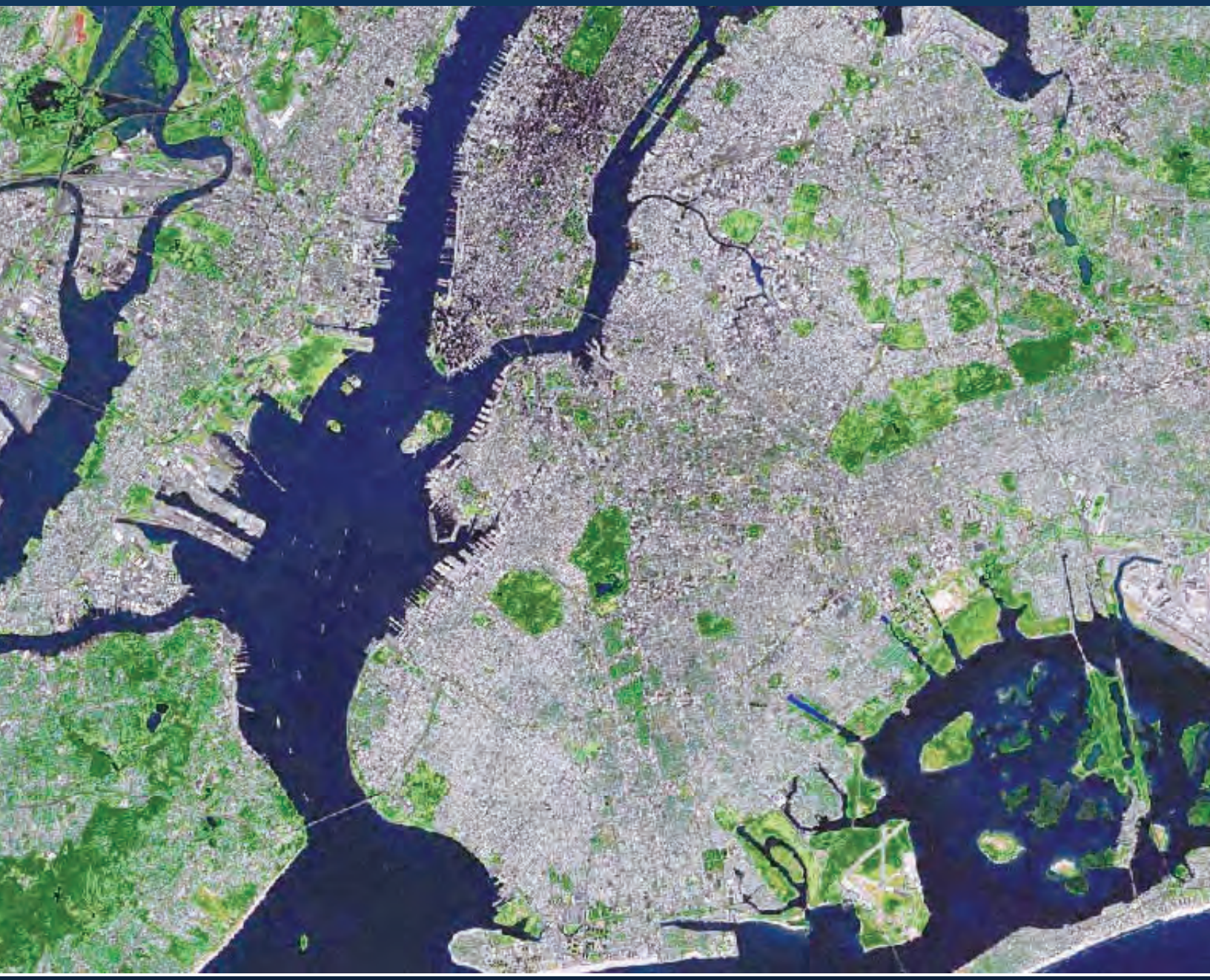
Reducing Greenhouse Gas Emissions in New York City

A Community Challenge

Prepared for the New York City Mayor's Office of Long Term Planning and Sustainability



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Preface

The MPA in Environmental Science and Policy program at Columbia University's School of International and Public Affairs' year-long workshop program culminates in the spring semester project requiring students to work with a government or nongovernmental agency client on a policy or management problem it faces. The Workshop in Applied Earth Systems Policy Analysis is a practical, real-world application of the skills acquired from the summer and fall workshop semesters, describing an environmental problem and then creating an operational and implementation plan to address the issue.

The following report is comprised of a community greenhouse gas emissions study completed as part of the Workshop in Applied Earth Systems Policy Analysis. The project, completed on behalf of NYC Mayor's Office of Long-Term Planning and Sustainability, involved designing a neighborhood challenge that engages individuals to reduce their individual greenhouse gas emissions.

Acknowledgements

We would like to thank our faculty advisor, Steve Cohen, for his support and guidance. We would also like to thank Adam Freed and Jon Dickinson at NYC Mayor's Office of Long-Term Planning and Sustainability, Cameron Bard of multifamily programs at NYSERDA, Luke Falk, Laura Hales of Low Carbon Zone London, Mary Hahnfeld of Recycle bank, Nick Taylor of Gainesville Green, Dave Westman, a climate change project specialist at Con Edison, and John Williams NYC director of energy analysis at NYSERDA, and Michael Freedman-Schnapp, policy director for City councilman Brad Lander, and all other individuals who took the time to speak with us.

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Acronyms

CESP	Community Energy Saver Programme (London)
CO_2	Carbon dioxide
CO_{2e}	Carbon dioxide equivalents
ConEd	Consolidated Edison
DECC	Department for Energy and Climate Change (London)
DEP	Department of Environmental Protection (New York City)
EERE	Energy Efficiency & Renewable Energy Division (U.S. Department of Energy)
EPA	U.S. Environmental Protection Agency
GHG	Greenhouse gas
GLA	Greater London Authority
ICLEI	International Council for Local Environmental Initiatives
LCZ	Low carbon zone
LEGGI	London's Energy and Greenhouse Gas Inventory
MLSOAs	Middle Layer Super Output Areas
MPAN	Meter Point Administration Number
NYC	New York City
NYMTC	New York Metropolitan Transportation Council
NYSERDA	New York State Energy Research and Development Authority
OLTPS	Office of Long Term Planning and Sustainability (New York City Mayor's Office)
kWh	Kilowatt hour
VMT	Vehicle miles travel

EXECUTIVE SUMMARY

New York City's PlaNYC sustainability initiative calls for a 30 percent reduction of greenhouse gas (GHG) emissions from 2005 levels by the year 2030. City government has already made great strides toward achieving this goal, but have yet to extend their efforts to NYC residential communities and small businesses. This report provides options and recommendations for the design and implementation of a GHG reduction challenge that would involve those two important segments of the city's population in emission-cutting efforts. Our research and findings are organized into three main elements of a robust and comprehensive community GHG reduction challenge: community boundaries, measurement of emissions, and community engagement. Our benchmarking study found that no single city has a comprehensive program incorporating all three of these elements, but that many cities' initiatives employ one or two to differing degrees.

