



**SUSTAINABLE
NEW YORK CITY**



**JANUARY 2006
NEW YORK CITY**



**DESIGN TRUST
FOR PUBLIC SPACE**

AN OFFICE OF THE DEPARTMENT OF CITY PLANNING



**SUSTAINABLE
NEW YORK CITY**

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Sustainable New York City is a project of the Design Trust for Public Space and the New York City Office of Environmental Coordination.

DESIGN TRUST FOR PUBLIC SPACE

<http://www.designtrust.org/>

NEW YORK CITY OFFICE OF ENVIRONMENTAL COORDINATION

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DESIGN TRUST FOR PUBLIC SPACE FOREWORD

The Design Trust for Public Space is a private non-profit organization dedicated to improving New York City's public realm. Since our founding in 1995, we've tackled a broad range of projects, but our goal has never varied: to provide project-specific, state-of-the-art design expertise.

In the conviction that environmental sustainability is fundamental to all public space design, the Design Trust has taken the lead in helping New York City become more sustainable. Key to these efforts is the publication of *Sustainable New York City*, created in partnership with the New York City Office of Environmental Coordination (OEC). New York is already leading the way in demonstrating how even older cities can improve their environment. *Sustainable New York City* lays the groundwork for further efforts, by declaring the city's support for green practices in everyday municipal operations.

To create *Sustainable New York City*, the Design Trust worked with a remarkable team, comprised of Design Trust fellow David Hsu, OEC Director Robert Kulikowski, and OEC Deputy Director Jonathan Dickinson. The team drew on the expertise of many City and State agencies that have jurisdiction over New York City's energy, water, and waste related systems, and solicited input from an array of expert sources, including the City University Institute for Urban Systems, Natural Resources Defense Council, and other environmental policy experts from Chicago, Santa Monica, Seattle, and elsewhere.

The collaborative process that produced *Sustainable New York City* evinced a deep-rooted optimism for the future of New York City's environmental quality. Over time, implementation of the sustainable practices it describes will conserve energy, improve air and water quality, and protect our waters, making New York City more beautiful and livable for all New Yorkers, now and for generations to come.



Deborah Marton
Executive Director, Design Trust for Public Space

OFFICE OF ENVIRONMENTAL COORDINATION FOREWORD

A sustainable city is important for all New Yorkers and is also critical if New York City is to be a place where people will want to live and businesses will want to grow in the 21st century. The City's history has shown that it is among the most sustainable urban areas in the United States, due in large part to innovations and practices that have been implemented over a number of years. However, to continue along the path of sustainability, current practices will have to be expanded and new ones developed to respond to changes brought on by the challenges of increased development, diminishing land supply and increasing population.

Describing New York City innovations and practices, as well as those from other "green" cities, this report brings together several examples of how diverse urban areas tackle common issues and respond to them in various ways depending on need. Recognizing that challenges, such as storm water management, are indeed relevant to many different areas with varying geography, population and other one-of-a-kind situations, these studies seek to provide insight into how problems may be addressed in cost-effective manners tailored to each specific situation and to illustrate the benefits provided. Overall, what this report hopes to accomplish is to spark imagination to adapt and build upon these model practices to fit commonly encountered challenges that may be encountered in a myriad of locales — urban, suburban or rural — each with its own unique set of characteristics.

By doing so, this report can serve as a source of ideas for how areas, especially dense urban areas, can think about and develop innovative solutions to preserve resources, protect water supplies and improve air quality.



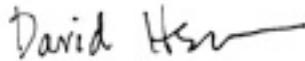
Robert R. Kulikowski, Ph.D.
Director, New York City Office of Environmental Coordination

FELLOW FOREWORD

Sustainability is a powerful idea that appeals to many institutions and people. In the words of the political scientist John Dryzek, “just as democracy is the only game in town when it comes to political organization, so sustainable development is emerging as the main game... when it comes to environmental affairs.” Yet we are confronted by the task of making this idea — this hope, really — into reality.

Throughout the writing of this report about the prospects for a more sustainable New York City, three questions always came to the fore: First, how does New York City affect the environment? Second, what role does the environment play in the everyday life of New Yorkers? And third, can we change and improve this relationship? Even though we know in a deep sense that we depend upon “the environment” to support us, the myriad connections between the natural world and the man-made city are not always obvious. What emerged through research into these questions was a thick catalog of strategies that can change how we provide, use, and protect natural resources, both globally and locally.

There is also a larger argument to be made about New York City’s influence in a world filled with cities. Good New Yorkers, I think, innately believe that New York City has everything, and that the city has an outsized effect on the world. The city that we enjoy today, however, is in large part thanks to the work of visionaries over a century ago, who built the water system, preserved crucial park space, and planned the shape of the city for both continuity and change. To meet growing environmental challenges, and to lead the way for other cities, we need to continue to set similarly ambitious goals for the future. This report, I hope, is only one step of many towards sustainability.



David Hsu
Fellow of the Design Trust for Public Space

REPORT SUMMARY

This report is a collaboration between the Design Trust for Public Space and the New York City Office of Environmental Coordination, in support of the City of New York’s current sustainability initiatives.

The aim of this document is to explore how New York City can continue along a path of sustainable development, and in particular, to make the case for the adoption of sustainable practices by highlighting successful efforts in New York and other cities. This report also seeks to examine and articulate future opportunities for sustainable development in New York and other jurisdictions by:

- Defining what sustainability might mean to New York City; and
- Demonstrating the benefits of sustainability to New York City and New Yorkers.

Part 1 of this report explores the meaning of sustainability, outlines the foundations of sustainability in New York City, and considers the future of sustainable practices. Part 2 of this report examines specific sustainability efforts in three areas in New York and other environmentally progressive cities from around the nation: Seattle, Chicago, and Santa Monica. These case studies:

- Highlight innovation in environmental practices;
- Demonstrate the benefits of sustainability; and
- Indicate future opportunities for sustainability efforts.

The three principal issues highlighted and examined in Part 2 of this report are:

- Protection of water and land;
- Conservation of energy, improvement of air quality, and adaptation to and mitigation of climate change; and
- Efficient use of materials.

PART 1: SUSTAINABLE DEVELOPMENT FOR NEW YORK CITY

INTRODUCTION

WHAT IS SUSTAINABILITY?

Over the past few decades, in a period of ever-increasing technological complexity and economic growth, concern has grown over the state of the global environment. Continued development, in both industrialized societies and emerging nations, is clearly affecting the earth's finite resources. This complex relationship between growth and the environment is stimulating interest in balancing social and economic advances with protection of natural resources.

The concept of *sustainable development* — defined by the United Nations as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (United Nations, 1987, p. 24) — encompasses social, economic, and ecological development. If sustainable development is a process, then the goal is *sustainability*, which can be described generally as an eventual state in which human priorities of social and economic development do not conflict with the protection and functioning of the natural environment.

Understanding of the concept of sustainability is still evolving. Though many different communities and institutions worldwide have adopted sustainability as a mantra — ranging from the United Nations to individual nations, from universities to corporations, from local community groups to professional bodies — these groups all now face the challenge of integrating development and the protection of nature in their everyday practices, activities, and goals. If sustainability is the ultimate goal, then sustainable development is a process likely to occupy our generation and generations to follow.

New York City is a microcosm of this global challenge. As the largest city in the United States and as one of the largest cities in the world, New York City has a tremendous opportunity to demonstrate leadership in protecting the global environment for future generations. New York City can draw inspiration from its past successes in protecting the environment, as well as from the successful examples of other environmentally progressive cities. As New York City continues to integrate sustainability into all aspects of city life, these efforts to protect the environment can and should improve the health, well-being, and quality of life for all New Yorkers.

FOUNDATIONS FOR SUSTAINABILITY

THE LOCAL CONTEXT FOR SUSTAINABILITY

Given that New York City is virtually defined by its spectacular built environment — the product of centuries of development, resulting in a highly modified natural environment — what would a sustainable New York City look like? In order to evaluate the prospects for New York City to achieve sustainability in the future, it is necessary to examine the historical ecological context of the city. This history should inspire and inform environmental ambitions and goals for the future: Sustainable development should build on New York's rich natural advantages, as well as the environmental efforts of previous generations.

NEW YORK'S NATURAL HISTORY

To read any account of New York's natural history is to be astonished at the remarkable natural environment that once existed here and to become more aware of the city's present natural wealth of resources.^[1] The original Native American inhabitants of the area farmed a wide variety of crops, such as corn, grapes, berries, and apples; hunted deer and turkey; and fished for shad, salmon, and trout. The harbor, at the intersection of the fresh water of the Hudson River and the salt water of the Atlantic Ocean, is naturally diverse, mingling migratory species from both bodies of water and providing many rich habitat areas, including freshwater wetlands, marshes, bedrock slopes, sod banks, sandbars, mudflats, and sand beaches. The first European visitors to New York marveled at the richness of the land

[1] For more detailed descriptions of New York's past natural history, see Burrows & Wallace, 2000; Kieran, 1982; for New York's present environment, see Waldman, 2000; Matthews, 2002.

and harbor, and prospered because of it. As recently as the 1850s, agriculture was practiced in all five boroughs, within the modern city boundaries; as late as the 1920s, commercial fishermen harvested oysters and lobsters from within the city's waters (Burrows & Wallace, 2000; Waldman, 2000).

Four centuries of urban development have irrevocably changed the city's natural environment, however. The activities of millions of people over the past hundreds of years have altered the flow of rainfall to the receiving waters of the harbor, assembled vast quantities of goods to build the city, removed large quantities of materials and waste, and affected the temperature and quality of the air that New Yorkers breathe.

Despite these changes, the city still has rich natural resources. For example, New York City has the greatest proportion of park and open space among major U.S. cities, as a percentage of its land area (Trust for Public Land, 2001). Other natural resources, such as the harbor, have steadily recovered from years of pollution. Most surprisingly, in a city that often seems to be built exclusively for humans, many kinds of wildlife have returned, including oysters and seals in the harbor; ibis, herons, and egrets nesting in the harbor's wetlands; white-tailed deer in the Bronx and northern Manhattan; and coyotes and wild turkeys spotted in Central Park (Feder, 2004; Matthews, 2002).

PAST DEVELOPMENT AND NEW YORK'S URBAN ENVIRONMENT

Though New York City represents a substantial alteration of the original natural landscape, the city is able to support its human population and protect significant portions of the landscape because of the foresight of previous generations. For example, the current water supply of New York City is drawn from protected lands in the Croton watershed, from the Catskill Mountains, and from the headwaters of the Delaware River; the municipal government began planning this advanced water supply system as early as the 1830s (Endreny, 2001).

Throughout the 20th century, New York's zoning, land-use, and planning policies shaped the city toward a high density concentration of businesses and residences, a form that preserved natural habitat throughout the city and region. High-density settlement patterns, along with the city's excellent public transportation system, also provide many advantages in terms of New York's energy use today. For example, many of the city's buildings are heated by steam that is a beneficial byproduct of power generation (also known as cogeneration) and distributed through the largest such distribution system in the world (NYC Economic Development Corporation [NYCEDC], 2004). The combination of this and other factors means that, despite its large size, New York City is extremely energy-efficient on a *per capita* basis: Subway systems and multifamily apartment buildings are among the most energy-efficient types of transportation and housing, respectively, and cogeneration is the most efficient way to use fossil fuels. Such existing patterns of sustainable urban development constitute a strong foundation for current and future sustainability initiatives in New York City.

New York City has a longtime commitment to providing quality open spaces, from the 19th-century creation of Central Park (opposite, top) to newly redeveloped resources, such as Brooklyn's Empire-Fulton Ferry State Park (opposite, bottom).

THE CITY OF NEW YORK'S CURRENT INITIATIVES IN SUSTAINABILITY

Building on this local context, the city's municipal government, the City of New York, is committed to protecting the environment, either through its own operations and planning, or through its policy-making and regulatory functions. Some of the City's departments currently engaged in environmental initiatives include:

■ Department of Buildings

Maintains an advisory committee to consider modifications to the City's building code to enable new sustainable technologies.

■ Department of Citywide Administrative Services

Encourages the conservation of energy by New York City agencies, in turn saving money and reducing emissions of air pollutants. The department is also actively engaged in the procurement of environmentally preferable products for other municipal agencies.

■ Department of Design and Construction

Executes sustainable building projects on behalf of the City. As of 2005, the department



has designed or built 25 buildings using green technologies, with another eight building projects in progress.

■ **Department of Parks and Recreation**

Builds parks, plants new vegetation, and restores habitat throughout the city; supports sustainability through the Greenstreets program, the Natural Resources Group, and other programs.

■ **Department of Sanitation**

Runs the largest curbside recycling program in the United States.

■ **Department of Transportation**

Improves air quality by working to switch City vehicles to alternative fuels, to improve traffic congestion, and to encourage alternative modes of transportation.

■ **Economic Development Corporation**

Works with major New York utilities, environmental advocates, and municipal agencies to increase the city's energy security and to improve its air quality.

Regularly updated information on the City's current environmental initiatives can be found at the New York City Office of Environmental Coordination's website (<http://www.nyc.gov/html/oec/html/sustain/greenapple.shtml>).

DEFINING SUSTAINABILITY

CHARACTERISTICS OF SUSTAINABILITY

A commitment to enhancing sustainable practices in New York City and other cities requires an awareness of the following characteristics:

■ **Sustainability is transformative**

Balancing social and economic development with a concern for the environment is a significant change from previous trajectories of human development. Pursuit of this goal may require transforming current methods, goals, and organizations to better protect and value the environment.

■ **Sustainability is integrative**

Resolving the competing demands of society, economy, and ecology requires a focus on overall effects and outcomes.

■ **Sustainability is continuous**

Fulfilling the needs of future generations requires that each generation preserve the environment, but it is also vital to build resources for the future by restoring and even improving the natural environment.

