apps 3.0 http://2011.nycbigapps.com/
	Implementation status of Smart traffic solutions	This indicator measures the use of ict for constant (individualized car) traffic analysis and control in order to prevent traffic jams, provide parking lots and minimize pollution.		3		Transcore brochure http://www.transcore.com/pdf/Traffic-Center-Case-Study-sm.pdf Pressemitteilung http://www.businesswire.com/news/home/20110927005530/en/York-City-Launches-Nation%E2%80%99s-Sophisticated-Active-Traffic NY511 services http://www.511ny.org/ http://www.troopers.ny.gov/Traffic_Management/ http://www.nypost.com/p/news/local/manhattan/city_gets_street_smart_gmTC2PaRgJdmjZFSwpv9EI
	Implementation status of Smart metering / Smart Grid solutions	This indicator measures the use of ict solutions for the management of a community-based energy provition and consumption as well as for the control of electic devices in households, fabrics, public buildings and other. The indicator provides evidence on whether ICT is used for energy savings and CO2 reduction by fostering small networks of local energy providers and by balancing energy consumption.		1		Smart Grid pilot program Queens http://www.coned.com/newsroom/news/pr20090804_2.asp IBM Projekt - http://www-03.ibm.com/press/us/en/pressrelease/37973.wss Smart Grid Initiative http://www.ny-iso.com/public/webdocs/newsroom/press_releases/2011/NYISO_Smart_Grid_Project_and_Control_Center_Groundbreaking_08082011.pdf Project New York Power Authority http://www.smartgrid.gov/sites/default/files/ny-power-authority-oe0000317-final.pdf energinet/217/1/?query=smart%20grid

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
ICT	eHealth Implementation status	The indicator discriminates the implementation grade of typical modern eHealth technologies, such as Telemedicine, Electronic Health records, Integrated Patient manage-ment Systems and other. In Stage 3, these technologies are fully implemen-ted and used in daily routine.		3		Health Information Network SHIN-NY http://www.iat.eu/ehealth/detailansicht.php?link=84&PHPSESSID=560198c9b77d0c2b3b8429a9239efcf7 New York City eHealth brochure. http://www.bronxrhio.org/images/downloads/nys%20ehealth%20brochure.pdf
Mobility	Number of commuters			5,985,000	value for New York-Newark NY-NJ-CT, 2010	http://mobility.tamu.edu/files/2011/09/newyo.pdf, p2
	Cycling modal-share			<1%	200000 cyclists / day, value for 2010, though the number is growing consi-derably	http://cityroom.blogs.nytimes.com/2010/05/06/after-criticism-cyc-ling-estimate-revised-downward/
	Pedestrian modal-share			5.6	value for 2000	http://www.fhwa.dot.gov/planning/census_issues/ctpp/data_products/journey_to_work/jtw4.cfm
	Passenger transport performance per year			23155,183,920	Value for 2006, Passenger km travelled by Subay, Rail and Bus	http://mta.info/mta/investor/pdf/2006_annual_report.pdf, p82
	Length of cycling lanes			675.9228	Value for 2009, Plan for 2030: ~ 2900 km of cycling lanes	http://www.nyc.gov/html/dot/html/pr2009/pr09_030.shtml
	Length of bus network			5,238.4017	MTA, Value for 2011	http://www.mta.info/mta/network.htm
	Length of urban rail net-work (metro, tram etc.)			1,351.8456	value for metro network	http://www.nycgo.com/research/nyc-statistics-page
	Number of airports			3	JFK Internatio-nal, LaGuardia, Newark Liberty International	http://www.nycgo.com/research/nyc-statistics-page
	Number of ports			1		http://www.panynj.gov/
	Number of registered cars			1,950,000	estimate for 2010, excluding the metropo-litan areas of Westchester, Nassau and Suffolk	http://www.nyc.gov/html/dot/downloads/pdf/nyc_greendividend_april2010.pdf, p3f
	Number of registered two-wheelers					
	Number of car-sharing vehicles offered in the city			26,000	Those are city-owned cars. Overall, the number of cars available for carsharing in NYC acounts for one third of all carsharing cars in the US	http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/pla-nyc_2011_transportation.pdf, p9
	GHG emissions from transport		CO_2–CH_4 tons	11.403	value for 2010	http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/green-housegas_2011.pdf, p9

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Mobility	CO_2 emissions			51.7	value for 2010	http://nytelecom.vo.llnwd.net/o15/agencies/planyc2030/pdf/green-housegas_2011.pdf, p10
	Pollutant concentration of NOx (average / year]			27	NO2 ppb, 2008-2009	http://www.nyc.gov/html/doh/downloads/pdf/eode/comm-air-survey-report.pdf, p14
	Pollutant concentration of Particulate matter (PM10) (average/year)			11.3	PM2,5 at street level 2008-2009, mostly dependent on: Average density of truck traffic within 1 mile Number of boilers burning residual oil within 1 kilometer Area of industrial land use within 500 meters Land area with vegetative cover within 100 meters (an inverse association; more vegetative cover was associated with less PM2.5) Traffic density within 100 meters	http://www.nyc.gov/html/doh/downloads/pdf/eode/comm-air-survey-report.pdf, p7
	Number of traffic accidents			73,060	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	...of which <18			531	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	...of which elderly >65 years			8,191	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	...of which pedestrians			10,803	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	...of which cyclists			3,526	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	Number of traffic deaths			268	value for 2011	http://www.dmv.ny.gov/statistics/2011NYCCrashSummary.pdf
	Cars per 1,000 residents			230	value for 2011	http://www.nyc.gov/html/dot/downloads/pdf/nyc_greendividend_april2010.pdf, p4
P&L	Share of freight vehicles (heavy trucks) in total road traffic		%			
	Share of freight vehicles (small trucks) in total road traffic		%			
	Share of road categories according to capacity / number of lanes / driving speed: Category 2	Calculation: Length of roads in each category [km] related to total lenth of road system [km]; City specific classifications can be described under comment				