Our research into how to best define communities for the purpose of the challenge was guided by two considerations: data availability and community identity. We determined that the challenge should be organized by borough, harnessing New Yorkers' strong identification with and pride in their home borough to help drive participation in the challenge. We also determined that the foundational data for the competition, those showing energy consumption, should be collected and organized according to zip code, as that was the most localized level of data available. We also found that Community Board districts could play a role in the challenge's organization, serving as neighborhood boundaries for community engagement efforts.

In approaching the question of how to measure emissions and emissions reduction, we first considered which sources made the greatest contribution to city-wide emissions and which sources offered the greatest potential for reduction. We then considered which sources could be most affected by individual behavioral changes made by participants in the challenge and how accurately emissions from each source could be measured. These considerations led us to focus on energy consumption in New York City buildings, which account for 75 percent of the city's GHG emissions. Our recommendations call for measuring the consumption of energy (in the form of electricity, natural gas, and heating oil) in city buildings and converting those measurements into emissions units of carbon dioxide equivalents. The results of this data collection and conversion, stored and displayed on a challenge website, would provide the quantitative base of the program that would ultimately determine who is most successful in the challenge. The zip codes and borough achieving the greatest per capita percentage of emission reduction would be the challenge "winners," though other boroughs and zip codes could also "win" the challenge by meeting predetermined emissions reduction targets.

With community boundaries and measurement parameters in place, we then investigated how to best engage NYC communities and drive participation in the program. Our research

led us to identify four key elements of community engagement: education of participants on why emissions reduction is beneficial and how to do it; partnerships with local businesses and community organizations to reach residents in all city communities; incentives to motivate participation in the program and promote friendly competition; and tools for participants to track their progress and compare it to that of their friends and neighbors. We recommend that all four elements be combined in outreach efforts, which would begin with an aggressive promotional campaign at the city level. The challenge website would also perform a crucial role in community engagement by presenting participants with easy-to-use tools to track their progress, share their success stories, and see how their zip codes and boroughs are stacking up against others. The website would serve as the platform for a points-based incentive system that rewards participants' behavioral changes and emissions reductions with points redeemable for prizes.

Following those findings, we designed detailed and comprehensive recommendations for how to design and implement the community GHG reduction challenge. Under our recommendations, the Mayor's Office would serve as the top organizational body, promoting the challenge citywide, soliciting funding, and collecting and organizing data at the zip code and borough levels. Borough Boards would oversee implementation and promotion at the borough level, while designated community engagement coordinators would handle outreach at the Community Board district level in cooperation with Community Boards. The challenge website would serve as the focal point for challenge participants—a place where they could find out how to reduce emissions, report their emissions reduction activities, and track reductions progress by their own household as well as by other households, zip codes and boroughs through interactive features such as calculators and graphs. Borough and zip code winners of the challenge would receive prizes such as street fairs or free concerts in their communities.

A recurring obstacle to the implementation of a community GHG reduction challenge was that of data availability: statistics on energy consumption and other emissions-related activities are simply not available at the neighborhood, block, building or household levels in New York City. Looking toward the long-term success of the challenge, we recommend the Mayor's Office or other city agencies pursue making such high-resolution data available, though the implementation of an effective challenge is still highly feasible in the absence of such data.

The information contained in this report offers a clear blueprint for the creation and implementation of a community GHG reduction challenge in New York City. We believe the options for establishing boundaries, measuring emissions, and engaging city communities that we have presented all hold great potential for success, and look forward to seeing the challenge in effect in NYC in the near future.

BACKGROUND INFORMATION

BACKGROUND INFORMATION

Introduction

Over the last several decades, global climate change has been scientifically proven to be a direct result of human activities. By increasing the concentration of carbon dioxide and other greenhouse gases (GHG) in Earth's atmosphere, our modern society is gradually warming the planet and altering its climate. Most recently, a March 2012 study found that climatic changes resulting from a warming planet have already increased the frequency of extreme weather events, "most notably heat waves and precipitation extremes" (CBC News, 2012). Such effects of human-induced climate change present potential threats to the infrastructure, economy, and health of New York City (NYC).

In consideration of these threats to NYC and the rest of the world, NYC's government has already taken steps to reduce direct and indirect emissions from city sources. Because "[u]rban areas are estimated to be the source of approximately 80% of global greenhouse gas (GHG) emissions," PlaNYC set a specific target of reducing the City's GHG emissions by 30 percent from 2005 levels by 2030 (The City of New York, April 2011). The Mayor's Office of Long-Term Planning and Sustainability (OLTPS), which is charged with implementing PlaNYC initiatives, has already made substantial progress in GHG reduction by working with universities, businesses, and City agencies to increase energy efficiency and shrink the City's carbon footprint (Columbia SIPA, 2012). The Mayor's Office wants to extend GHG reduction efforts to the neighborhood level by educating communities on how to reduce emissions and begin measuring neighborhood-level emissions and tracking reductions.

This report offers research and recommendations on how the Mayor's Office could extend GHG reduction programs to the City's communities. The report addresses three issues in an effort to provide the foundation of a future community-level GHG reduction initiative. First, we analyze potential boundaries to define city "communities" that can be used to organize reduction campaigns. Second, we propose metrics that can be used to measure emissions and gauge the success of reduction efforts. Third, we discuss possible outreach strategies to inform New Yorkers seeking to participate in efforts to reduce greenhouse gases.

Methodology

We approached the research for this report by identifying and distinct program components and strategies in the areas of Measurements and Metrics, Neighborhood Boundaries, and Community Engagement. To ensure we had complete knowledge of all current initiatives to inform our recommendations for a NYC program we divided the research into two phases: a benchmarking study of existing programs in global cities and an examination of NYC programs and contexts. The methods of research throughout each of these phases included literature review, Web search, and expert interviews. After both re-

search phases were complete, we combined our findings with informed analysis to make specific recommendations for the design and implementation of the community greenhouse gas reduction challenge.

Phase I: Benchmarking Study of Existing Programs in Global Cities

Initial research began with a survey of existing neighborhood level GHG inventory and reductions programs in target cities. Cities prioritized for this first round of research were those with developed and deployed sustainability initiatives – cities that are members of the C40 Cities Climate Leadership Group. We extended this scope to include various cities with political leaders in the Urban Sustainability Directors Network and other cities our expert interviewees suggested were relevant.

Phase II: NYC Programs and Context

Research in the second phase focused exclusively on existing programs and institutional infrastructures already in place in NYC. We evaluated boundaries in terms of ease of data collection as well as political presence for the potential to manage recommended program options. In order to identify potential networks of community engagement, we analyzed existing strategies and organizational channels employed by urban initiatives, including those outside the realm of emissions reduction and sustainability.

Phase III: Program Options and Recommendations

The final phase of this project entailed formulating distinct options for various aspects of a community level GHG reduction challenge. Drawing from the synthesized research conducted in the first two phases, we presented favored options while also including feasible alternatives of varying intensity, scope, resource requirements, and time frame.