■ **Sustainability is measurable**

Evaluating progress, balancing competing development aims, and allocating resources efficiently requires objective measurement of progress towards desired goals.

■ **Sustainability is ambitious and pro-active**

Harnessing the collective imagination, inspiring creative excellence, and setting ambitious goals to address environmental issues are all necessary if sustainability is to be successful.

The themes above are drawn from contemporary debates and understandings of sustainability in an environmental context, but they also closely align to the principles of good government. As noted above, the City of New York already has innovative programs to protect the environment throughout its agencies. In order for the City to continue to address both global and local challenges, this report asserts that sustainability must build on the City's existing efforts and continue innovation in the following critical areas:

- Delivering efficient services;
- Anticipating problems and planning for the future;
- Focusing public resources on specific problems or tasks, regardless of agency or departmental organization;
- Working with other political units, including cities, states, the federal government, and even other nations; and
- Educating citizens in critical policy debates and issues.

MEASURING SUSTAINABLE DEVELOPMENT

The success of sustainability as an environmental strategy for New York and other cities can and should be measured, both qualitatively and quantitatively, on the basis of five principal criteria:

- Stewardship of natural resources,
- Health and productivity,
- Economic development,
- Efficient government, and
- Education.

Each case study in Part 2 of this document will be evaluated on the basis of all or some of these criteria, which are further described below.

STEWARDSHIP OF NATURAL RESOURCES

Sustainable approaches to the local and global environment should seek to protect and preserve irreplaceable existing resources, use required resources efficiently, and to improve and restore natural resources that benefit both humanity and nature.

HEALTH AND PRODUCTIVITY

The health and productivity of city dwellers — including the citizens of New York — is closely tied to the quality of the urban environment in which they live (Kenzer, 2000). Sustainability efforts should demonstrate that improvements to the environment also enhance the well-being of local residents, workers, and visitors.

ECONOMIC DEVELOPMENT

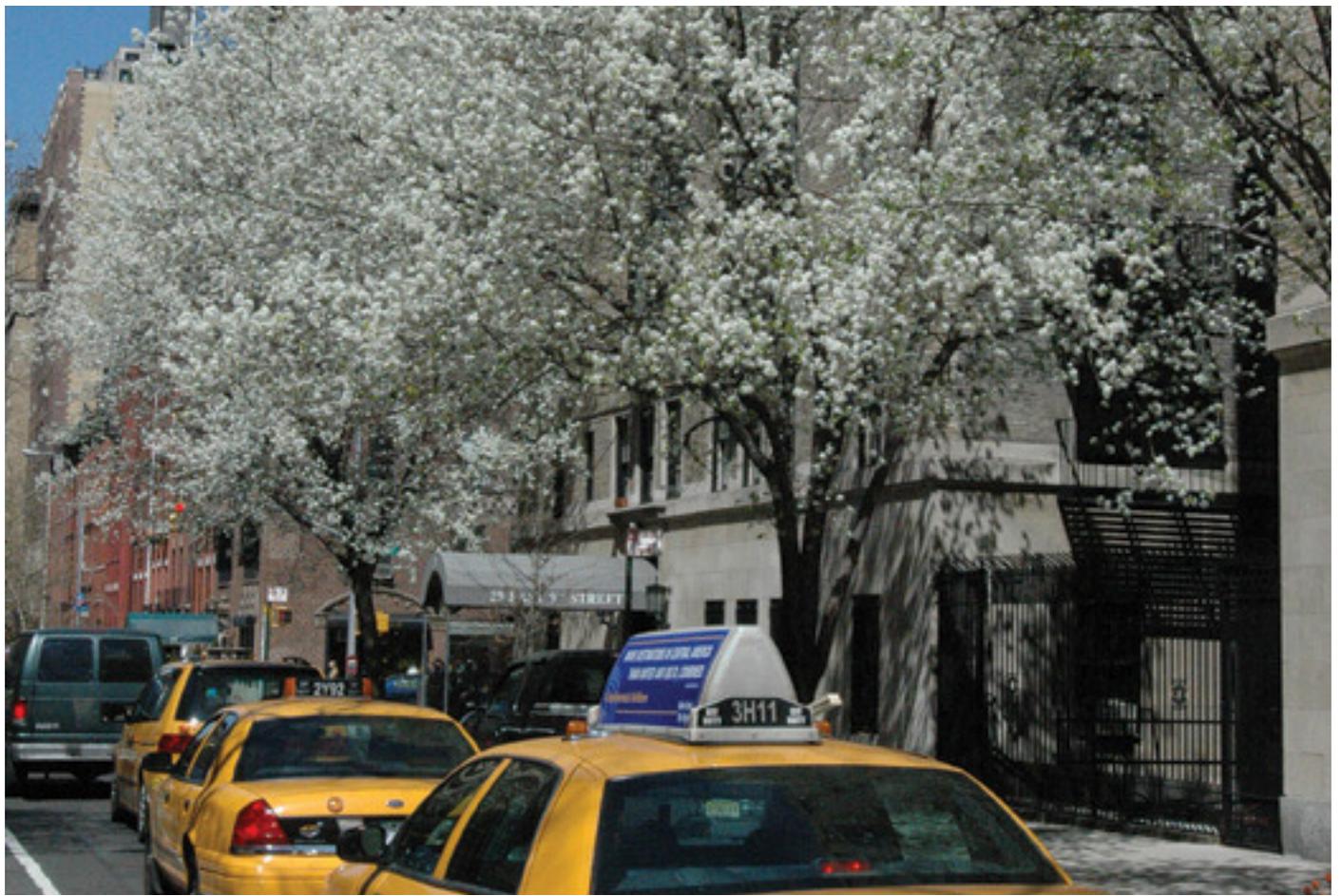
Sustainable development should seek to bolster economic growth through new technologies and industries that do not harm the environment. Cities, and other organizations committed to sustainability, should attempt to stimulate markets for ‘green’ products and services, e.g. economic activities that consume fewer resources and generate less waste than existing industries and technologies. Sustainable development should also contribute to urban economic development by creating a cleaner environment, a key criteria for attracting and retaining a talented work force (Mercer Human Resources Consulting, 2005).

EFFICIENT GOVERNMENT

Sustainable development should provide a useful framework for government when planning for future environmental efficiency, through its policymaking and regulatory functions. Environmental problems often cross jurisdictional and inter-departmental boundaries, or are the unintended result of changing economics, technologies, or systems (specific examples will be examined in Part 2). The ability of government to solve such problems is a key indicator of its efficiency and flexibility (Portney, 2002).

EDUCATION

Sustainable development must engage the general public in civic and volunteer efforts, raise awareness of the environmental impact of individual behaviors, and build support for long-term government initiatives (Coyle, 2004).



ACHIEVING SUSTAINABILITY IN NEW YORK CITY

CAN NEW YORK CITY AFFECT THE ENVIRONMENT?

Given that problems of the environment are often global, it is sometimes asked, can the actions of New York City really improve the state of the earth? This report asserts that the city's residents, businesses, and municipal government can implement measures that advance sustainability on both local and global scales.

New York City has already pursued numerous initiatives to reduce its direct impacts on the local environment, through its buildings and the activities they contain, and through its gross consumption of energy, water, and materials. New Yorkers benefit directly from past and current protection of the local environment, and these efforts can be continued.

The city also has a special ability to contribute to the improvement of the global environment. New York City is a global capital of finance, culture, arts, and the media. It is the largest city in the United States and one of the largest cities in the world, on the basis of population and gross domestic product. The City of New York is the largest municipal government in the United States and is uniquely able to innovate at the local level. The following sections show that the City of New York — through its own sustainable practices, and through collaborating with the city's residents and businesses — can lead by example, encouraging other cities to improve the health, well-being, and quality of life of their citizens by addressing environmental problems.

UNDERSTANDING NEW YORK CITY'S ECONOMIC IMPACT

New York City is an economic powerhouse among cities, states, and even nations. The economy of the New York City metropolitan region accounted for 4.3% of the United States' gross domestic product (GDP) in 2002. Table 1 shows that New York City has the largest economy among U.S. metropolitan areas. Table 2 shows that if New York City were a separate nation, it would be the 14th largest economy in the world, with a GDP of \$449 billion, larger than the Netherlands, Australia, Russia, and Taiwan (Global Insight, 2003).

New York's Gross Metropolitan Product (GMP) vs. Cities and Nations
(US dollars in billions, 2002)

Table 1

New York is #1 Among U.S. Metro Areas:

1	New York, NY	\$ 448.9
2	Los Angeles-Long Beach, CA	411.0
3	Chicago, IL	349.5
4	Boston, MA	266.9
5	Washington, DC-MD-VA-WV	236.5
6	Philadelphia, PA-NJ	192.3
7	Houston, TX	185.4
8	Atlanta, GA	177.9
9	Dallas, TX	166.9
10	Detroit, MI	161.7

Table 2

New York is #14 Among Nations:

1	United States	\$ 10,446.0
2	Japan	3,996.0
3	Germany	1,993.0
4	United Kingdom	1,568.0
5	France	1,436.0
6	China	1,237.0
7	Italy	1,188.0
8	Canada	727.0
9	Spain	655.0
10	Mexico	636.0
11	India	484.0
12	South Korea	470.3
13	Brazil	452.0
14	New York, NY	448.9
15	Netherlands	419.0
16	Los Angeles-Long Beach, CA	411.0
17	Australia	398.0
18	Chicago, IL	349.5
19	Russia	347.0
20	Taiwan	282.2
21	Switzerland	267.2
22	Boston, MA	266.9
23	Belgium	247.0
24	Sweden	240.9
25	Washington, DC-MD-VA-WV	236.5

Source: Global Insight, July 2003

At first glance, it may not be obvious how New York City can leverage its economic power to influence sustainable development or to affect global environmental problems. A good way to think about New York City's opportunities to affect sustainability is to examine briefly its closest economic peers, according to GDP. For example, Brazil (#13) is a rapidly developing country with a highly urbanized population of approximately 186 million. Although economic development in Brazil has been rapid, as measured by GDP growth, there are concerns that development is being fueled by the destruction of the country's environment (UN, 1992).

In contrast, the Netherlands (#15) is a much smaller country than Brazil, with a population of approximately 16.4 million. However, as a highly urbanized country for many centuries, the Netherlands has put in place national economic and other policies that shape urban growth, protect nature, and preserve open space (UN, 1992).

The point of these comparisons is not that New York City should necessarily adopt Dutch

Efforts to green the city's streets and clean the harbor have proved remarkably effective. The waters around New York City are the cleanest they've been in a generation, and tens of thousands of street trees have been planted in the past decade.

social, economic, or environmental policies. Rather, New York City can and should embrace its status as the world's fourteenth largest economy as an opportunity to support policies that positively contribute to the global marketplace and environment.

NEW YORK'S NATIONAL AND GLOBAL INFLUENCE

New York has a significant opportunity to influence other cities, states, and nations. Though New York, like other municipalities, is still learning how sustainable development might be incorporated into its economy and culture, it is undeniable that New York City has opportunities to advocate for sustainability on the national and even world stage.

One way to think about New York's global influence is to consider its remarkable concentration of industries, services, and global decision-makers. As New Yorkers and New York businesses become more aware of the potential benefits of sustainability, they will increasingly apply that knowledge in their business practices.

New York is a hub of the global economy, where much of the world's financial capital is created and traded. Through these activities, New York City firms have a considerable ability to influence the development of a more sustainable economy by changing perceptions of the relationship between the economy and the environment among global corporations, consumers, and investors. For example, a recent federal law, the Sarbanes-Oxley Act, has required many New York-based financial firms to identify the environmental and regulatory risks posed by their business activities. Sustainability has also been embraced as part of an intensified commitment to corporate social responsibility (CSR). For example, three of the world's major financial institutions — J.P. Morgan, Citigroup, and Bank of America, all headquartered in New York City — have committed to lending policies that are designed to protect the environment (Davis, 2005). For these firms — and, increasingly, for the world economy they influence — anticipating and avoiding environmental problems simply makes good business sense.

WHAT CAN CITIZENS DO TO HELP ACHIEVE SUSTAINABILITY?

The City of New York maintains a number of websites to help educate its citizens about the environment. A useful summary can be found at www.nyc.gov, by clicking on "Residents" and then "Environment". The Federal Citizen Information Center (<http://www.pueblo.gsa.gov/>) publishes free and low-cost consumer publications on a wide range of subjects, and the U.S. Environmental Protection Agency also has a special section for concerned citizens (<http://www.epa.gov/epahome/citizen.htm/>).

Many leading environmental organizations have informational websites on practices that help city residents protect the global environment. A few examples include:

- American Museum of Natural History's Center for Biodiversity and Conservation, <http://research.amnh.org/biodiversity>
- Environmental Defense, www.edf.org
- Natural Resources Defense Council, www.nrdc.org/cites
- New York League of Conservation Voters, www.nylcv.org
- Sierra Club's summary of local resources, zoomer.sierraclub.org
- Trust for Public Land, www.tpl.org
- Union of Concerned Scientists, www.uscusa.org

There are also a number of books to help consumers and children educate themselves about the environmental consequences of consumption. Examples include *The Consumer's Guide to Effective Environmental Choices: Practical Advice from the Union of Concerned Scientists* (1999), and *50 Simple Things Kids Can Do to Save the Earth* (1990).

New York City also represents a major center of production and consumption in the global economy, especially for culture, arts, and media, all of which can play a critical role in promoting sustainable development nationally and worldwide. Cultural products such as books, television, movies,

magazines, newspapers, and the Internet all shape people's lives and aspirations, stimulating consumption of particular goods, and changing attitudes about material wealth and life. As New Yorkers become more conscious of their impact on the environment, they have a privileged opportunity and the responsibility to communicate this consciousness worldwide.

WHAT CAN BUSINESSES DO TO BECOME MORE SUSTAINABLE?