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
P&L	Share of road categories according to capacity / number of lanes / driving speed: Category 3	Calculation: Length of roads in each category [km] related to total lenth of road system [km]; City specific classifications can be described under comment				
	Share of road categories according to capacity / number of lanes / driving speed: Category 4 (narrowest streets in city)	Calculation: Length of roads in each category [km] related to total lenth of road system [km]; City specific classifications can be described under comment				
	No. of freight train stations in urban area					
	No. of port facilities in urban area					
	Average distance to port facilities from city centre					
	Average distance to freight train stations from city centre					
	Average distance to airports from city centre					
	Classification of manu-facturing companies in the city (by no. of employees)					
Security	Number of registered crimes		Absolute figures	2,334	2011, total crime rate per 100,000 population	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf
	Victims		Absolute figures			
	Crime detection rates		Absolute figures			
	Organized crime		Absolute figures			
	high-rise buildings (construction type: steel skeleton construction, ferroconcrete skeleton construction)		Absolute figures	573	number of skyscrapers	http://www.emporis.com/statistics/most-skyscraper-cities-worldwide
	residential buildings		Absolute figures			
	bridges			2,027		http://www.nyc.gov/html/dot/html/faqs/faqs_bridge.shtml
	tunnels					
	public transportation					
	public areas for mass events (sports, concerts)					
	Storm	Low, medium, high				
	Torrential rains	Low, medium, high				
	Hail	Low, medium, high				
	Thunderstorms	Low, medium, high				
	Flood	Low, medium, high				
	Earthquakes	Low, medium, high				
	Tsunamis	Low, medium, high				

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
Security	Fire incidents		Absolute figures	39,834	2012, 25,254 structural fires; 14,580 non-structural fires	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf
	Casualty events (medical emergencies)		Absolute figures	3,347	total of incidents 2012	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf
	Traffic accidents		Absolute figures	176,482	Overall traffic crashes 2012	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf
	General emergencies		Absolute figures	206,782	2012 non-fire, non-medical emergencies	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf
	Police officers					
	Fire fighters			15,404	2012, 10,260 (uniformed); 5,144 (civilian) = 15,404, total population 8,244,910 (2011)	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf;
	Ambulance personnel			111	2012, personnel 111; total population 8,244,910 (2011)	http://www.nyc.gov/html/ops/downloads/pdf/mmr0912/0912_mmr.pdf;
	Availability of IT-Security Organisations			Yes		
Buildings	Total Number of buildings			3,370,647	2010	http://furmancenter.org/files/sotc/SOC_2011.pdf
	Total Number of households					
	Floor space ratio (FSR; in DE: GFZ)					
	Gross floor area					
	GFA residential	quality of buildings				
Water	Population connected to potable water supply	Percentage of total population	%	95		http://www.nyserda.ny.gov/~/media/Files/EERP/Commercial/Sector/Municipal%20Water%20and%20Wastewater%20Facilities/nys-assess-energy-use.pdf
	Population connected to public or private wastewater systems		%			
	Average annual precipitation			1,071		http://www.klimadiagramme.de/Namerika/newyork.html
	Total amount of water supplied	water supply		511 billions		http://www.pwconserve.org/issues/watersheds/newyorkcity/index.html
	Domestic water consumption/demand: domestic use	Percentage of total population			average each New Yorker 100 gallons/day	http://www.nyc.gov/html/dep/html/wastewater/wwsystem-control.shtml
	Tariff for water supply	Average values for city area		0.88	Combined water and sewer rate in New York City is: $8.21= 6,45€ per 100 cubic feet of water; 3,17$/100ft³ = ca. 2,5 €/100ft³ 100ft³ = ca. 3 m³ 35ft³= ca. 1m³	http://www.nyc.gov/html/dep/html/residents/wateruse.shtml
	Length of water distribution network		km			
	Length of sewer system		km	9,656,064		http://www.nyc.gov/html/dep/pdf/wwsystem.pdf

Recommended areas	Name of indicator (unit)	Description	Unit/Type of Value	Figure	Comment	Source
Water	Tariff for sewage	Average values per person and year		1.373	water rate and 5,04$ sewer rate) Umrechnungs-kurs: 0,7708, Gallons in m³: x/0,00378	http://www.nyc.gov/html/nycwa-terboard/html/rate_schedule/index.shtml
	Tariff for storm water	Average values per person and year				
	Energy recovery from wastewater	Chemical and heat energy				
	Amount of sludge pro-duced from wastewater treatment	Total amount of sludge		438,000	1200 t/d wet sludge	http://www.nyc.gov/html/dep/html/wastewater/wwsystem-biosolids.shtml

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