BOUNDARIES


Manhattan
Jersey City
Hudson River
East River
Greenpoint
Queens
Williamsburg
DUMBO
Navy Yard
Brooklyn Heights
Downtown Brooklyn
Clinton Hill
Bushwick
Cobble Hill
Boerum Hill
Fort Greene
Bedford-Stuyvesant
Cypress Hills
Carroll Gardens
Red Hook
Gowanus
Park Slope
Prospect Heights
Upper New York Bay
Crown Heights
Brownsville
East New York
Prospect Park
Lefferts Gardens
Windsor Terrace
Green-Wood Cemetery
Sunset Park
Prospect Park South
East Flatbrush
Kensington & Parkville
Flatbush
Canarsie
Borough Park
Bay Ridge & Fort Hamilton
Flatlands
Dyker Heights
Midwood
Bergen Beach
Bensonhurst
Marine Park
Mill Basin
Jamaica Bay (GNRA)
Bath Beach
Brooklyn Marine Park
Lower New York Bay
Gravesend
Sheepshead Bay
Gerritsen Beach
Brighton Beach
Manhattan Beach
Sea Gate
Coney Island
2 Kilometers
2 Miles


BRONX
MANHATTAN
QUEENS
BROOKLYN
STATEN ISLAND

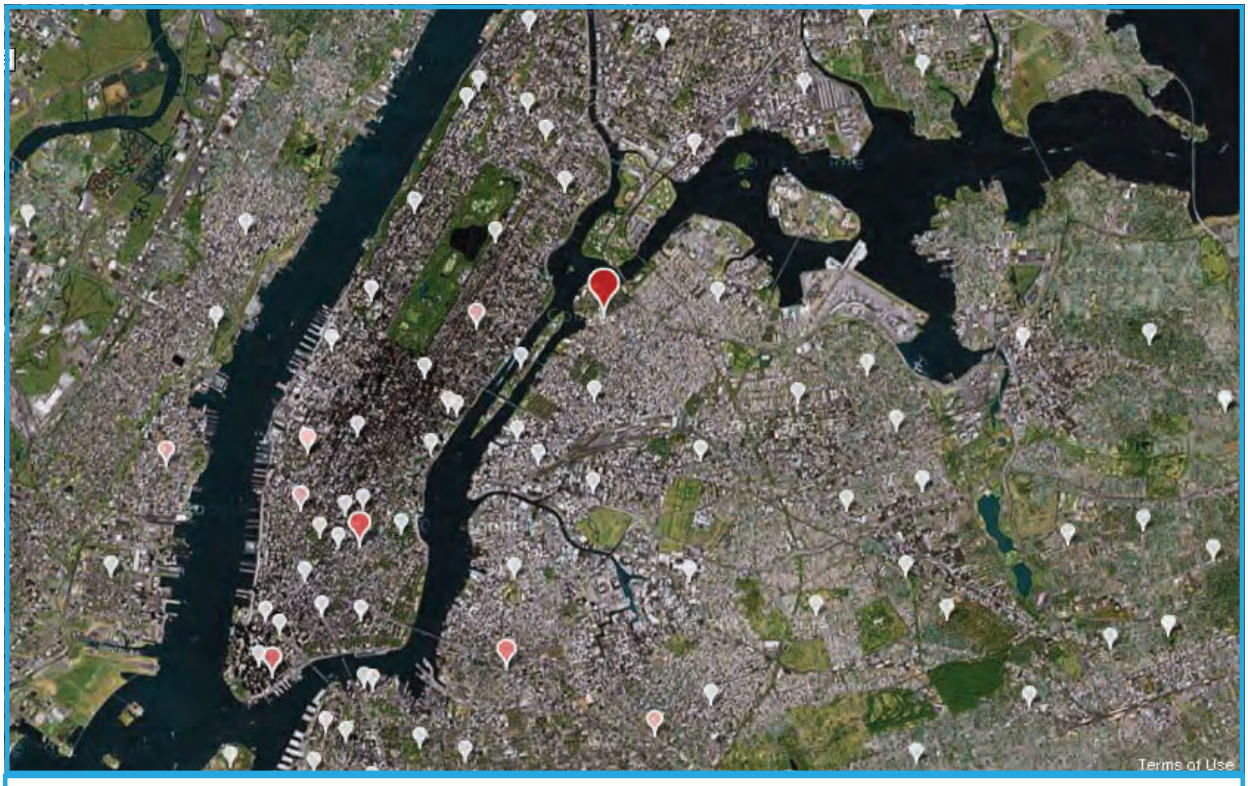

10013

BOUNDARIES

Types of Boundaries

The task of lowering community-level GHG emissions in New York City begins with the question, "What constitutes a community in New York City?" We began our inquiry by benchmarking other cities around the world. While different definitions of community" have been applied to emissions reduction programs with varying levels of success, most programs have not been in place long enough to produce significant data that might support a clear conclusion. As a result, examples below are presented along with their advantages and limitations.

The 2009 survey "Measuring Urban Greenhouse Gas Emissions: The Challenge of Comparability" found that the measurement of emissions is linked to the question of community boundaries within measuring cities. The same study placed such boundaries into two categories: territorial or settlement boundaries and administrative boundaries (Bader & Bleischwitz, 2009). Territorial or settlement boundaries define urban neighborhoods in the colloquial sense, as New Yorkers might refer to parts of Northern Manhattan as "Harlem" or Southern Manhattan as "the Financial District." While these boundaries offer the advantage of familiarity and residents often self-identify as members of particular neighborhoods, their exact placement can be subject to wide



Every New Yorker asked could have a different definition of what neighborhood they live in.

spread disagreement. For example, one New Yorker living in Northwestern Manhattan might consider herself a resident of Harlem, while her next-door-neighbor might consider himself a resident of Morningside Heights. In contrast, administrative boundaries are more concrete; they are defined by municipal agencies or other government bodies, and often serve a specific purpose. Examples of such boundaries include Community Boards, school districts, and police precincts.

Administrative boundaries offer the distinct advantage of preexisting and, in many cases, long-standing organization with a staff and specific authority. In its Greenhouse Gas Emissions Analysis Protocol, the International Council for Local Environmental Initiatives (ICLEI), better known as Local Governments for Sustainability, calls for community-level emissions to be divided into areas within existing administrative boundaries over which a local government body has jurisdictional control (ICLEI, 2008). While applying administrative boundaries to the community GHG reduction challenge offers the advantages of clear, well-established placement and existing governing authorities, they lack the support of widespread knowledge and allegiance—for example, a city resident may have no pride in the (or even know which) police precinct they belong to. Beyond organization and community pride, the survey also indicated that data availability should be a leading consideration when determining community boundaries for a GHG reduction program (Bader & Bleischwitz, 2009).

ICLEI calls for the use of existing administrative units when creating community level environmental initiatives.

Boundaries in Urban Community GHG Programs

Local Governments for Sustainability applied its boundary recommendations through its Carbon Dioxide Emissions Project in fourteen cities, one of which was Miami, Florida. Miami used existing municipal jurisdictions as "communities," assigning an elected official, an administrative official, and a scientific expert to oversee emissions reductions activities (MiamiDade.gov, 2006).