There are many organizations and websites devoted to helping companies understand and address the business implications of sustainable development:

- Business for Social Responsibility, www.bsr.org
- ClimateBiz.com, www.climatebiz.com
- GreenBiz.com is a leading website with “articles and practical tools for building the business case and taking action on the environment”, www.greenbiz.com
- Natural Capitalism, www.natcap.org
- Natural Step is a non-profit environmental education organization working to build an ecologically and economically sustainable society, www.naturalstep.org
- World Business Council on Sustainable Development, www.wbcsd.ch

Recommended books on implementing sustainability in business practices include:

- *The Ecology of Commerce*, by Paul Hawken
- *Natural Capitalism*, by Paul Hawken, Amory Lovins and Hunter Lovins
- *Cool Companies: How the Best Businesses Boost Profits and Productivity by Cutting Greenhouse Gas Emissions*, by Joseph Romm
- *Mid-Course Correction: Toward a Sustainable Enterprise: The Interface Model*, by Ray Anderson

A LEADERSHIP ROLE FOR THE CITY OF NEW YORK

Cities, and their municipal governments, can also contribute to more environmentally sustainable policies. As the United Nations' Agenda 21 states, “local authorities usually have the political power and credibility to take initiatives and to assess and deploy resources in innovative ways reflecting unique local conditions. This gives them the capacity to manage, control, experiment, and lead urban development” towards environmental goals. In many cities, including New York, the municipal government plans and constructs infrastructure, determines a range of local environmental policies, and implements state and federal regulations (United Nations, 1992).

The City of New York, as the municipal government of the largest city in the United States, is positioned to take a leadership role among cities in pursuing sustainability. The City of New York has already joined a number of initiatives with other cities and states to pursue municipal, regional, and global environmental objectives. In May 2005, Mayor Michael R. Bloomberg joined a coalition of 131 mayors committed to fight global climate change at the municipal level (Sanders, 2005). This bipartisan coalition represents nearly 29 million citizens in over 35 states. In July of 2004, the City of New York was also the only city government to join eight states in filing a landmark lawsuit against five of the largest greenhouse gas emitters in the United States (City of New York, 2004).

As one of the largest governments in the United States, the City of New York can also pursue sustainability using its unique size and scale. The City of New York is a huge consumer of goods and services, including:

■ Real Estate

As the NYC Economic Development Corporation's Energy Task Force recently noted, the City of New York is one of the largest property owners and tenants in the city, with more than 2,500 major assets containing 200 million square feet, plus an additional 22 million square feet in leased space. The task force's report further states that “[The City] has a distinct, if indirect, influence over practices in the private community in such areas as design, construction, operation, and energy policy choices” (NYCEDC, 2004 p. 47).

■ Supplies and Equipment

The City of New York spends over a billion dollars every year on supplies, materials, and equipment — in Fiscal Year 2004, the figure was nearly \$1.28 billion, including \$715,320 on cleaning supplies alone (NYC Comptroller, 2004). The majority of these expenditures are in the New York City area and can be influenced by local environmental regulations. Increasing the number of green products purchased could alter spending patterns throughout the region and private sector.^[2]

■ Energy

The City is also one of the biggest energy consumers in New York, spending nearly half a billion dollars annually on heat, light, and power (NYC Comptroller, 2004). The City and Housing Authority together account for more than 10% of New York City's total energy consumption. As the City has noted, “by expanding and improving their efforts to deploy distributed resources, City agencies can significantly reduce electric demand and energy usage in the city; [and] reduce the burden on taxpayers” (NYCEDC, 2004).

By building on past commitments to sustainability and leveraging its significant local, regional, national, and international influence, New York City can play a leadership role in protecting the environment.

CONCLUSIONS

Part 1 of this report has attempted to define sustainability, to outline the foundations for sustainability in New York City, and to assess some implications of implementing sustainable development practices in New York. The material that follows in Part 2 will explore six case studies, three in New York City and three in municipalities across the country. These case studies will evaluate specific sustainable initiatives in three broad areas of environmental interest: water and land protection; energy, air quality, and climate; and waste and materials. In each case, this report will analyze the benefits of the initiative and draw conclusions as to the opportunities for continued sustainable development.

^[2]
For further discussion, see
Case Study #3, below.

By investing in innovative sustainable projects, such as the groundbreaking Staten Island Bluebelt program (opposite), New York City can make the case for other municipal sustainability efforts, locally and across the nation.



PART 2: CASE STUDIES IN URBAN SUSTAINABILITY

WATER AND LAND PROTECTION

CONTEXT AND BACKGROUND

Sustainable development of New York City's water resources requires an understanding of the complete cycle of water usage — from nature to the city and back to nature. Since the building of the Croton water system in the 1830s, the City of New York has been extremely successful in supplying water to its growing urban population. Prudent management of infrastructure and conservation efforts enables the continued use of the same water supply system today. What is perhaps less well understood is that New York City's water supply also depends on natural ecosystems, water cycles, and protected lands to provide clean drinking water for the inhabitants of New York City.

The reliance of New York City's water supply upon natural processes establishes a strong link between the needs of the city and the health of the environment. Protecting the environment is therefore a proactive measure that current generations can take to meet the needs of future generations. Case studies below, describing New York City's Staten Island Bluebelt and the City of Seattle's natural drainage systems, demonstrate efforts to manage urban stormwater — basically the rainwater that falls upon cities and its runoff. These innovative approaches to urban stormwater management use natural processes to preserve critical water resources and improve local and regional water quality. Finally, this section will examine how these case studies can be applied to ongoing conservation efforts and to one of the most persistent water pollution problems, combined sewer overflow (CSO) events.

FRESH WATER AS A CRITICAL URBAN AND NATURAL RESOURCE

Water is necessary for all life. More than 70% of the planet is covered by water, but humanity is dependent specifically on fresh drinking water, which constitutes less than 2.5% of all water on earth (Postel et al., 1996). For many cities and nations, fresh water is increasingly scarce due to human-caused disruptions to natural water cycles, through urbanization, irrigation, flood control, and the effects of global climate change (Gleick, 1993; Vorosmarty & Sahagian, 2000). However, fresh water is still a potentially infinitely renewable resource, because it is the product of natural solar, biological, geological, and chemical cycles of the earth.

Supplying cities with water has been a central challenge of humanity throughout history. “Unlike other important commodities like tin, copper or wheat, fresh water has no substitute for most of its uses” (Postel et al., 1996). We need water for drinking and irrigation, and increasingly, we use water to wash ourselves and our possessions, to dispose of our waste, to generate mechanical and electrical power, and to enable modern chemical and industrial processes.

NEW YORK CITY'S FAMOUS WATER SUPPLY

New York City's water supply has been a principal concern from the beginning of the city to the present day. The island of Manhattan, though surrounded by water, has few freshwater springs, and water from the first private wells dug by Dutch settlers had to be brewed into beer to make it drinkable. Even at this early date of settlement, humans had a significant negative impact on the quality of water in Manhattan; groundwater was frequently polluted by rubbish, ashes, and human and hog wastes (Koeppel, 2000).

In order to guarantee a reliable water supply, protected from environmental disruptions, the City's current water system draws from protected lands in the Croton watershed, from the Catskill Mountains, and the headwaters of the Delaware River to supply the city and parts of Westchester County. The system itself is an engineering marvel, using 19 reservoirs and three controlled lakes to store 580 billion gallons of water. The system is flexible, economical, and energy-efficient: “approximately 95% of the total water supply is delivered to consumers by gravity.... only 5% of the water is regularly pumped to maintain the desired pressure. As a result, operating costs are relatively insensitive to fluctuations in the cost of power” (NYCDEP, 2005). In comparison, California water agencies represent approximately 7% of the state's energy consumption (Pacific Institute, 2004).

NATURAL CYCLES OF WATER CLEANING

Protecting New York City's water supply in the present and in the future depends on an understanding of how natural water cycles provide fresh water. The vast majority of water on earth is in the ocean and in the air. Fresh water is found mostly in the form of ice (such as glaciers and permanent snow), and less than one percent is accessible to humans as ground water in aquifers and soil moisture, or surface waters in rivers, lakes, and ponds (Winter, 1988).

Fresh water moves through natural ecosystems and enables a variety of mechanical, biological, geological, and chemical processes. When water first enters the ground, microbes in the soil degrade dissolved organic matter and lower the acidity of water. In addition, biodegradation, the decomposition of organic chemicals by living organisms using enzymes, is capable of breaking down organic pollutants such as petroleum hydrocarbons (ibid.). Other processes that affect water quality are the precipitation and dissolution of minerals, sorption and ion exchange, and the dissolution and exsolution of gases, all of which together result in concentrations of calcium, bicarbonate, magnesium, sodium, oxygen, nitrogen, hydrogen sulfide, and methane.

Water quality is a key indicator of ecosystem health, and vice versa. The movement of fresh water is a critical component of the carbon, nitrogen, and phosphorus cycles, all of which constitute the chemical building blocks for life. Proper functioning of ecosystems maintains the existing chemical balances that distinguish clean drinkable water from brackish water, which requires filtration and other forms of treatment. For example, natural wetlands, such as in New York Harbor, are particularly rich areas for the cleaning of water, occurring through key activities such as the transport of minerals and nutrients by sedimentation and flooding, denitrification by microbes, and biodegradation of inorganic compounds. These ecological activities occur through the interaction of microbes, plants, waterbodies, and soil, with water as the common element moving throughout the ecosystem. The presence of cities and their large human populations, however, significantly alters the natural water cycle (ibid.).



The hydrologic cycle describes the movement of water above, below, and on the earth at a variety of scales.

Credit: United States Geological Survey (Winter, 1988)



Water flows from source to city to nature.

Perhaps the most important feature of New York's surface water system, however, is its dependence on protected lands and ecosystems, rather than filtration, to provide clean drinking water.^[3] New York is by far the largest major city to rely upon such an unfiltered drinking water supply. Seattle, San Francisco, and Boston also rely upon similar unfiltered sources, but New York serves a larger population than all other three cities combined, supplying the city dependably with 1,290 million gallons per day (MGD) (NYCDEP, 2005). Halting development in the watershed allows natural filtration and cleaning of water, and avoids disruption of the natural water cycle.^[4]

WATER CONSERVATION IN NEW YORK CITY

Recognizing that fresh water is a natural resource, the City of New York has put in place several extremely successful water-conservation programs since the mid-1980s. Over the past 20 years, an aggressive program of leak detection in the city's water system reduced the number of leaks by almost 90%, allowing more water to be delivered directly to customers. From 1994 to 1997, the City of New York's incentive programs for toilet replacement replaced 1.3 million old toilets with more water-efficient models, reducing the entire city's water consumption by over 5%. Universal water metering and a metered rate structure also provide customers with direct economic incentives to reduce water use. Finally, education programs for building tenants, owners, and maintenance staff have raised awareness of water efficiency and quality. The cumulative success of these programs is astonishing, with a total reduction of the city's water consumption from 1,450-1,500 million gallons per day (MGD) in 1990 to less than 1,250 MGD^[5] since 1996, despite population growth and some of the hottest summers on record (NYCDEP, 2005).

[3] Some filtration is used in the New York City water supply system. The new Croton filtration plant, currently under construction in Van Cortlandt Park in the Bronx, will filter 10% of the City's water supply from the Croton Valley Watershed.

[4] The natural water cycle can be disturbed by activities such as agriculture, which can result in erosion, sedimentation, and unbalanced chemistry due to fertilizers or pesticides; irrigation, which can physically disrupt or dislocate natural water flows; or urban and industrial development, which can contaminate water supplies from septic tanks, fluid storage tanks, landfills, industrial lagoons, and gasoline and oils on road surfaces.

[5] The city's dependable water supply is 1,290 million gallons per day (MGD), with actual water use at 1,250 MGD.

In addition to ongoing changes in water consumption habits, further water conservation may occur through technological innovation, as in the construction of water-efficient buildings. Good examples already exist for the implementation of water-efficient construction in New York: The Battery Park City Authority, an early leader in green building practices, has residential building guidelines that meet or even exceed the U.S. Green Building Council's guidelines (Battery Park City, 2005). The Solaire, a 27-story, 293-unit building constructed according to the guidelines, uses half the potable water of comparable residential buildings (U.S. Department of Energy Building Technologies Program [USDOE], n.d.). Efforts to implement similar water-conservation technologies could facilitate reductions in the production of wastewater, which in turn lessen the load upon existing sanitary and stormwater management systems.

WASTEWATER DISPOSAL IN CITIES

The final link in the human cycle of water use is disposal of sanitary water and stormwater. As the population of cities has grown, so has the amount of human wastewater. The United States generates nearly 50 trillion gallons of raw sewage daily (NRDC, 2004). The geographic expansion of cities has also resulted in increased stormwater, or rainfall runoff from buildings and roads. Paved areas and roofs disrupt natural water flows and absorption, and rainwater must be channeled into stormwater infrastructure to avoid flooding and property damage.

Wastewater requires proper collection and treatment. Human wastewater, such as raw sewage, is a public health risk because of the presence of dangerous bacteria and viruses, and it damages ecosystems by upsetting natural nutrient balances. Urban stormwater runoff often contains oil and chemicals, as well as deposited atmospheric pollutants from dust, pesticides, and chemical fertilizers. Other environmental impacts of wastewater include the replacement of naturally occurring species by more pollution-tolerant competitors, sedimentation of natural drainage channels, and groundwater contamination.^[6]

The federal Clean Water Act of 1972 had a remarkable effect on the health of the nation's waters by regulating allowable water pollution levels, outlawing illegal pollutant discharges, and funding the building of new sewage treatment plants. The United States now has nearly 20,000 wastewater treatment plants. Since the passage of the Clean Water Act, testing and monitoring of New York Harbor shows that water quality is perhaps at its highest level in the past 30 years (NYCDEP, 2003). New York City currently operates 14 water pollution control plants in order to meet the U.S. Environmental Protection Agency's criteria for water treatment and disposal.