Paris, France utilized preexisting city communities called "arrondissements municipaux" (or just "arrondissements") for its GHG reductions program. The city collected data from each of the arrondissements, which are similar to NYC boroughs in size and cultural identity, at the outset of the program and used it to pinpoint inefficient heating as the leading cause of inefficient energy use (Le Figaro, 2008). The Parisian government then mandated insulation and window upgrades as

Two of London's Low-Carbon Zones

London's community greenhouse gas reduction initiative RE:CONNECT involved the formation of new community units called low-carbon zones. Below are descriptions of two low-carbon zones, including how they were formed, their geographical and social makeup, and how they have functioned within RE:CONNECT so far.

Muswell Hill (Borough of Haringey)

Muswell Hill low-carbon zone encompasses a cross section of the local neighborhood, including businesses, privately- and council-owned housing, community buildings, schools, faith groups, and a library. The area was chosen as a Low Carbon Zone because of strong local support for the initiative. The approach to the program in Muswell Hill reflects the council's commitment to climate change mitigation and the active participation of an engaged local community, led by the Muswell Hill Sustainability Group. The group is active in the management of the zone and has selected 15 volunteers to act as community champions of the program. Haringey also made a successful bid to receive over £300,000 from DECC's Low Carbon Communities Fund, to put toward photovoltaic solar arrays installed on three schools and a zero-carbon teaching cabin, the Living Ark.

Ham and Petersham (Borough of Richmond)

The villages of Ham and Petersham are positioned together next to Richmond Park near the Thames River. The two villages are home to socioeconomic diversity, with affluent areas next to those of relative poverty. The zone's focus is on delivering measures to a core area of 500 homes plus schools and community buildings within a wider community of over 3,000 homes. Residents of the zone are offered Green Homes Assessments to identify infrastructure-based opportunities for emissions reduction. Interest levels in the offer are high and initiatives to encourage simple energy-saving measures and other advice have been well received. In addition to Carbon Reduction Emissions Target (CERT) funding, the British Gas utility is providing solar panels valued at £100,000 for free to the schools and community buildings via its 'Green Streets' project. The council is matching funding in the amount of £165,000 toward the more expensive home improvement measures.

RE:CONNECT
LOW CARBON ZONES

well as increased use of biomass heating fuel to address the problem and pursue lower community GHG emissions (Bio Publications, 2011).

In contrast, the City of London in the United Kingdom created entirely new community boundaries for its community-level GHG reduction program, dubbed RE:CONNECT. The program, operated by the office of the Mayor of London, is part of the city's "Delivering London's Energy Future Climate Change Mitigation and Energy Strategy." RE:CONNECT operates across ten geographical "low-carbon zones" (LCZs), each of which is located in a different administrative borough and includes "local residents, communities, and businesses." Each of the ten zones contains a mix of residential, public, and commercial property and each was chosen because of its distinctive "make-up, community, and location" (London.gov.uk, 2011). Although the zones do not cover all of the areas within London's city limits, they were designed to "act as exemplar models for a whole-community approach to reducing CO_2 emissions that can be rolled out within and beyond London" (Davis, Daw, Doust, Hudson, & Wyke, 2011). Laura Hales, the Project Manager for one Low Carbon Zone explained that borough governments chose the Low Carbon Zone boundaries and each government had different reasons for choosing the boundaries that it did, but that choices often "depended on the potential for energy savings and what work was already planned for the area." In the case of her own Zone, Ms. Hales stated that its boundaries coincided with one of the London government's Community Energy Saving Programme (CESP) areas and that:

> *Under CESP, utility companies are obliged to contribute funding for energy saving measures in low income areas. By situating the LCZ in a CESP zone, we hoped to be able to combine utility company funding with council and Greater London Authority funding to bring additional energy saving measures to residents* (Hales, 2012, phone interview).

Ms. Hales also explained that the Low Carbon Zone boundaries coincided with those that defined areas of the city for an infrastructure upgrade program:

> *A council regeneration scheme was planned for the area which involved improving the external appearance of housing and street scene in the area. In becoming a low carbon zone, this gave us the opportunity to add additional energy efficiency and renewable measures to the scheme (Hales, 2012).*

London's low-carbon zone model shows the advantages of drawing up entirely new community boundaries for the purpose of a GHG reduction program. Choosing to create new boundaries affords program organizers the freedom to consider building types and land use as they do so, allowing for more homogeneous building stock within each zone, as was the goal in London.

Existing New York City Community Boundaries

Following our investigation of other cities' community GHG reduction boundaries, we turned to NYC and examined community boundaries that are used for government administration, data collection, and providing services. Our findings informed our evaluation of community boundary options in NYC in terms of accuracy and feasibility. We analyzed boroughs, community districts, city council districts, zip codes, school districts, and police precincts.

NYC Community Districts

The smallest units of NYC government we examined were the city's 59 community districts, which are administered by Community Boards (NYC DCP, 2012). Community Boards are charged with providing input on land use and zoning issues in their districts, assessing the needs of their neighborhoods, and addressing community concerns (The City of New York, 2012). Community districts also serve as boundaries for the collection and organization of data such as population, income support, land area, and land use. Established channels for data collection and dissemination make community districts an attractive option for community boundaries in the GHG reduction program. Community Boards' direct interaction with and advocacy for members of local communities match up well the needs and goal of the community GHG reduction challenge, and utilization of community districts would follow Local Governments for Sustainability's recommendation to use existing geopolitical boundaries for such programs. However, the effectiveness of community district boundaries would be limited by lack of relevant data at the community district level and residents' general unfamiliarity with their community district and board. We also examined the most numerous community units—police precincts, of which there are 76—along with the city's 31 school districts, but found that the functions and boundaries of these units to be incompatible with the needs of the community GHG reduction challenge.

The boundaries of NYC's 51 City Council districts are generally similar to those of Community Boards, though not identical. In addition to its function as a legislative body, the City Council also approves the city budget, oversees the activities of city agencies, and works with Community Boards in local issues (NYC.gov, 2012). Like community districts, council districts offer the advantage of strong administrative structure with the added benefit of an elected representative of the district that could serve as a contact person with

community GHG reduction challenge administrators and promote the program to his or her constituents. An energy consumption reduction program operated by the New York State Energy Research and Development Authority (NYSERDA) in 2010, "Reduce the Use in District 39," adopted the boundaries of City Council District 39 in Brooklyn. (See the Design Option: Examining the NYSERDA Neighborhood Challenge Model in the Recommendations chapter for more information on the NYSERDA program.)

Councilmember Brad Lander is reducing his electricity usage by using power strips that turn off when electronics are charged.