Parts of New York City's water system, as is the case in many older municipalities, use combined sewers to collect both raw sewage and stormwater for treatment. Since upgrading the city's water pollution control plants, New York City is now able to treat all sewage generated in the city under dry-weather conditions, i.e., when it is not raining. However, during heavy rainstorms, water pollution control plants and sewer pipes in older systems are not always able to handle the sudden surges of water into the system; when these systems flood, wastewater bypasses treatment plants and is released into local water bodies via combined sewer outfalls. Such an event is known as a combined sewer overflow (CSO).

New York City has 460 combined sewer outfalls, located in all five boroughs. Though they are only part of the overall city sewage system, they are considered to be one of the major causes of water pollution and poor water quality in the harbor (HydroQual, 2004). Combined sewer outfalls in New York City flood during half of all rainstorms, discharging approximately 27 billion gallons of wastewater in an average rainfall year (USEPA, 2004). "On average CSO events occur about once per week (and as often as 70 times per year at some outfalls) and the average weekly polluted discharge is about 500 million gallons Citywide" (Riverkeeper, 2005a). Given that the total dry weather capacity of New York City's sewage treatment plants is 1.8 billion gallons per day (Riverkeeper, 2005b), this means that each year approximately 4% of the city's wastewater remains untreated and is released to the harbor.

^[6] Biological and technological waste processes also occasionally mutually reinforce one another to damage the environment. For example, one of the main current environmental issues in New York harbor is the phenomenon of eutrophication. Discharge of biological wastes and nitrogen fertilizers encourages the growth of algae species in the harbor, upsetting natural nutrient and species balances, starving other plants and organisms of dissolved oxygen, and occasionally resulting in algae blooms that produce chemicals toxic to humans and other organisms.

Combined sewer overflow is essentially a stormwater management issue. Reducing stormwater entering the system would eliminate the potential overflow of untreated wastewater into the harbor, minimizing the need to carry out expensive retrofitting of the City's sewer system. The following sections focus on innovative solutions for reducing urban stormwater.

ENGINEERING FOR NATURAL PROCESSES IN THE CITY

The use of engineered natural systems for stormwater management represents one of the single best opportunities to improve water quality in urban areas. Two case studies, from the Staten Island Bluebelt of New York City and the City of Seattle's natural drainage systems, demonstrate how the proper engineering of stormwater infrastructure can actually encourage the functioning of natural processes to meet human needs within the city. The Staten Island Bluebelt is a model initiative for the protection of natural habitat and lands within a suburban residential area. The City of Seattle's natural drainage systems demonstrate how these same principles have been applied into a variety of existing urban settings. Together, these two case studies provide strong examples of how New York City and other cities might approach environmental problems caused by stormwater.

CASE STUDY: NEW YORK CITY'S STATEN ISLAND BLUEBELT

INTRODUCTION

South Richmond, a suburban community on the southern end of New York City's Staten Island, has been recognized for its open spaces and unique natural habitat since the 1970s, when the City's Planning Commission zoned it as a designated open space. This designation preserved many of the area's natural ponds, streams, wetlands, and vegetation, while transferring development rights to adjacent areas. Today, South Richmond retains the largest concentration of freshwater wetlands within the city's boundaries (Vokral et al., 2001).

As the community has grown over the past 30 years, however, human and environmental needs have changed. Before the Bluebelt program, South Richmond was one of the last major areas in New York City without any water infrastructure to dispose of sanitary wastes and stormwater, and it relied upon increasingly inadequate septic systems. Increased urban development in areas adjacent to the existing watershed resulted in localized flooding and erosion, as well as degraded water quality from stormwater runoff and failing septic systems. The Bluebelt program was developed as a direct response to these issues.

The Staten Island Bluebelt program is one of New York City's most successful recent environmental initiatives. It exemplifies a sustainable approach to one of the city's oldest problems — management of water and infrastructure — and demonstrates how thoughtful intervention can both enhance a natural ecosystem and meet the changing needs of the city.

WHAT IS THE BLUEBELT PROGRAM?

The Bluebelt program was initiated in the early 1990s by the New York City Department of Environmental Protection. It provides the community of South Richmond, Staten Island, with new stormwater management infrastructure that is based on natural systems and hydrological principles, also known as best management practices (BMPs). The Bluebelt was the first large-scale application of BMPs in New York City and is also one of the largest continuous systems of BMPs in the country. Disturbance of the community and the ecosystem was minimized by using existing natural drainage channels, and at the time it was begun, the Bluebelt was the largest wetlands restoration project in the country (NYCDEP, 1996).

Widely recognized for its success in improving quality of life for local residents, while simultaneously improving the environment, the Bluebelt program provides an elegant example of engineering natural systems and processes to achieve the following goals:

COLLECTION OF CONTAMINANTS FROM RUNOFF

Urban stormwater flowing over ground and paved areas, such as roads and parking lots, collects pollutants such as pesticides, oils from automobiles, and atmospheric pollutants deposited as dust. Channeling stormwater into sewer systems allows these pollutants to settle in retention ponds, from which polluted sediment and suspended solids can be collected regularly.

INTRODUCTION OF AQUATIC PLANT SPECIES TO ABSORB POLLUTANTS

Plant species are selected for their ability to absorb water and pollutants, and can be introduced into natural drainage areas.

REDUCTION OF STORMWATER VELOCITIES

Urban stormwater flows are faster and more frequent than in non-urbanized areas. Reducing the velocity and energy of moving stormwater protects natural channels such as stream banks from erosion, in turn avoiding the creation of more sediment.

RECHARGE OF GROUNDWATER SUPPLIES

Avoiding the creation of urban stormwater in the first place avoids many of its subsequent negative effects. Simply allowing water to be absorbed into groundwater is referred to as infiltration, and preserves natural flows between surface water and groundwater.

The Bluebelt's constructed wetlands control and treat urban stormwater while also creating attractive natural environments.





INNOVATIVE ASPECTS OF THE BLUEBELT PROGRAM

ACQUISITION OF NEW LANDS

NYCDEP purchased more than 250 acres of natural waterways and more than 12,000 acres of watershed to create new water drainage alongside existing ecosystems that were already protected by zoning and parks. Public ownership of the properties also halted development within the most sensitive watersheds (NYCDEP, 1996).

OPTIMAL USE OF BMPS

Other municipalities across the country and the U.S. Environmental Protection Agency have developed and experimented with a wide range of urban stormwater BMPs, including constructed wetlands, swales, filter strips, rain gardens, basins, trenches, sand filters, porous pavements, and treatment controls (USEPA, 2005a). NYCDEP examined over a hundred BMP designs used around the country and selected the most appropriate BMPs for each particular Bluebelt watershed. Finally, new lands and natural drainage areas that were acquired allowed for the optimal implementation of BMPs, individually or in systems (Vokral et al., 2001).

PUBLIC OUTREACH & SUPPORT

NYCDEP encouraged extensive community involvement, with multiple public forums, and instituted a Citizen's Advisory Committee composed of representatives from civic, homeowners, environmental, and building associations. Newsletters, signage, and a 24-hour hotline for residents to report environmental violations have all publicized the project and informed local residents of the importance of the Bluebelt in serving their needs and protecting the local environment.

Many of the drainage ponds and streams constructed by the Bluebelt's engineers (top) blend seamlessly into the landscape when flooded and planted with appropriate vegetation (bottom).

BENEFITS OF THE BLUEBELT PROGRAM

STEWARDSHIP OF NATURAL RESOURCES

Although the Bluebelt was constructed to meet human needs, it improves the natural environment at the same time. Pollutants, erosion, and flooding all result in degraded water quality and impacted wetlands. Studies by the U.S. Environmental Protection Agency show that the Bluebelt exceeds its intended performance levels in removing pollutants and suspended solids (O'Connor, 2005).

The Bluebelt also integrates existing parks with newly acquired areas to enlarge habitat areas for both existing and new species, including plants, birds, frogs, salamanders, and insects (NYCDEP, 1996). This increased biodiversity enables ecosystems to adapt and respond to other, future environmental stresses.

HEALTH & PRODUCTIVITY

The Bluebelt's immediate capture and control of stormwater reduces human exposure to these pollutants in the transport, treatment, or release of stormwater, including potentially toxic chemicals. The installation of stormwater infrastructure also has reduced flooding and property damage that previously affected the quality of life of local residents. One example is the reduced flooding from heavy rainfall events, such as Hurricane Floyd in 1999. Prior to the building of the Bluebelt, even minor storms caused flooding and property damage, but rainfall from the hurricane caused little or no impact (NYCDEP, 2000).

EFFICIENT GOVERNMENT

In addition to the significant ecological benefits of the Bluebelt, the system is also extremely cost effective. Detailed cost/benefit studies compared the cost estimates of traditional sewer construction versus the costs of each wetland acquisition, and in total, the Bluebelt to date has been estimated to save about \$80 million over conventional approaches (NYCDEP, n.d.). These cost/benefit studies also do not take into account the additional benefits of open space preservation and habitat creation, the financial costs of construction disruptions, or the additional regulatory costs to mitigate the installation of new sewers (Gumb, 1997).^[7]

^[7] It would also be illustrative to compare (both financially and environmentally) a conventional combined sewer system with the Bluebelt system for a specific size drainage area.

EDUCATION

Citizens participate in the Bluebelt program in a variety of ways. NYCDEP works with community groups to organize clean-up days, which both engage the local community and enable the efficient operation of the Bluebelt by removing debris and trash. Signage at new Bluebelt projects and the Adopt-A-Bluebelt program educate the general public about the benefits of watershed preservation and the environmental consequences of using solvents, fertilizers, pesticides, and detergents.

CONCLUSIONS

The Staten Island Bluebelt program provides an excellent example of infrastructure that meets human and urban needs through the protection of land and natural processes. With the creation of the Bluebelt, interaction with the combined sewer system is limited and water is preserved as a critical resource for both humans and nature. Thoughtful intervention in the area's ecosystems and infrastructure provides critical benefits in major areas of sustainability, including stewardship of natural resources, human health and productivity, efficiency of government and education of the public.

CASE STUDY: SEATTLE'S NATURAL DRAINAGE SYSTEMS

INTRODUCTION

The city of Seattle, situated on Puget Sound between the Cascade and Olympic mountain ranges, is well known for its lush natural setting. Among the city's celebrated natural resources are rich local fisheries. Pacific salmon, steelhead trout, and other species return from the open ocean to spawn in Seattle's rivers and streams. However, rapid growth and sprawl has led to increased stormwater runoff — from new buildings, parking lots, and roads — generating concerns about the impact of water pollution on the local aquatic habitat. According to the *Seattle Post-Intelligencer*, “dirty storm water is suspected in recent years of killing Seattle salmon [and hatchery fish] before they spawn” (Stiffler, 2005). Dwindling fish runs have resulted in several species of Pacific salmon being added to the federal endangered species list (Levitt & Bergen, 2004). As a result, the City of Seattle and the Washington Department of Ecology have launched programs to protect and improve the health of Seattle's freshwater ecosystems, particularly through management of stormwater in urban areas.

In 1998, the City of Seattle announced that it would fund a series of small and innovative projects to celebrate the coming millennium. Employees of Seattle Public Utilities, the public works agency, proposed pilot projects replacing existing inadequate stormwater systems using natural drainage systems. A team of engineers, architects, planners, and staff drawn from a wide range of City agencies set out to demonstrate that natural drainage systems could meet or exceed the performance of existing stormwater infrastructure, improve aquatic ecosystem health, and remain cost-effective (ibid.). Their success is outlined below.

WHAT ARE SEATTLE'S NATURAL DRAINAGE SYSTEMS?

Natural drainage systems (NDS) are civil structures and biological systems engineered to use soil and plants to fulfill the function of traditional infrastructure, such as gutters, catch basins, and sewage pipes. “The natural drainage systems approach to these problems is simple in concept: restore and utilize the environment to do the work it was intended to do” (ibid., p. 10). Impervious surfaces — that is, surfaces such as pavement that block the flow of water — can be replaced by surfaces that absorb water, and therefore avoid concentrating surface pollutants from passing cars in runoff waters.

The first application of these principles was called the Street Edge Alternative (SEA) project. The City of Seattle has also gone on to apply these principles to increasingly large and dense urban projects, including the Broadview Green Grid, an entire neighborhood encompassing 15 city blocks, and the High Point Project, one of the largest mixed-income housing redevelopments in Seattle's history, with 1,600 units on 34 blocks of new streets. The municipal government is also examining



Narrow streets, bordered by beds of dense planting, allow for minimized run-off and natural infiltration. The Street Edge Alternative project (top, left and right) served as a pilot for these approaches, which were then applied when building the 15-block Broadview Green Grid neighborhood (below, left and right).

application of the NDS approach in a variety of industrial, commercial, residential and mixed land use types (Horner et al., 2002). Principles of the NDS approach include the following:

ADDITION OF NATURAL VEGETATION ALONG CITY STREETS

The NDS approach adds vegetation along street edges in a network of swales, gardens, and cascades, allowing stormwater to be absorbed directly into the ground or channels for drainage.

REPLACEMENT OF IMPERVIOUS SURFACES BY POROUS SURFACES

The NDS approach proactively removes existing impervious surfaces, such as city streets and pavement, and replaces them with porous surfaces and stormwater gardens that result in less runoff, reducing the scale of the eventual 'downstream' problem.

TRAFFIC AND STREET RECONFIGURATION

Narrower streets generate less runoff. Streets were redesigned not only to be narrower, but also to include new sidewalks for pedestrians and slaloming curves to slow traffic. Although municipal traffic engineers and emergency-response professionals were initially concerned that narrower streets would slow traffic and the response of public services, the success of the pilot project gradually gained their acceptance and approval (Levitt & Bergen, 2004).