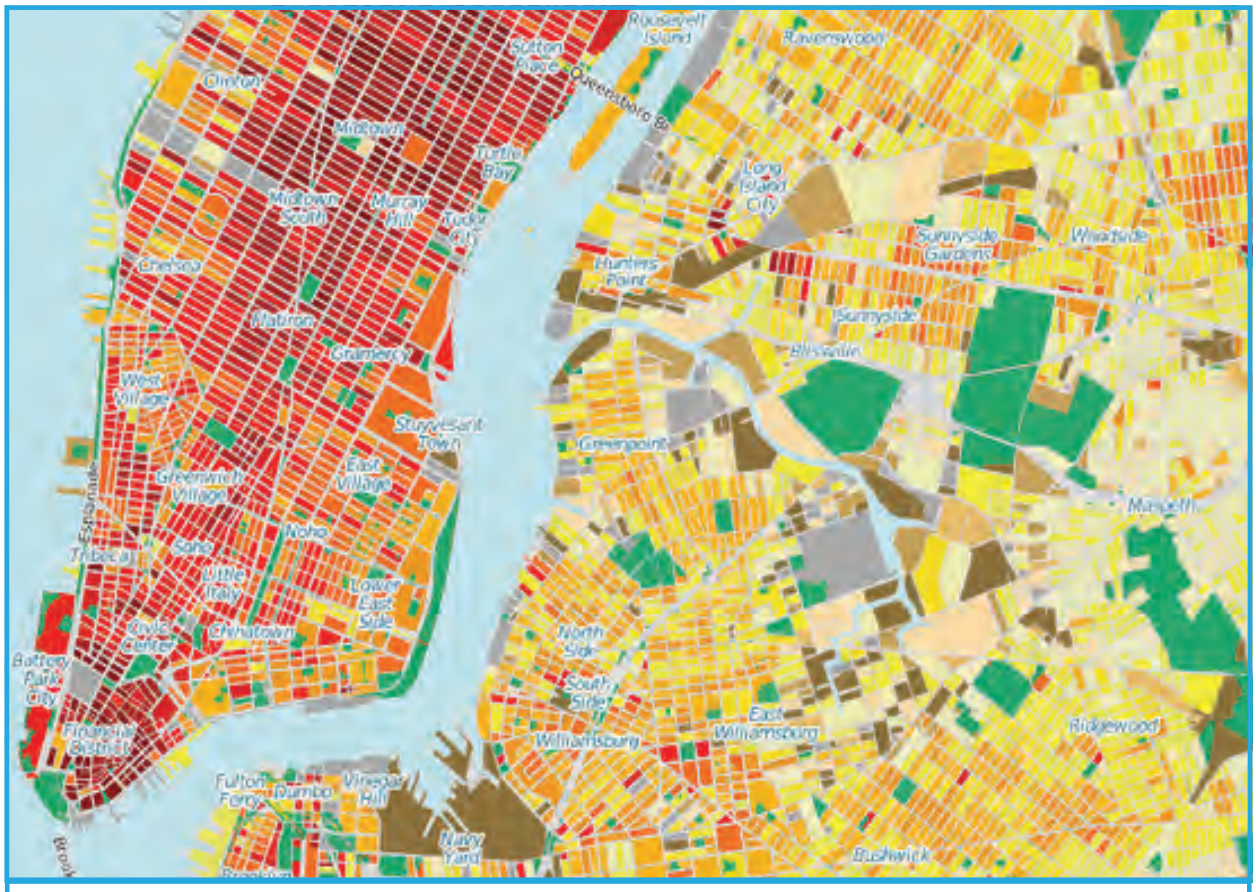
The program was successful in its achievement of an average six percent energy use reduction in participating households (NYSERDA, 2011), though the cost of the program would make a similar program aimed at GHG reduction difficult to roll out citywide. Data collection methods used in the program, which involved gaining permission from participants to access their energy use information and manual entry into program databases, would also be challenging to use at the city level. In general, City Council districts vary widely in geographical size, population, and zoning, making direct comparison of GHG emissions data difficult, although a competition would likely focus on percent reductions within districts, rather than between districts. However, the collection of that data at the City Council district level would also be hindered by the fact that zip codes, for which energy consumption statistics are available, are often split into two or more Council districts.

The adoption of zip code areas as boundaries for the community GHG reduction challenge offers many advantages. One NYC program that defines communities by zip codes is the creation of Community Health Profiles. Data collection for the profiles, which include information on hospitalizations, demographics, health care/preventive services, health status, maternity, and child health/mortality, was organized by zip code because a survey of New Yorkers found that they are familiar with their own zip codes but not, for example, their community districts (NYC.gov, 2009). Zip codes are also attractive definitions of NYC communities because they meet the crucial GHG measurement criterion of available energy consumption information. (More on measuring emissions for the program follows in the Measurement chapter.) PlaNYC's Inventory of New York City Greenhouse Gas Emissions relies heavily on energy consumption information from utilities (Dickinson & Tenorio, 2011), so the question of data availability from utilities should be a key consideration in the setting of boundaries for the community GHG reduction challenge.

According to interviews we conducted with representatives of OLTPS and the Consolidated Edison (ConEd) electricity and natural gas utility, energy consumption data is available at the zip code level from ConEd, and is most likely available from the National Grid natural gas utility as well, perhaps at an even higher resolution within zip codes (Dickinson J. , 2012) (Westman, 2012).

Considering OLTPS's existing relationships with both ConEd and National Grid, acquisition of zip code level or higher resolution data is expected to be highly feasible. A precedent for the application of zip code level exists in the form of a block-by-block energy consumption map of New York City created by researchers at Columbia University (Howard, Parshall, Thompson, Hammer, Dickinson, & Modi, 2012), although the final statistics used to create the map were a result of complex statistical models that limited their accuracy and would be difficult for nonexperts to understand. Despite the advantages offered by zip code-defined communities, program organizers should consider the comparatively large geographic areas encompassed by zip codes, which would limit the program's ability to attribute GHG reduction progress to small neighborhoods or individual households.

The largest areas examined as possible communities for the GHG reduction program were NYC's five boroughs. Each borough has



The more densely populated an area the higher the energy consumption, therefore the higher the potential for reduction.

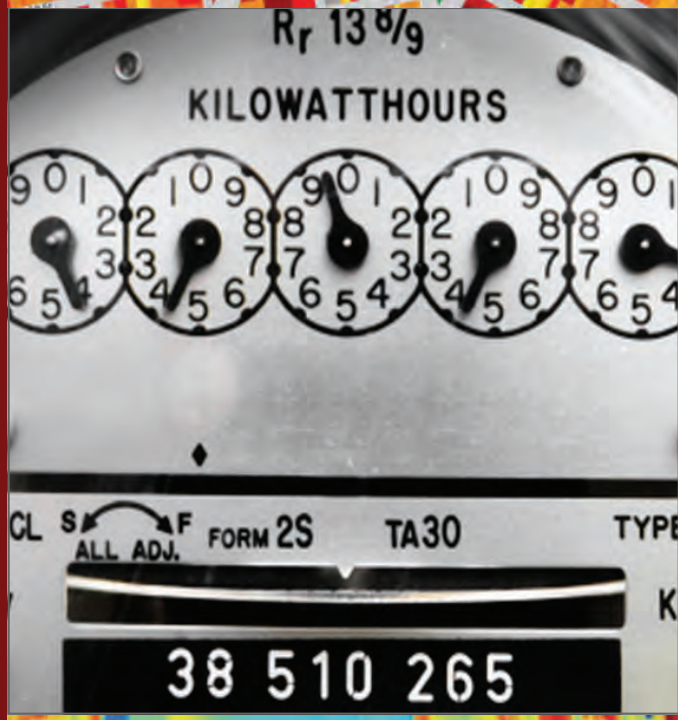
an administrative body, the Borough Board, and an executive, the Borough President. The Boards, which consist of the Borough President, appointees of City Council members, and the chairs of Community Boards within each borough, hold public meetings and make recommendations about the use and sale of city properties, among other functions (NYC.gov, 2012). While the Borough Boards and Borough Presidents could be advantageous to promotional and outreach efforts as part of the community GHG reduction challenge, their political influence and budgeting powers within city government are limited. However, drawing up GHG reduction communities along borough lines would harness feelings of pride and ownership that many New Yorkers associate with their home borough.

Ideally, data collection for the program and the definitions of city communities would take place Ideally, data collection for the program and the definitions of city communities would take place at multiple levels, incorporating several of the boundaries described above. A model of such multilevel operation can be found in the NYC "My Neighborhood Statistics" program, which measures the effectiveness of city agencies at the neighborhood level. The program's website provides interactive tools that residents can use to view data based on addresses, blocks, Community Boards, police precincts, and school districts (NYC.gov, n.d.). The tracking of primary individual data at extremely high resolution would be a great asset to the community GHG reduction challenge by providing participants with broad and deep information on their progress toward emissions reduction goals that would keep them engaged and motivated. Including such a tool in the GHG reduction program, while highly desirable, is not feasible due to the lack of relevant data at each level of resolution.

Conclusions

Based on the findings described above, we believe that four sets of boundaries are the most feasible and best suited to serve as the bases for the community GHG reduction challenge (in ascending order of geographical size): (1) community districts, (2) City Council districts, (3) zip codes, and (4) boroughs. Consideration of each boundary's aforementioned advantages and weaknesses combined with cost/benefit analyses framed by available funds should indicate which boundaries or combination of boundaries would be best for utilization in the community GHG reduction challenge.

MEASUREMENT & METRICS



MEASUREMENT & METRICS

Introduction to Measurements

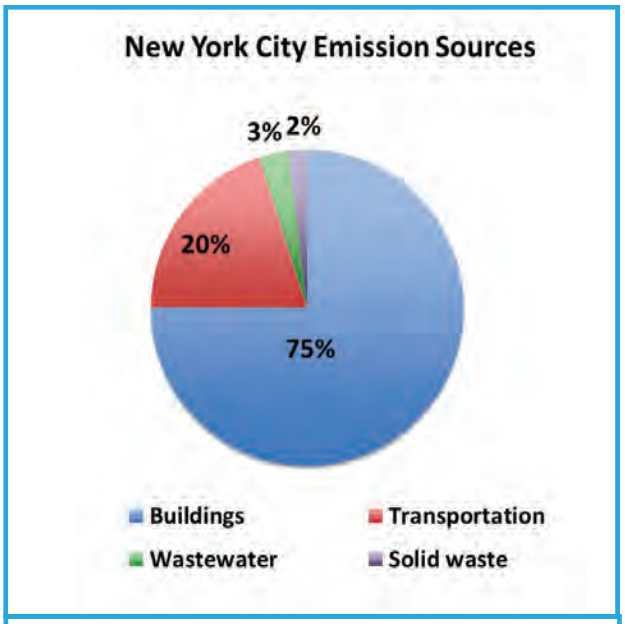
This chapter of the report details the measures and metrics used in other carbon emissions reduction initiatives and takes into account what measurement schemes are feasible in New York City. We focused on the three activities that produce the most community emissions: energy consumption, transportation, and solid waste generation.

To analyze community indicators we assessed the existing metric used to calculate emissions for the Inventory of New York City Greenhouse Gas Emissions. Our research of measurements and metrics included: "scope 1 (Direct emissions from on-site fossil fuel combustion or fugitive emissions)" and "scope 2 (Indirect emissions from energy generated in one location but consumed in another, such as electricity and steam)" emissions, as defined by the 2011 GHG inventory report (Dickinson & Tenorio, 2011). We wanted to determine if the measures of citywide emissions could also be used at the neighborhood level.

Many of the programs and measurement schemes described below rely heavily upon the availability of extremely high resolution data (at the city block, building, housing unit, or individual level) in one or more of those activity categories. Our research indicated that availability of such data was essential to many GHG reduction programs in other cities, allowing for comprehensive and accurate measurement of individual behaviors' effect on local emissions. Many of these same cities chose to focus on energy consumption as the central rubric for measuring emissions reductions, as the data were available and accurate. Few cities included localized measurement of other sources in their programs, suggesting a lack of high-resolution data on those behaviors. We also learned that disaggregated data in each of the three specified categories of emission-generating behaviors may not be available to OLTPS at this time. Therefore, we present our findings on measurement and metrics recognizing that, for example, data on household electricity consumption might not be available, even though these indicators are essential components of community GHG reduction challenges in other cities. As a result, we recommend working with utilities and other key organizations to gain access to the level of data that would be ideal for use in the community GHG reduction challenge.

Measuring Buildings' Energy Consumption

City buildings accounted for 75 percent of NYC's total 54.3 million metric tons of CO_2 emissions in 2010, and half of that 75 percent was emitted from residential buildings (Dickinson & Tenorio, 2011). Buildings' large share of total city-wide emissions should make them prime targets for the community GHG reduction challenge. Gauging reductions in buildings' energy use by measuring or modeling their consumption of electricity, natural



Buildings are the largest source of emissions in NYC, which is why decreasing emissions from this sources is the priority of this initiative.

gas, and/or heating oil could provide accurate estimates of GHG emissions reductions.

The University of Florida's "Gainesville Green" initiative represents an ideal model for collecting disaggregated energy consumption data for buildings. The initiative, currently in trial phase, involves collecting household and neighborhood data on energy consumption from the local municipally-owned utility and presenting it on an interactive public website. Although it considers only energy consumption, the data collected through Gainesville Green could be converted into GHG emissions. The city government's ownership of its electrical utility allowed for close coordination within the program and circumvented obstacles to high-resolution data collection such as privacy laws that may prevent a privately owned utility, such as ConEd or National Grid, from sharing data with a government agency (Taylor N. , 2012).