INNOVATIVE ASPECTS OF SEATTLE'S NATURAL DRAINAGE SYSTEMS

APPLICATION IN DENSE URBAN AREAS

The Street Edge Alternative program began as an experiment in a low-density residential neighborhood



of single-family homes. The subsequent success of the program led the public works agency to address the stormwater infrastructure needs of increasingly large and dense urban areas, demonstrating the applicability of these innovative techniques on not just relatively undeveloped “greenfield” sites, but also in the high-density built environment typical throughout Seattle and other cities.

A SYSTEMATIC APPROACH TO STORMWATER MANAGEMENT

As part of the project, Seattle Public Utilities established a memorandum of understanding with the University of Washington’s Center for Urban Water Resources to evaluate the success of the various projects, adding a strong aspect of quantitative monitoring, testing, and analysis to the program (Horner et al., 2002). Results of this evaluation will be cited in the sections that follow.

MINIMIZED MAINTENANCE COSTS

Seattle Public Utilities also made active efforts to engage resident organizations in the regular clean-up and maintenance of street gardens, minimizing the ongoing costs of government maintenance (Levitt & Bergen, 2004).

BENEFITS OF SEATTLE’S NATURAL DRAINAGE SYSTEMS

STEWARDSHIP OF NATURAL RESOURCES

Studies of the SEA program suggest that over the two-block area that was monitored during the first two years of operation, the transmission of pollutants through stormwater runoff was reduced by 98% and stormwater flow velocities were reduced by approximately 20%, compared to a conventional street and gutter system (Horner et al., 2002). These sizeable reductions in runoff significantly reduce envi-

The High Point Project, a 34-block mixed income development, incorporates such natural drainage systems as this grassy swale (above), which absorbs run-off from the street.

ronmental pollutants, including such toxic organic compounds as hydrocarbons and pesticides, as well as oils and greases, nutrients, and heavy metals. Pollutants in stormwater runoff affect natural ecosystems negatively; for example, creeks that are heavily affected by urban runoff have diminished biodiversity, including the replacement of native species and vegetation by pollution-tolerant organisms, as well as diminished growth and health of individual species and communities (Heaney et al., 1998). Urban stormwater also directly affects groundwater quality and may introduce pollution from pesticides, organic compounds, pathogenic microorganisms, heavy metals, salts, and nutrients such as nitrogen fertilizers.

HEALTH AND PRODUCTIVITY

Residents and community activists have enthusiastically supported the NDS approach in their neighborhoods because it improves quality of life by adding trees and plantings that have visual and aesthetic appeal, by adding sidewalks where there were none before, and slowing the speed of local traffic. Some residents believe that their property values have risen after installation of the NDS systems, though no study has been done to date (Levitt, 2004).

EFFICIENT GOVERNMENT

In addition to the inherent environmental benefits of using the NDS approach, the City of Seattle has found that it is also more cost-effective. Seattle Public Utilities estimates that the construction of infrastructure based on the NDS approach costs 25% less than traditional roadside stormwater systems, because reducing runoff at the source reduces the need to build additional pipes and holding tanks. These cost savings do not include the additional economic benefits of carbon sequestration, additional trees and other plantings, cleaner water, and replenished groundwater (ibid.).

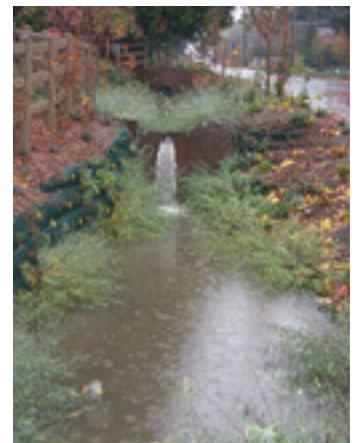
EDUCATION

Seattle's NDS projects have built local and international awareness of sustainable infrastructure, while also creating a body of research materials suitable for use by professionals and scholars. On the local level, residents have been involved in many stages of planning and implementation of individual NDS components. More broadly, Seattle's engagement in these innovative pilot programs has generated significant interest from the press and from jurisdictions worldwide. Finally, the strong link between the City and researchers from the University of Washington ensures that the effectiveness of the program is studied quantitatively and can be rigorously applied elsewhere (Levitt & Bergen, 2004).

CONCLUSIONS

Seattle's NDS approach offers an innovative solution to stormwater management in dense urban areas. Implementation of similar systems in New York and other cities can reduce the amount of water that must be treated and therefore reduce combined sewer overflows.

Porous infiltration zones, under drains (left) and along roadways (center), capture the sudden surges in run-off (right) that are typical during rainstorms.





ENERGY, AIR QUALITY, AND CLIMATE

CONTEXT

From the earliest days of civilization, humans harnessed the energy found in nature to serve their needs, by burning wood for lighting, cooking, and heating, or capturing wind and hydrodynamic power for agriculture and irrigation. Since the Industrial Revolution, technology has vastly expanded our ability to use a diverse range of energy sources, including fossil fuels such as coal, oil, and natural gas; renewable energy sources, such as solar, wind, and hydrodynamic power; and nuclear power.

The expansion of energy technology into every aspect of human life has serious environmental consequences, and those consequences may manifest far from where the energy was originally produced or consumed. Fossil fuels, in particular, generate highly mobile pollution, with profound effects on human health and the natural environment, some of which may not yet be fully understood. Only in the last 30 years has it been recognized that fossil-fuel consumption is changing the global climate for centuries to come. One hundred years ago, regional air pollution was a relatively unknown problem. Now, distant rural power plants can generate pollutants that migrate to affect cities,^[8] while energy-hungry cities concentrate the consumption of fossil fuels and produce soot and smog that affect urban populations, as well as surrounding areas. In short, the impact of energy use is not necessarily localized; energy usage at the local, national, and global levels can all have direct environmental consequences for a given city.

This section examines the inter-related issues of energy use, air quality, and climate change at the national and urban scales, to set the context for efforts to reduce energy use, make energy usage more efficient, and improve the environment in New York City. This section then assesses a promising municipal-scale approach to improving energy efficiency, through green buildings. Over the past decade, green construction practices have emerged as one of the best opportunities to reduce the nation's overall energy consumption and improve air quality; these efforts to improve the environment can also directly benefit human health and productivity. The case studies in this section, from the City of New York and the City of Chicago, examine the benefits and lessons learned from the differing efforts of two big-city municipal governments to promote green buildings.

UNDERSTANDING ENERGY USE IN A NATIONAL AND URBAN CONTEXT

A brief summary of energy use in the United States and in cities helps to set the context for understanding New York City's energy consumption. The United States is the largest consumer of energy in the world, using 94.3 quadrillion BTUs in 2003, or 25% of the world's total energy; the United States also is one of the largest consumers of energy in the world on a *per capita* basis, with each person using 355 million BTUs per year (U.S. Energy Information Administration [USEIA], 2003b). The majority of energy in the United States comes from fossil fuel use — 86%^[9] — with only 8% from nuclear power and 6% from renewable sources (USEIA, 2005b). As a result, the United States produces approximately 24% of the world's total greenhouse gas emissions (USEIA, 2003a) and is one of the leading emitters of greenhouse gases on a per capita basis as well (USEPA, 2005a). Energy in the United States is generally used in four major end-use sectors: industrial (33%), transportation (28%), residential (21%) and commercial uses (18%) (USEIA, 2005b).

Cities themselves are voracious consumers of energy. In 2006 over half of humanity lives in cities, and the vast majority of energy use occurs there. In addition to their direct needs for energy, cities consume physical land area, food, and materials, all of which in turn further stimulate energy needs for construction, transportation, and industry. For example, the ecological footprint of London — i.e. the surrounding lands required to support the city's needs — has been calculated to be close to 50 million acres, or 125 times the city's actual land area (Sustainable London Trust, 1996). Finally, there is also a direct correlation between urbanization and increased energy use: “a recent analysis showed that a 1% increase in per capita [GNP] leads to an almost equal (1.03%) increase in energy consumption. However, an increase of the urban population by 1% has been reported to increase energy consumption by 2.2%, i.e., the rate of change in energy use is twice the rate of urbanization”

^[8] In recognition of this mobility, the City of New York recently brought a lawsuit against power plants in the Midwest to reduce their contribution to air quality problems in New York City. For more information, see www.nyc.gov/html/law/pressreleases/pr072104.pdf

^[9] Includes natural gas and coal byproducts, as well as imported electricity. All figures are rounded to nearest whole number.

(Santamouris, et al., 2001, p. 9). Although high-density urban living often allows residents of cities to consume less energy on a *per capita* basis, it is important to recognize that urbanization plays a key role in stimulating aggregate energy consumption.

URBAN ENVIRONMENTAL CONSEQUENCES OF ENERGY USE

Increases in local temperature and lowered air quality are environmental consequences of energy use closely associated with cities. The urban heat island effect describes a process where modification of the physical environment through building and energy use results in raised temperatures in the city. New York City has been found to be 5.4 to 7.2 degrees F hotter than the surrounding countryside, and Chicago, 3 to 5 degrees F hotter (Getzelman et al., 2003; Earth Pledge, 2005). In cities, the replacement of trees and vegetation with dark, heat-absorbing surfaces, such as asphalt and pavement, causes higher levels of heat absorption and raises inner-city temperatures. In addition, the combustion of fossil fuels, as through vehicle use, elevates temperatures in city centers both by directly releasing heat into the environment and also by releasing ozone and carbon dioxide (see diagram, "Urban Heat Island Effect," right). The resulting urban heat island effect has numerous negative impacts on urban dwellers, including increased discomfort outdoors and negative consequences for health from higher temperatures and raised concentrations of such temperature-related pollution as smog and ozone; in addition, the urban heat island effect further increases energy demand to cool buildings (American Lung Association [ALA], 2005; Getzelman et al., 2003).

Energy use in cities also results in direct exposure to products of combustion such as soot, smog, noxious gases, and toxic chemicals. "Air pollution threatens public health in all regions of the world today, although the nature and extent of the risk varies" (Davis & Saldiva, 1999, p. 5). The largest metropolitan areas in the United States all suffer from air-pollution problems in varying

Urban Heat Island Effect:
In cities, hard surfaces absorb the heat of the sun and energy use heats the air, resulting in a "heat island" around urban areas.



GLOBAL CLIMATE CHANGE, HUMAN HEALTH, AND URBAN IMPACTS

Global climate change caused by human use of fossil fuels is expected to have numerous health impacts (World Health Organization, 2003), including:

- Direct exposure to higher temperatures, resulting in increased heat-related illnesses;
- Changes in weather patterns and intensity, resulting in injury and dislocation of humans and ecosystems;
- Ecosystem disturbances, resulting in shifts in population, disease vectors, and food production; and
- Changes in temperature and air quality, resulting in increased impacts of air pollution.

In addition to health effects, global climate change may also directly affect New York City's built and natural environments. The Metropolitan East Coast Assessment, as part of a national climate change research program, is studying the impacts of climate change on New York City's infrastructure, wetlands, water resources, public health, energy demand, and institutions (Metropolitan East Coast Assessment, 2000). As a preliminary study concludes, "Climate change will affect people in cities multidimensionally. Heightened frequencies of storm-surges will damage major infrastructure juxtaposed to already threatened coastal wetlands; health impacts cannot be separated from the impacts of augmented heatwaves on energy demand... Climate change impacts may not be limited by a city's boundaries. For example, a major climate-related disruption of the New York Stock Exchange [i.e., by flooding] would have reverberating impacts on global financial markets" (ibid.).^[10]

degrees, as measured by the U.S. Environmental Protection Agency's number of high air quality index days (Environmental Defense, 2004b). The American Lung Association estimates that "over 52% of the population [of the United States] lives in counties that have unhealthy levels of either ozone or particulate pollution," with serious implications for chronic diseases such as adult and pediatric asthma, chronic bronchitis, emphysema, cardiovascular disease, or diabetes (ALA, 2005, para. 4).

^[10] In recognition of this risk and its complexities, the New York City Department of Environmental Protection has formed a Climate Change Task Force, which is working in conjunction with the Earth Institute at Columbia University to research potential impacts of climate change on the City's water supply and wastewater treatment infrastructure.

ENERGY, AIR QUALITY & CLIMATE CHANGE: NEW YORK CITY CONTEXT

As noted above, New York City benefits from key intrinsic advantages that allow for reduced energy use and greenhouse gas emissions. New York City's historical development as a high-density city significantly reduces the city's overall energy use. An extensive public transportation network and a high proportion of large multifamily apartment buildings represent relatively energy-efficient modes of transportation and housing.

In the past decade, New York City has made significant progress in terms of air quality. The city is currently in attainment for four out of the six criteria pollutants tracked by the U.S. Environmental Protection Agency (EPA), including carbon monoxide, sulfur dioxide, lead, and nitrous dioxide; all four of these pollutants, and particulate matter, exhibit downward trends since 1993 (USEPA, 2003b). However, New York City has opportunities for improvement in the last two EPA categories: The American Lung Association recently ranked New York as the 9th and 12th most polluted metropolitan area in ozone and particulate matter, respectively (ALA, 2005). Further reductions in New York City's energy consumption, through lowered use and improved efficiency, could continue to improve local air quality and address global climate change.

NEW YORK CITY'S CURRENT EFFORTS

The City of New York is currently engaged in wide-ranging efforts to further reduce energy consumption in its operations, and thereby to reduce local air pollution and greenhouse gas emissions. A few examples of projects in the City of New York's operations include:

■ Local Law 77 of 2003

Enacted by the New York City Council, this local law mandates the use of ultra-low sulfur diesel fuels and best available technology for all off-road vehicles used in New York City construction projects.

■ Traffic lights

Conversion of the City's traffic lights from incandescent bulbs to energy-saving light-emitting diodes reduces carbon dioxide emissions by more than 25,000 tons per year and saves \$7 million per year (NYC Office of Environmental Coordination [NYCOEC], 2005).

■ Energy Cost Reduction Program (ENCORE)

Since 1998, through the City's partnership with the New York State Power Authority (NYPA), the City has completed more than \$162 million in energy conservation projects (NYC Comptroller, 2005).

■ School Coal Boiler Conversion

Beginning in 1997, NYPA, the School Construction Authority (SCA), and the New York City Department of Design and Construction (DDC) funded the conversion of 300 school boilers from coal-burning to natural gas. This initiative reduces greenhouse gas emissions by more than 75,000 tons annually and reduces annual nitrogen oxide (NO_x) and sulfur dioxide (SO₂) emissions by 650 and 4,200 tons respectively (NYCOEC, 2005).

GREEN BUILDINGS

We shape buildings; thereafter they shape us. — WINSTON CHURCHILL

Buildings, as the fabric of cities, scarcely draw our notice, but to notice buildings is to notice how they shape our lives. Most of our activities and lives occur indoors — studies and surveys suggest that people occupy buildings for more than 85% of their lives (Jenkins, 1992; Klepeis et al., 2001) — but it is not widely recognized that we consume most of our energy *through* buildings, in everyday activities such as heating, cooling, lighting, and powering of appliances, or in the ongoing construction, maintenance, and remodeling of buildings.

GREEN BUILDINGS: ENVIRONMENTAL OPPORTUNITIES

Buildings offer one of the best opportunities to reduce the total energy used each year in the United States. The U.S. Department of Energy (DOE) calculates that buildings in the United States account for more than 65% of the nation's total energy consumption, 35% of total primary energy use, and 30% of total greenhouse gas emissions (U.S. Green Building Council [USGBC], 2004).

Over the past decade, interest has grown in green buildings that use less energy and materials, save money and increase value, and improve the health and productivity of their occupants. The U.S. Green Building Council, a national non-profit organization formed in 1993, has grown to over 4,000 member organizations nationwide, and develops consensus-based industry standards such as the Leadership in Energy & Environmental Design system, or LEED. The LEED system's elements have become accepted widely by the construction industry, municipalities, and homeowners, with over 1,800 registered and certified projects in all 50 states (Costlow, 2002; Gardner, 2004; USGBC, 2004).

This broad movement to change the ways in which buildings are designed, built, and operated comes at a fortuitous time, in the midst of rapid change in the nation's building stock. One study estimates that half of the buildings in use 25 years from now will be built in that same period (Nelson, 2004). Put another way, half of the buildings that will be used in 2030 have yet to be built and will continue to affect national energy trends long into the future.

Progress in the area of green buildings has rapidly altered industry standards and stimulated a better understanding of how much energy can be saved from buildings. A 1996 study by the Intergovernmental Panel on Climate Change found that the adoption of proven existing energy-efficiency technologies in buildings could reduce greenhouse gas emissions from buildings in 2050 by roughly a quarter, in both the developed and developing worlds (Pacala & Socolow, 2004). Initial calculations by Atelier Ten Environmental Design, a New York City green building consultant, suggest that new commercial office buildings in the Northeast that use a variety of green building practices can reduce the energy used in cooling by 10% to 50%, in heating by 30% to 70%, and in electricity by 45% to 55% (Atelier Ten Environmental Design, 2005).

GREEN BUILDINGS: ECONOMIC OPPORTUNITIES

A number of studies have also emerged to demonstrate that green buildings make good economic and business sense. Analyses of green buildings show that certain types of LEED projects do not cost more — as is typically believed — and that even minimal investments to support green design result in significant cost savings (Matthiesen & Morris, 2004; Kats et al., 2003). Businesses engaged in building upgrades or retrofits can expect a 35% to 50% reduction in energy consumption with a three- to five-year payback period, resulting in returns on investment of over 20% to 35% (Romm, 1999). “The Energy Cost Savings Council, a partnership of electrotechnology manufacturers and trade associations says that *businesses can expect to achieve a savings of \$1 per square foot of floor space* with [various] kinds of whole-building upgrades” (ibid., author's italics).

CASE STUDIES IN GREEN BUILDING

The following case studies examine the experiences of the City of New York and the City of Chicago in stimulating the development of green buildings in both the public and private sector. The lessons learned can have a significant impact on the future development of green buildings in New York and other cities.

CASE STUDY: NEW YORK CITY'S HIGH-PERFORMANCE BUILDING PROGRAM

INTRODUCTION

The City of New York was an early leader in the development of green buildings. The NYC Green Buildings Task Force began as an interagency collaboration to integrate sustainable practices into municipal design and construction. In 1997, the NYC Department of Design and Construction (DDC) established the Office of Sustainable Design (OSD) to promote environmentally sound building construction. In 1999, the Design Trust for Public Space and DDC together issued the internationally recognized *High Performance Building Guidelines* to identify opportunities for the City to maximize the value of public capital investments.^[11]

^[11]
The *High Performance Building Guidelines* and a companion publication, the *High Performance Infrastructure Guidelines*, are available from the Design Trust's website, <http://www.designtrust.org>

As of early 2005, the City of New York had contributed to 25 pilot projects with a total construction cost of approximately \$950 million. Four of these projects are now completed, with five in construction and sixteen in design. Eight of these pilot projects, four of which are scheduled to open in 2006, are designed to receive various ratings, from certified to platinum, as defined by the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) program. Given DDC's approximately \$400 million budget for building construction each year — as well as Local Law 86 of 2005, which requires that new City buildings be designed to qualify to meet LEED certification — significant opportunities lie ahead to further promote sustainable design in the City's construction practices.

Widely acclaimed green buildings have also been built in New York City by the private sector. Four Times Square, the 48-story Condé Nast building, was one of the first urban high-rise buildings to incorporate design features that encourage energy efficiency, indoor air quality, and recycling. The Solaire in Battery Park City is one of the most environmentally advanced residential buildings in the United States, incorporating green roofs, solar panels, rainwater harvesting, and greywater recycling (USDOE, n.d.). An estimated 60,000 square feet of green roofs currently exist, or are under construction, in the city (Chamberlain, 2005). Finally, Bank of America has broken ground for its new headquarters building in midtown Manhattan, One Bryant Park, and has designed it with the hope that it will become the first high-rise office building in the United States to achieve the highest LEED rating of platinum (Feder, 2004).

WHAT IS THE HIGH PERFORMANCE BUILDING PROGRAM?

The High Performance Building Program is designed to promote green building objectives in the City's capital construction process through demonstration projects, policy development, and education.



PILOT PROJECTS AND RESEARCH

DDC designated a select number of projects “High Performance Pilot Projects” to explore the opportunities of sustainable design, including designing for the quality of indoor daylight and air quality, building envelope improvements, insulation, energy efficiency controls, and the use of environmentally preferable materials. These improvements have been applied to a wide range of projects, including a library, a courthouse, a museum, children’s centers, a prison, and a garden (NYCDDC, 2002). DDC’s Office of Sustainable Design has also pursued a number of research projects, including the development of construction specifications, design manuals, and cost/benefit analyses of several projects.

DESIGN PROCESS & TRAINING

DDC now requires that all of the design and construction projects it undertakes on behalf of other City agencies begin with a sustainable design meeting. A training program for all DDC design managers began in December 2004 with the aim of promoting sustainable design practices in all of the agency’s activities.

INNOVATIVE ASPECTS OF THE HIGH PERFORMANCE BUILDING PROGRAM

CENTRAL CONSTRUCTION AGENCY

As the home of the City’s high performance buildings program, DDC concentrates much of the City’s expertise in green buildings in one agency. Through its development of construction specifications, in particular, the agency is able to assist and influence the green building practices of other agencies throughout the City.

Buildings created under the auspices of DDC’s high performance building program include the Bronx Criminal Court Complex (all top row; middle row, right); Brooklyn’s Kensington Branch Library (middle left); the Queens Botanical Garden administration buildings (middle, center); and the New York Hall of Science in Flushing Meadows Park, Queens (bottom).

NEW YORK CITY-SPECIFIC GUIDELINES

Rather than using national green building standards — which are necessarily geographically generic — the *High Performance Building Guidelines* identify specifically the particular strategies and policies that are most relevant to New York City's climate and urban environment. The DDC and the Design Trust for Public Space followed up on the building guidelines' success by publishing the *High Performance Infrastructure Guidelines*, which recommends sustainable practices for the design and construction of city streets and sidewalks; although a national readership is expected, the document specifically addresses New York City issues and is illustrated throughout with sustainable infrastructure projects within the city.

LEVERAGING OF OUTSIDE EXPERTISE

The City has been successful in obtaining assistance and experience for its projects. The New York State Energy Research and Development Authority (NYSERDA) provides energy-feasibility studies, computerized energy modeling, commissioning services, and green materials specifications (NYCDDC, 2002).

LEVERAGING OF OUTSIDE FINANCING

The City has also been successful in pursuing the high performance building program at little or no expense to taxpayers by obtaining financing for energy improvements from the New York Power Authority (NYPA), which pays for the initial costs of energy conservation measures and is then repaid by the City over time through energy savings.

BENEFITS OF THE HIGH PERFORMANCE BUILDING PROGRAM

STEWARDSHIP OF NATURAL RESOURCES

DDC's preliminary analysis of energy and emissions reductions of its first 11 projects indicates that the buildings will achieve nearly one-third less energy use. Five buildings reduce greenhouse gas emissions by over 2,700 tons of carbon dioxide equivalents annually.

HEALTH AND PRODUCTIVITY

The urban heat island effect has numerous health impacts on urban dwellers by increasing discomfort outdoors and increasing temperature-related pollution, such as smog and ozone. Though it is difficult to calculate the number of lives affected by increases in the city's temperature, numerous studies show that warming from global climate change is expected to result in increased mortality due to exposure to higher temperatures and air pollutants (Kalkstein & Greene, 1997; Longstreth, 1999). Reduction of the urban heat island effect, through such green-building practices as the planting of trees, light-colored or green roofs, and light-colored paved surfaces, would benefit city inhabitants by reducing exposure to heat- and pollution-based illnesses.

ECONOMIC DEVELOPMENT

Studies show that pursuing energy efficiency through whole building retrofits are a low-risk, high-return investment, with 35% to 50% reductions in energy use, with less than three- to five-year pay-back periods (Romm, 1999). As a rough example of the potential benefits of such retrofits, if the estimated energy savings of \$1 per square foot of floor space a year (ibid.) is applied to the vast New York City commercial real estate market of 350 million square feet, then New York City businesses could expect to save \$350 million per year, or nearly 4% of New York City's total energy bill in 2004 (Con Edison, 2004).

EFFICIENT GOVERNMENT

Computer modeling of 11 high performance building designs contracted by the NYC Department of Design and Construction found that annual energy costs were reduced an average of 32.5%, compared

to typically designed buildings.^[12] The resulting cost savings of more than one million dollars per year repaid the initial cost investment within five years and are expected to pay for themselves again every five years going forward.

^[12] Specifically, the savings are relative to hypothetical minimally code compliant designs.

EDUCATION

Architects who have worked with DDC to implement the recommendation of the High Performance Building Guidelines have generally offered “high praise and positive feedback” on the program (NYCDDC, 2002, p. 16). The guidelines prompted the architects to consider new materials, systems, and processes (ibid.). Future research and pilot programs may yield similar feedback and will contribute to the dissemination of sustainable practices, within both the public and private sectors.

CONCLUSIONS

The City of New York, by pursuing green building through DDC, has begun to develop a pipeline of pilot projects that provide useful research and insights that can be extended more widely throughout its capital construction program. The City has also demonstrated that it can apply energy efficiency to a wide and diverse group of projects. Given the magnitude of the City’s budget, many additional opportunities exist to lower air temperatures, improve air quality, and to reduce energy — for example, by continuing to plant trees, adapting City construction specifications, and designing a program to replace roofs.

In 2005, New York City enacted Local Law 86, which mandated that new City construction be designed to qualify for LEED silver certification; further, the law requires that renovations to existing buildings reduce potable water consumption and increase energy efficiency. This law, coupled with New York State’s Green Building Tax Credit and existing New York City High Performance Building Guidelines, will further stimulate green building construction practices in New York City.

CASE STUDY: CHICAGO'S COMPREHENSIVE APPROACH TO ENERGY AND GREEN BUILDINGS

INTRODUCTION

Chicago, the third largest city in the United States, has become a leader in municipal environmentalism. Under Mayor Richard M. Daley, the City of Chicago's efforts to revitalize and beautify the city strongly emphasize sustainable practices. In 2005, the City issued an agenda that outlines specific environmental goals for 2010 and 2020, in addition to describing a wide-ranging program of current sustainability initiatives. These efforts are supported by a range of City agencies — including the Department of Environment, created by the Mayor in 1992 — and include extensive agency interaction with the private sector, financial incentives, and active regulation to encourage green building projects (City of Chicago, 2005).

WHAT IS CHICAGO'S APPROACH?

The City of Chicago supports green building through a comprehensive program of energy efficiency and green construction. Chicago's policies are comprehensive in that they address new municipal capital construction and seek to monitor and reduce energy use in all of the City's buildings. The City of Chicago has also devised a package of incentives and requirements to stimulate the market for green buildings in the private sector.

MANDATORY SPECIFICATIONS FOR MUNICIPAL BUILDINGS

The Chicago Standard “consists of 46 practices and technologies from the LEED rating system that are reasonable and appropriate for the design, construction, renovation, and operation of buildings in Chicago” (City of Chicago, 2004, p. 2). All new City buildings are required to meet the Chicago Standard and are therefore eligible for LEED certification. Buildings meeting the standard are expected to see energy savings in the range of 15% to 20%.



PUBLIC FINANCING REQUIREMENTS

The City of Chicago has stated that any project receiving public funding is required to have a portion of its roof covered by vegetation. This has been a powerful incentive to building green roofs, resulting in nearly 154 green-roof projects in Chicago, totaling more than two million square feet (Chamberlain, 2005; City of Chicago, 2005).