London's Energy and Greenhouse Gas Inventory (LEGGI) uses a unique combination of disaggregated data on energy consumption and statistical modeling to quantify GHG emissions in the city. London's Department for Energy and Climate Change (DECC) receives consumption data, which is collected through individual meter readings, directly from electrical utilities. These data are organized according to Meter Point Administration Number, each connected to an address and postal code. Next the consumption data are organized by postal code and aggregated into Middle Layer Super Output Areas (NHS Data Model and Dictionary for England, 2012), local government districts, and government office regions. This aggregated data is then merged with matching data organized by one-square-kilometer grid cells that are used to spatially divide the city's boroughs. Where grid cells' consumption data overlap with those for Middle Layer Super Output Areas, consumption is divided evenly among the cells, limiting the geographical precision of electricity consumption information in those areas. London's Energy and Greenhouse Gas Inventory efforts are also hindered by consumption disclosure issues that prevent the disaggregation of data from commercial and industrial consumers to levels below the local authority. To address this issue, London's Energy and Greenhouse Gas Inventory simply filled in data gaps in certain areas with data from nearby areas (Department for Environment Food and Rural Affairs, 2012), limiting geographic accuracy. Despite its limitations, London's process for

Modeling Emissions Data in London

Although London's Energy and Greenhouse Gas Inventory (LEGGI) also had access to "bottom-up" disaggregate energy consumption data from utility providers, it supplemented this data with statistical modeling in geographic areas with data gaps (due to industrial and commercial consumers for which data is not released). For utility usage, the LEGGI model combined regional information with population, and for road transportation used a complex model based on automated and manual traffic counts to estimate emissions. While these methods may be somewhat inaccurate, modeling allowed London to create a comprehensive emissions inventory.

collecting and analyzing electricity consumption data—particularly its foundation in geo-tagged and aggregated household-level statistics—offers a model that produces complete and relatively accurate results. It must be noted that utilization of the London model is not feasible in NYC due to the lack of availability of household-level electricity consumption data to OLTPS and other city agencies.

To address the unavailability of household-level electricity consumption, managers of the community GHG reduction challenge could employ different methods of data collection besides sourcing it from utility companies. These alternative methods would rely primarily on community members' voluntary disclosure of information on home electricity use. The U.S. Department of Energy's Energy Efficiency & Renewable Energy Division (EERE) provides rough estimates of the electrical demand of many household appliances. This reference, combined with simple calculations provided by the division's Energy Savers initiative to measure daily energy consumption, could provide useful information to program participants about the top sources of electricity consumption (and, by extension, GHG emissions) in their homes (Energy Star.gov, n.d.). For example, disclosure of electricity use to ConEd could be done through a modified version of the utility's existing "Home Energy Calculator" that quantifies consumers' electricity consumption and its cost, and offers tips on how to conserve and lower electrical bills (Consolidated Edison , 2012).

Another option would be that participants authorize utilities to disclose their energy use data to the city. However, this would require active participation and significant resource allocation by the utilities to appropriately geo-code data, which the companies may be reluctant to undertake (Dickinson J. , NYC Context Interview). As an alternative, the Mayor's Office could create an online portal where New Yorkers would voluntarily disclose their electricity use to a database that could be used in the community GHG reduction challenge. The creation of an online voluntary disclosure platform could also offer added benefits such as graphical representations of participants' energy use that would allow them to track their progress, offering a concrete motivation to continue participation in the initiative and continue pursuing energy

conservation and GHG reduction. The reporting portal could also serve as a home page or other component of a larger community GHG reduction challenge website where participants could share stories about how they reduced their energy use and/or GHG emissions, find information about how to further reduce their emissions, and hear other conservation stories from their neighbors and other participants. Another online platform that could be utilized or emulated as a measurement and/or voluntary disclosure tool is Environmental Protection Agency's (EPA) residential emissions calculator that estimates emissions from kilowatt hours (kWh) of electricity consumption using the base conversion of 6.8956×10^{-4} metric tons CO_2 / kWh (United States Environmental Protection Agency, 2011). This tool offers the benefit of estimating emissions directly (in tons of CO_2), but is less comprehensive than the ConEd calculator. Although the above examples of measurement and disclosure tools could be useful to the community GHG reduction challenge in a variety of ways, the measurements they provide are only estimates and should not be relied upon for the program's foundational statistics if more accurate or complete data are available. The absence of audits or verification of these data is also a factor limiting their usefulness.

The consumption of natural gas and heating oil, the leading sources of heat in NYC buildings, should also be measured as part of the community GHG reduction challenge. Like electricity, the quantity consumed of these two fuels can be relatively easily converted into CO_2e, making the acquisition of consumption data an important requirement for the initiative.

Natural gas, which is supplied to NYC households primarily by ConEd, presents the

Although there is central heating in these buildings, residents often have to open their windows as a form of temperature control in the winter, thereby wasting energy.

same basic data availability problems as electricity—a lack of high-resolution consumption statistics and privacy regulations blocking the acquisition of such information. The gas utility National Grid, which serves approximately 1.5 million New Yorkers in Brooklyn, Queens, and Staten Island, has provided data at a higher resolution than zip code level in the past (Dickinson J. , 2012), and might therefore be receptive to requests from the Mayor's Office to do so again. Although consumption data from National Grid customers would only cover a small fraction of NYC natural gas-using communities, it could be an important first step toward gaining gas data from ConEd. In London, managers again benefit from the fact that the local gas utility is publicly owned, but also work with the private operating partner Xoserve to compile consumption data. Government gas consumption data is combined with localized estimates from Xoserve where necessary and fed into the square kilometer grid for final analysis, with certain extrapolations that limit accuracy (Mayor of London, 2010).

In contrast to electricity and natural gas, New York City heating oil consumption data is readily accessible to OLTPS. Estimates on consumption of heating oil for the NYC Greenhouse Gas Inventory is compiled by combining oil-fired boiler permit information collected by the NYC Department of Environmental Protection with the square footage of the buildings where the boilers are installed (Dickinson J. , NYC Context Interview). The existence of building-level consumption estimates that are already in use by OLTPS should make their integration into the community GHG reduction challenge highly feasible. However, because the data are estimates based on boiler type and building square footage and not based on usage pattern, these data would not be useful for determining emissions reduction as a result of reduced heating oil use. Rather, the existing data could be used to provide baseline estimates of heating oil-related emissions and OLTPS could rely on voluntarily disclosed consumption numbers from home and building owners during the course of the initiative.

Measuring Transportation

Transportation accounted for 21 percent of NYC's greenhouse gas emissions in 2010 (Dickinson & Tenorio, 2011), making it an important target area for community GHG reduction. However, the accurate measurement of transportation emissions at the community level is hindered by two main challenges: tying transitory emissions to a specific community of origin and accurately quantifying emissions from a variety of vehicle and fuel types.

One potential solution to the location and assignment problem associated with measuring transportation emissions is a partnership with NYC DEP, which collects vehicle miles travelled (VMT) data from the New York Metropolitan Transportation Council (NYMTC). Vehicle miles travelled data, which includes "borough of origin" designations based on census and traffic statistics (Dickinson J. , 2012), could be used to site and assign transit-based GHG emissions to appropriate communities with relative accuracy. While vehicle miles travelled data is attractive

for the use in the community GHG initiative, largely because it is available at neighborhood resolution and higher, its accuracy is hobbled by exogenous factors. Transportation choices in NYC take place at the intersection of socio-economic, political, institutional, and infrastructural considerations, most of which are outside of the control of the individual New Yorker. Outer-borough residents, for example, may be more reliant on car travel than those living in Manhattan due to a lack of public transit options in their communities, leaving them unable to adopt lower-emissions transit methods.

Idling vehicles are a source of emissions that is difficult to measure.