EXPEDITED PERMITTING REVIEW PROCESSES

Chicago has developed an expedited permit review process for private-sector developers seeking building permits, depending on the type of building and its environmental strategy. Reaction from developers has been enthusiastic. By giving permitting incentives for green buildings, the City is able to communicate early in the design process with developers who may not yet have considered green building methods (City of Chicago, 2005).

INTERACTIVE EDUCATION EFFORTS

The City of Chicago found that a lack of information about green building was an obstacle for many developers. The City is currently developing interactive maps and websites to enable both the public and professionals to identify the most recent developments in green building. The City also transformed a brownfield site into a municipal showcase for green-building technology, the Chicago Center for Green Technology (CCGT), itself a LEED platinum rated building (Chamberlain, 2004; City of Chicago, 2005).

INCENTIVES

A bill has been sent to the Illinois state legislature to allow sustainable technology as an item eligible for tax-increment financing, which lowers the cost of using green-building technologies in initial costs, rehabilitation, and repair.

INNOVATIVE ASPECTS OF CHICAGO'S APPROACH

MANDATORY REQUIREMENTS OF MUNICIPAL BUILDINGS

The requirement that all new City of Chicago buildings meet a uniform and reasonable standard, tailored to the local climate, has ensured that all municipal buildings will include sustainable design features (City of Chicago, 2005).

COMPREHENSIVE STIMULUS TO THE PRIVATE SECTOR

The combination of incentives (financing and permit review) and requirements (for minimum roof cover and public buildings) has been highly effective in stimulating developer interest. A new parallel green building code based on model building codes will enable developers to incorporate new features into their buildings not currently allowed by the old code (Olsen, 2005). Finally, by inviting architects and engineers to participate, the City of Chicago is able to ensure that the best professional opinions participate in the process.

BENEFITS OF CHICAGO'S APPROACH

STEWARDSHIP OF NATURAL RESOURCES

The City of Chicago, like the City of New York, is just beginning to evaluate the performance of its green buildings. However, initial results have been encouraging. "A study conducted in Chicago, for instance, demonstrated that a green roof absorbed nearly half the water that was captured elsewhere in a conventional roof rain barrel during a downpour... the same Chicago study, conducted in 2003,

*Chicago's Sanctuary
Place affordable-
housing development
contains six town-
houses and a 63-unit
single-room-occupancy
building (opposite,
top). Each structure
uses green materials
and energy-saving
materials throughout,
and a solar array on the
roof provides energy
for hot-water heating
(opposite, bottom).*



showed that green-roof temperatures were 19% to 31% cooler during peak daytime hours in July compared with a conventional roof.... monitoring of the City Hall green roof since 2001 shows that average temperatures on the roof are considerably lower than those of the Cook County Administration Building next door” (Chamberlain, 2005).

HEALTH AND PRODUCTIVITY

Similar to New York City, Chicago suffers from approximately 3 to 5 degrees F of urban heat island effect. Limiting this effect would reduce illnesses and mortality related to elevated temperatures (Kalkstein & Greene, 1997; Longstreth, 1999; also see discussion on pages 32 and 37, above).

ECONOMIC DEVELOPMENT

Chicago's comprehensive approach to green building is effectively overcoming the first cost barrier for most developers to install energy efficiency measures. As developers and tenants realize the cost benefits of energy efficiency, the City is stimulating the private sector toward investments that are low-risk and high-return.

EFFICIENT GOVERNMENT

Chicago's mandated construction standards follow energy-efficiency strategies that have proven cost benefits in energy savings, as described above in the New York case study. The City of Chicago's novel efforts, such as expedited permit review and requirements, cost the municipal government little other than administrative costs. The comprehensive approach followed by Chicago reflects aggressive leadership, ambitious goals, and excellent agency collaboration. For example, in order to pursue an agenda of green buildings, each agency has at least one staff member who can act as 'a champion' for green buildings (City of Chicago, 2005).

The landscaped areas (above) on Chicago's City Hall roof, created in 2001, were intended to serve as both an advertisement and proving ground for green roofs. The planting systems incorporate three different soil depths and are being monitored for plant success, heating and cooling functions, and run-off absorption.

EDUCATION

Chicago's innovations in educating developers, tenants, and citizens are enabling businesses and citizens to rapidly find information and to better apply the municipal government's findings to entities in the private sector. Thousands of building professionals and members of the general public have toured the City's Chicago Center for Green Technology or participated in the center's green technology workshops, and the City has plans for additional future educational programs (City of Chicago, 2005).

The Chicago Center for Green Technology (top and middle rows) is a LEED platinum complex that demonstrates green-building practices; in addition to hosting tours and educational seminars on green practices, CCGT also houses several firms offering green services. Other buildings built under the 'Chicago Standard' include the Bethel Commercial Center (bottom left); the Oriole Library (bottom center); and the Center for Neighborhood Technology (bottom right).

CONCLUSIONS

The City of Chicago's approach is impressive because of its thoroughness and aggressive timeframe. Mandating that Chicago agencies build to meet LEED standards has already stimulated widespread interest in green building. The City of Chicago's comprehensive approach also combines requirements and incentives to ensure that every private developer has a reason to pursue green building initiatives. Given the demonstrated benefits of Chicago's approach, outlined above, cities nationwide can look to Chicago as an example of how to mandate municipal change while also stimulating the private sector toward energy efficiency.





WASTE AND MATERIALS

A large, empty rectangular area with a thin green border, intended for notes or additional information related to the section header above.

CONTEXT

Achieving sustainability and preserving the earth's resources requires examining how materials are produced, consumed, and treated upon reaching the end of their lifecycle. Cities provide particularly valuable case studies when examining material use and disposal, because they concentrate people, goods, and services, and generate wastes disproportionate to their land area (see discussion of ecological footprint concept on page 31, above).

What is waste? Modern technologies and industries are capable of producing a dizzying array of goods and services, but these same modern technologies and industries also create additional waste materials that are never seen or used. One estimate is that for every 100 pounds of product, 3,200 pounds of waste are created elsewhere (Hawken, 1994). If waste is broadly defined as materials that cannot be used again — such as packaging that is discarded after shipping, products that eventually become obsolete, or toxic chemicals that outlive their original purpose — then most materials will eventually become waste.

The following case studies will demonstrate how two programs at the municipal scale — first, environmentally preferable purchasing (EPP), and second, waste prevention programs — can reduce or prevent the generation of waste. EPP, as increasingly practiced by federal, state, and city governments, seeks to minimize the adverse environmental impacts of purchases. Waste prevention can be defined as “practices that eliminate or reduce the amount and/or toxicity of waste that is generated in the first place, as opposed to dealing with waste once it has been generated” (NYC Department of Sanitation Bureau of Waste Prevention, Reuse and Recycling [DSNYBWP], 2004). The two programs are similar in that they simply represent a more thoughtful approach to consumption, and also have a significant potential to stimulate industries to produce more environmentally sustainable goods and services.

UNDERSTANDING WASTE AND MATERIALS IN A NATIONAL CONTEXT

Solid-waste disposal poses challenges for cities nationwide. According to the U.S. Environmental Protection Agency, the amount of solid waste produced by cities increased from 88.1 million tons in 1960 to 236.2 million tons in 2003, a 168% increase. The amount produced in pounds per person per day rose from 2.7 pounds in 1960 to 4.5 pounds in 2003, a 66% increase, or over 1% growth per year (USEPA, 2003a).

At the same time, an increasingly diverse array of chemical compounds is being produced, with unknown effects upon public health. According to the Los Angeles Times, “an estimated 80,000 chemicals are in commercial use today” (Cone, 2005b). In July 2005, the U.S. Centers for Disease Control (USCDC) published the largest-ever toxic chemical study, which found that Americans are carrying at least 148 toxic compounds at varying levels in their bodies. Although the health effects of toxic chemicals have not yet been established (U.S. Centers for Disease Control and Prevention [USCDC], 2005), this is because “even the most basic toxicity testing results cannot be found in the public record for nearly 75% of the top volume chemicals in commercial use” (Environmental Defense, 1997). Many of these chemicals enter the environment through use or subsequent release into air, water, land, or groundwater. Municipal solid waste packed into landfills is one significant source. Leachate — water runoff from landfills — can contain potentially toxic concentrations of chemicals that can then pollute groundwater sources.

On the individual scale, certain products are known to be problematic for human health and productivity. Cleaning products are among the most frequently reported products involved in poisonings reported to Poison Control Centers nationally (Litovitz et al., 1995). The use of these products is widespread: “The cleaning industry employs about 2.8 million potentially exposed janitors. In addition to these professional janitorial staff, who can be assumed to use cleaning products daily, many other building occupants perform light cleaning on a routine or occasional basis, e.g. dusting, wiping off desks and counters, etc. All building occupants are potentially exposed to the volatile components of cleaning products.” (USEPA, 2005d).

WASTE & MATERIALS: LOCAL CONTEXT

The disposal of solid waste for a large, dense city such as New York City offers particular challenges. New York generates over 15 million tons of solid waste each year; in 2000, the New York City Department of Sanitation handled over 18,000 tons of solid waste per day (NYC Independent Budget Office [NYCIBO], 2004a, 2004b). Since the closing of the Fresh Kills landfill in 2001, the City has exported its solid waste at an annual cost to the municipal budget that exceeds \$1.2 billion per year, using diesel trucks that have significant impacts on traffic congestion and air quality (ibid.).

WASTE PREVENTION: A LONG-TERM OPPORTUNITY

Thoughtful consumption is one of the most promising aspects of sustainability. The following case studies will show how the City of New York and other cities may be able to implement more sustainable waste-prevention practices, significantly reducing the toxicity and amount of waste generated, first by changing consumption immediately and then by taking proven measures to reduce the amount of paper waste generated.

CASE STUDY: SANTA MONICA'S ENVIRONMENTALLY PREFERABLE PURCHASING PROGRAM

INTRODUCTION

Santa Monica, California, is a coastal city bordered by the greater Los Angeles area to the east and the Pacific Ocean to the west. Despite its small size — a population of approximately 85,000 — Santa Monica is a success story among cities for its pursuit of sustainability at the municipal level. Since the creation of its Sustainable City Program^[13] in 1994, Santa Monica has become a role model for comprehensive vision, continuity, and effectiveness. Most importantly, Santa Monica demonstrates sustainability in ways that are reproducible in other cities, large and small, including a high number of energy-efficient buildings per capita, a high rate of recycling, and progressive energy and climate policies (SustainLane, 2005).

^[13]
For more about Santa Monica's Sustainable City Program, see <http://www.santa-monica.org/epd/scpr/>

WHAT IS SANTA MONICA'S EPP PROGRAM?

One of the most impressive achievements of the Sustainable City Program was the adoption of environmentally preferable purchasing (EPP) throughout all of the City's departments. Santa Monica was



Santa Monica's sustainability initiatives include green cleaning and equipment programs, integrated pest management, alternative fuel vehicles, and a range of energy efficiency programs. Environmentally preferable purchasing programs have been particularly successful, winning a number of awards for municipal staff.

able to transform how it bought products and services to emphasize EPP across a wide range of areas, including custodial services, fleet maintenance, and pest management. Santa Monica's subsequent experiences with EPP found that in many cases, "these environmental products and services perform as well or better than their traditional counterparts and, in some cases, also save the city money" (USEPA, 1998). Santa Monica has also demonstrated how a system-wide approach to environmental issues can transform or simply improve existing municipal services.

INNOVATIVE ASPECTS OF SANTA MONICA'S EPP PROGRAM

RESEARCH & DEVELOPMENT

From the beginning, Santa Monica engaged external organizations such as universities, local independent consultants, and non-profit organizations to establish objective and comprehensive standards for EPP. Students from UCLA compiled information on several major product groups and determined the relative order of importance of product groups to be tackled. The City also compiled information from Green Seal, the Washington Toxics Coalition, Canada's Environmental Choice Program, Germany's Blue Angel program, and local independent consultants (USEPA, 1998).

REFORMING EXISTING PROCUREMENT PROCEDURES

Santa Monica incorporated EPP within existing procedures in order to minimize the creation of additional work for procurement staff. For example, alternative cleaning products were stocked at the City of Santa Monica's central warehouse, so procurement staff in individual departments were able to purchase EPP products as they would any other. The establishment of a central Environmental Purchasing Department, in addition to research by the individual municipal agencies, allowed the

coordination and dissemination of EPP information among procurement staff in different agencies, by serving as a central point to distribute specifications for alternative products upon request (Kubani, 2005).

SEQUENTIAL PROGRESS

By focusing on one product group at a time — progressing through, in order, cleaning products, integrated pest management, and fleet maintenance — Santa Monica was able to develop and tailor their different environmental purchasing goals for each product group (USEPA, 1998).

FOLLOWING A SYSTEM-WIDE APPROACH

Initial pilot programs allowed Santa Monica to test products for efficiency and to include end-users in the selection process. For example, testing of cleaning products by end-users, such as custodial staff, allowed purchasing staff to receive feedback on alternative cleaning products, and also overcame initial skepticism about substitute EP products (*ibid.*).

BENEFITS OF SANTA MONICA'S EPP PROGRAM

HEALTH AND PRODUCTIVITY

Eliminating the use of toxic and potentially carcinogenic compounds has obvious health benefits, particularly for end-users such as custodial staff who have the most daily exposure to chemicals in cleaning products and materials. Citywide, Santa Monica replaced its traditional cleaning products with less toxic or nontoxic alternatives in 15 of 17 cleaning product categories. Hazardous materials use declined by 3,200 pounds per year (USEPA, 1998).

EFFICIENT GOVERNMENT

Replacement of traditional cleaning products with less toxic or nontoxic alternatives in 15 of 17 categories also reduced spending on custodial products by approximately 5%, largely due to reduced amounts of packaging and storage, because the non-toxic products are stored easily in concentrated form and dispensed as necessary. Santa Monica's switch to integrated pest management, *i.e.*, reducing pests through a variety of non-chemical means, at all municipal facilities reduced costs by up to 30% over traditional methods of chemical pesticide application (*ibid.*).

CONCLUSIONS

Santa Monica is an excellent example of sustainable municipal practice because of the overall speed and effectiveness with which environmentally preferable purchasing was adopted. Though Santa Monica is a relatively small city, by fiscal year 1996 — just five years after the inception of its sustainable practices — Santa Monica purchased approximately \$32.5 million worth of environmentally-preferable products and services (*ibid.*). By studying Santa Monica's practices, other cities may find similar opportunities to increase the size and scale of their EP purchasing programs.

CASE STUDY: CITIGROUP'S PAPER-REDUCTION EFFORTS IN NEW YORK CITY

INTRODUCTION

The City of New York has a number of programs to reduce waste and protect the environment, including the foundations of an environmentally preferable purchasing program. Local Law 19, the City of New York Environmental Procurement Policy passed in 1989, requires City agencies and departments to purchase products from recycled materials “whenever practicable.” A subsequent mayoral directive in 1993 outlined implementation plans for the acquisition and use of environmentally preferable products, including cost-effective procurement incentives that favor the purchase of these products. Another mayoral directive, in 1996, aimed to reduce costs by conserving supplies and by reducing the solid waste generated by the City’s activities. As a result of these policies, in fiscal year 2004, the City purchased over \$100 million in EPP products, ranging from recycled paper to hybrid vehicles (NYC Department of Citywide Administrative Services [NYCDCAS], 2005).^[14]

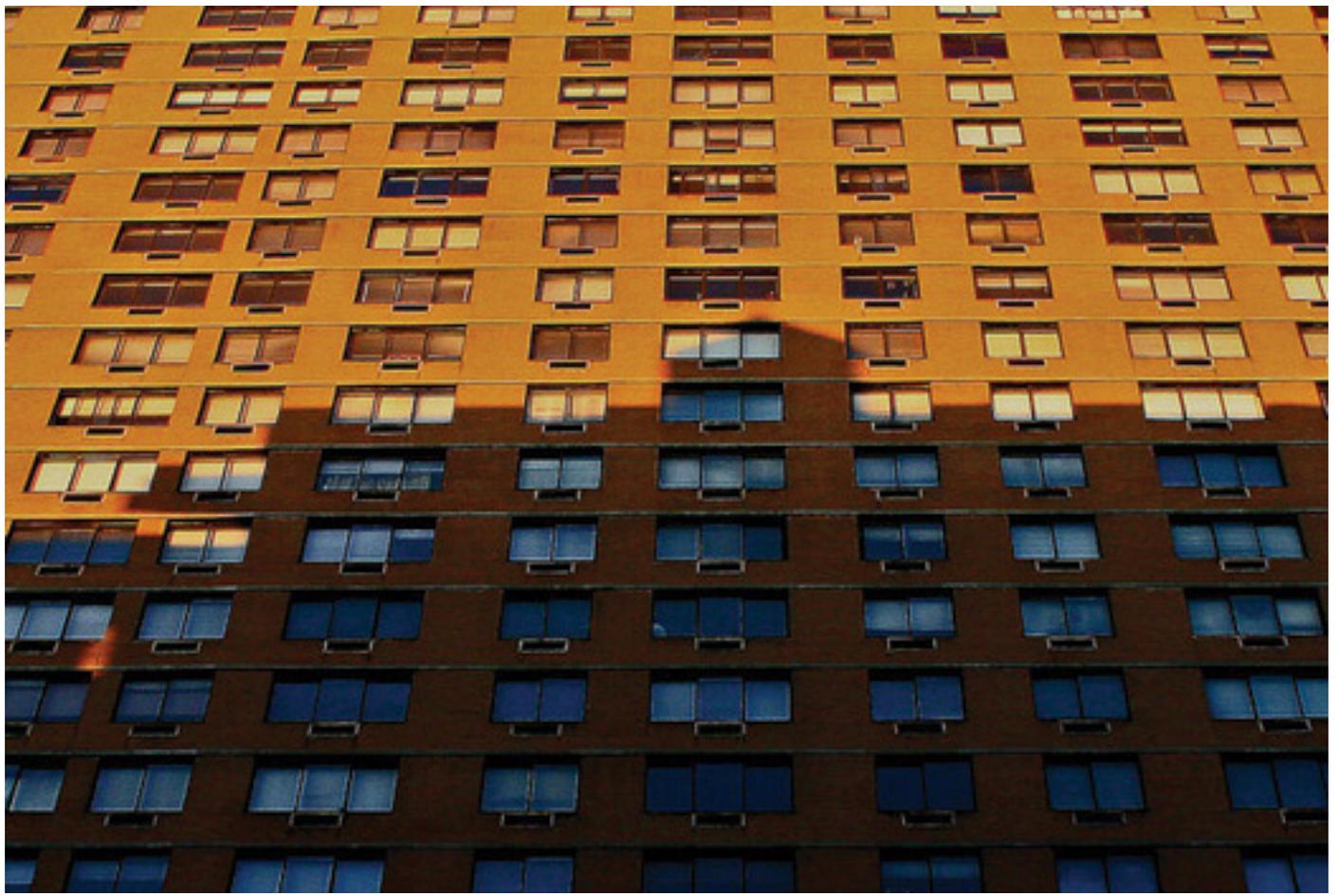
Paper usage is one of the most significant opportunities for municipal conservation because of the City’s high number of clerical employees and workers. Technological change is already changing the City’s use of office paper. The City’s purchases of copy and bond papers dropped from \$11 million dollars in fiscal year 2003 to just over \$10 million in fiscal year 2004. Purchases of printing paper dropped considerably more, from \$3.7 million in fiscal year 2003 to \$2.9 million dollars in fiscal year 2004, due to “the increased use of electronic media for storage of information, increased use of e-mails for transfer and distribution, and print-on-demand practices” (ibid., p. 14).

Paper waste reduction efforts have also been successful in New York City’s private sector. The following case study examines efforts by Environmental Defense, a leading national advocacy firm, to reduce paper use at Citigroup, a major financial services firm. Citigroup, with approximately 300,000 employees, is one of the few corporations with a work force similar in size to that of the City of New York.

WHAT IS CITIGROUP'S PAPER-REDUCTION PROGRAM?

Citigroup has engaged in a comprehensive program of paper-use reduction, including changing employee use of paper, starting an annual evaluation of paper suppliers, and incorporating environmental priorities into its purchasing of paper and systems. This has resulted in significant financial and operational savings, as well as environmental benefits that are explored further below.

^[14] These purchases will soon be augmented: In 2005, New York City enacted a series of five environmental procurement laws (Local Laws 118-212 and 123) that will result in the purchase of fewer toxic custodial products and other products with hazardous substances, in the procurement of products with increased recycled content and energy efficiency, and in the creation of a position of citywide environmental purchasing director.



INNOVATIVE ASPECTS OF CITIGROUP'S PAPER-REDUCTION PROGRAM

CHANGING PAPER-USE BEHAVIOR

Citigroup has reduced the number of its printed publications and created double-sided customer statements and forms. Educational signs have been placed at printing and copying locations. Default settings for double-sided printing and copying are currently being tested on computers and printers to determine if they will both reduce paper use and meet the needs of employees (Environmental Defense, 2004a).

PAPER SUPPLIER EVALUATION PROCESS

Citigroup and Environmental Defense established an annual review process for paper suppliers. The firm now requests information about paper suppliers' environmental management, forestry practices, manufacturing techniques, pollution prevention, and compliance with environmental regulations. Meetings with vendors help Citigroup explain its particular goals in terms of environmental purchasing and performance (ibid.).

PURCHASING RECYCLED PAPER

Though the relative price of recycled and virgin paper fluctuates, Citigroup negotiated with multiple suppliers to purchase 30% recycled content paper^[15] — at the same cost as virgin paper — that meets high performance standards (ibid.).

^[15] The City of New York also requires that paper purchased by the City have 30% recycled content.

BENEFITS OF CITIGROUP'S PAPER-REDUCTION PROGRAM

EFFICIENT GOVERNMENT

There are substantial business advantages to be reaped from waste reduction and prevention. Citigroup and Environmental Defense calculated that if "every Citigroup employee uses double-sided copying to conserve just one sheet each week, the firm can save an estimated \$700,000 each year" (ibid., p. 2). Although, at that rate, Citigroup's 300,000 employees would conserve only around 1.5 million sheets per year — a very small percentage of overall paper use — savings accrue from more than just reduced paper purchasing: When Citigroup and Environmental Defense examined hidden costs of paper use, adding in the costs of "paper storage, printing, copying and recycling, disposal and postage... these quickly add up to as much as 31 times the purchasing cost, or an estimated \$62 per ream," assuming an initial per-ream cost of \$2 (ibid., p. 1).

By using recycled copy paper instead of virgin paper, Citigroup has significantly reduced its annual environmental impact. The firm and its suppliers have eliminated over 4.2 million pounds of greenhouse gas emissions, equal to the amount released annually by 375 cars, and saved over 33 billion BTUs of energy, the amount of residential energy used annually by 300 households.

STEWARDSHIP OF NATURAL RESOURCES

According to Environmental Defense, the total environmental costs of copy paper are quite high. "Over 4.6 million tons of copy paper were shipped in the U.S. in 2000. Producing, using, and disposing of this much copy paper consumes enough wood to build over one million average U.S. homes, a day's worth of water flowing through Niagara Falls, and more energy than that used by all the households in Los Angeles City each year, while generating over 5.2 million tons of solid waste, and greenhouse gas emissions equivalent to the tailpipe emissions of over two million cars" (ibid.).

Citigroup bought nearly 6,500 tons of paper in 2004. By using recycled-content paper, rather than virgin paper, Citigroup estimates that they and their suppliers saved over 33 billion BTUs of energy, avoided 4.2 million pounds of harmful emissions, prevented nearly 20 million gallons of wastewater and over 2 million pounds of solid waste, and preserved over 6,700 tons of wood (Citigroup, n.d.).

ECONOMIC DEVELOPMENT

Studies have shown that there is currently an excess of recycled paper capacity in the United States (Gleason et al., 2002). If, however, the use of recycled paper continues to grow — or is stimulated by changes in purchasing behaviors — then it is reasonable to expect that there are opportunities to

UPPING THE ANTE: IMPACTS OF RAISING THE CITY OF NEW YORK'S RECYCLED-CONTENT REQUIREMENT TO 50%

The City of New York currently buys 5,000 tons per year of **30%** recycled-content paper, already resulting in reduced environmental impacts each year compared to using virgin paper:

- Energy: 25.2 billion BTUs saved (15% improvement)
- Atmospheric Emissions: 3.2 million pounds carbon dioxide equivalents (12% better), plus reductions in nitrogen oxides, particulates, sulfur oxides, hazardous air pollutants, volatile organic compounds, total reduced sulfurs.
- Solid wastes: 1.6 million pounds (17% better).
- Waterborne wastes: 300 pounds of biochemical oxygen demand, 96,300 pounds of chemical oxygen demand (27% better), 4800 pounds of suspended solids (10% better)
- Effluent flow of 15.3 million gallons (18% better)
- Wood use of 10.4 million pounds (43% better).

If the City is able to raise the recycled content of its paper to **50%**, as is commonly available, then compared to the current 30% recycled content requirement, the improved impact to the environment would be:

- Energy: 16.8 billion BTUs saved (10% better)
- Atmospheric Emissions: 2.1 million pounds carbon dioxide equivalents (8% better), plus reductions in nitrogen oxides, particulates, sulfur oxides, hazardous air pollutants, volatile organic compounds, total reduced sulfurs.
- Solid wastes: 1.1 million pounds (11% better)
- Waterborne wastes: 31,500 pounds of biochemical oxygen demand, 64,200 pounds of chemical oxygen demand (18% better), 3200 pounds of suspended solids (7% better).
- Effluent flow of 10.2 million gallons (12% better).
- Wood use of 6.9 million pounds (29% better). (United States Office of the Federal Environmental Executive, n.d.)

create additional jobs and economic growth within the city. The existing Visy paper plant in Staten Island and the recent 20-year commitment by Hugo Neu demonstrate the viability of recycling industries in New York, providing light industrial and manufacturing jobs.

CONCLUSIONS

Citigroup provides an excellent case study in paper-waste reduction for New York City and other sizeable municipal governments: Like Citigroup, New York City employs a high proportion of office and clerical staff, and both are large institutions that have the purchasing power to negotiate with multiple paper suppliers.

As Citigroup's program shows, small changes in specifications can have significant cost and environmental outcomes. Altering New York City's specifications for computers, printers, and copying machines to allow double-sided printing could lead to significant cost savings through the efficiency benefits associated with reduced paper processing and disposal, more so than even any direct savings from reduced purchasing. Altering requirements for recycled-paper content could also have important positive environmental benefits (see sidebar, above). As with so many of the practices outlined in this document, small steps towards greater sustainability can help tip the balance toward a greener future, both in this generation and in generations to come.

Achieving environmental sustainability is not a simple process. Preserving our natural resources, locally and globally, will require concerted efforts by governments, businesses, and individuals, all willing to trade decades of practice for new systems and behaviors. The case studies presented in this document can serve as examples of how some of the nation's most environmentally progressive cities are reassessing their own practices and embracing this challenge.

Environmental benefits from Citigroup's paper reduction program include the prevention of over 2.1 million pounds of solid waste, the amount produced annually by over 500 households, and the conservation of over 6,700 tons of wood, equivalent to more than 46,700 trees.



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Part 2: Water and Land Protection

Context and Background

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Context and Background

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