Although metrics for converting consumption of common vehicle fuels such as gasoline and diesel to CO_2e emissions do exist, cost-effectively applying them to hundreds of vehicles travelling from or through city communities is difficult. London's program addressed this problem head-on, beginning with a combination of automatic and manual vehicle counts around the city. Counted vehicles were classified in one of eleven different vehicle categories and then used as a basis for a complex model that accounted for influential factors such as major traffic events and produced localized vehicle emissions data (Mayor of London, 2010). NYC vehicle miles travelled data could be adapted into a similar model that could serve as the main vehicle emissions measurement rubric for the community GHG reduction challenge.

As noted with other emissions sources, online tools are available for individuals and households to calculate their CO_2 emissions produced by their transportation patterns. The EPA offers a calculator to measure individual transportation emissions that focuses on vehicles per household, their fuel efficiency, and average miles traveled (United States Environmental Protection Agency , 2011). Stanford University's "Commute Cost and Carbon Emissions Calculator," when provided with transportation information, outputs total CO_2 emissions and total costs associated with users' regular commute (Stanford University Parking and Transportation Services, n.d.). As noted with other online measurement tools, the data provided by these two examples should be regarded as rough estimates and should not be used in official calculations for the community GHG reduction challenge. However, the estimates they provide could be useful as facilitators of more emissions-conscious transportation choices by program participants and New Yorkers in general, and therefore may be deserving of promotion by the initiative.

Measuring Solid Waste

Direct emissions from solid and liquid municipal waste, along with the emissions that result from their transport and processing, account for only a small portion of NYC GHG emissions—about five percent in 2009 (The City of New York, April 2011)—but because waste reduction is a simple action that can be taken by citizens to help reduce emissions, it is worth examining. Measuring the emissions from waste and waste management would first require quantitative data on the amount and type of waste generated. Neither of these data sets are readily available in NYC; the most current data on the city's solid waste stream are from the Department of Sanitation's 2004-2005 Residential and Street Basket Waste Characterization Study. The study randomly sampled waste to examine and categorize its contents, and the results were aggregated to the borough level (New York City Department of Sanitation, Bureau of Waste Prevention, Reuse and Recycling, 2012). Although the study focused on characterizing solid waste and not measuring overall quantities, it could be used as a model for a similar study that would collect quantitative solid waste data at the neighborhood and/or borough level. Once accurate estimates of the amount of solid waste generated by each community were made, they could be combined with waste characterization data to calculate resulting GHG emissions in each community.

Prioritizing Emissions Tied to Individual Behavior

Clearly, there are many ways to measure emissions sources and their contributions to total GHG emissions in NYC. In the context of the community GHG reduction challenge, the best-suited measurement options focus on emissions sources that are under individual New Yorkers' control. While our emphasis on measuring energy use in City buildings is based largely on buildings' sizable contribution to citywide emissions and data availability, it is also due to that fact that simple, low- or no-cost actions taken by residents can have

One CFL light bulb uses 1/4 the power of an incandescent bulb. By switching, emissions will be reduced and money will be saved.

a major impact on energy consumption and GHG emissions. To offer a few examples, by reducing hot water use, moderating indoor climate control, turning off or unplugging lights and appliances, or replacing incandescent light bulbs with compact fluorescents, City residents can significantly reduce household energy consumption and GHG emissions.

Our analysis of NYC GHG inventory data from 2005 to 2010 (see Appendix A for the full analysis and explanation of methods) illustrates the significant role changes in individual behaviors can play in achieving the goal of lower citywide emissions. Broad policy accomplishments at the city government level, such as 15.9 percent of the net GHG emissions reduction realized between 2005 and 2010, were a result of individual changes in behavior such as reduced electricity consumption and lower vehicle mileage. Reducing energy consumption was the individual behavioral change that had the greatest effect on emissions during the five-year period, but its reduction rate of just 3.4 percent indicates there is room for greater reductions.

Transportation is another activity that is driven by individual behavioral changes that holds potential for GHG emissions reduction at the community level. Two-thirds of the 21 percent of NYC's total transport-related GHG emissions come from private vehicles, indicating that individual New Yorkers choosing modes of transit other than cars and trucks could have a major impact on overall GHG emissions from the transportation sector.

This basic analysis of past GHG emissions reduction in NYC lends support to selecting measurement systems and methods that quantify the positive results of individual GHG emissions reduction actions. These measurements hold the greatest potential for maximum impact in the form of emissions reduction and also provide the positive reinforcement necessary to keep participants in the community GHG reduction challenge engaged and motivated.

Alternative forms of transportation help reduce greenhouse gas emissions.

Conclusions

Energy consumption in buildings is the leading source of emissions in NYC and, despite significant barriers, offers consistent and reliable data city-wide. Energy consumption should therefore be a priority target for the community GHG reduction challenge. As such, measurement of energy consumption in all its forms (electricity, natural gas, and heating oil) should be a central component of the initiative. Ideally, measurement of energy consumption would be taken at the highest-resolution level possible, be it zip code, neighborhood, block, lot, or household. In light of the significant obstacles preventing the collection of such data, alternative measurement methods such as voluntary reporting, statistical modeling, or disaggregation of lower-resolution data are all viable alternatives.

With or without access to high-resolution data, the program's measurement efforts should focus on measuring emissions sources such as home energy consumption and transportation that are directly tied to individual behaviors. That focus will help gauge changes in the sectors that hold the greatest potential for GHG reduction and also provide New Yorkers with concrete evidence that their choices have contributed to the success of the program and made their city a better place to live.

COMMUNITY ENGAGEMENT

COMMUNITY ENGAGEMENT

Who Makes Up Communities?

Before tackling the issue of how to engage New York communities in the community GHG reduction challenge, we need to define "community." The goal of reducing energy use in buildings informs the definition of communities for the challenge. The target audience for community outreach will be the residents (owners and renters) and small businesses that occupy NYC's buildings. Small businesses could be distinguished from larger businesses or corporations based on number of employees (as used by NYSERDA) or electricity consumption per month (as used by ConEd) (Falk, 2012). Since New York City's government has already initiated GHG reduction initiatives for hospitals, universities, and city-owned buildings (Post, 2009), the owners and occupants of those building types would not be included in the community challenge. Occupants of industrial facilities would also be excluded, given their distinct energy uses and demands.

Within the community group that encompasses residents and small businesses around the City, there are hundreds of cultural and socioeconomic enclaves. The enclaves populating each community included in the greenhouse gas reduction challenge should be analyzed prior to engagement efforts in order to tailor the messages of the challenge to achieve maximum participation in every community.

Elements of Community Engagement

Achieving meaningful greenhouse gas emissions reduction at the community level in New York City involves engaging and motivating community residents to work toward a shared goal. A successful GHG program at the neighborhood level should include information about the benefits of GHG reduction, clear guidelines of how to achieve emissions reductions, and tools and incentives to keep residents motivated and actively participating in the GHG reduction project.

We organized our research findings on community engagement by beginning with four methods of governmental community outreach (Cohen, 1979): positive modeling, public awareness, data gathering, and incentives. To better apply these methods to the requirements of the community GHG reduction challenge, we adapted them into four more specific categories of community outreach action: (1) education, (2) partnerships, (3) incentives and (4) tools. This chapter presents discovered best practices in all four categories based on research of other cities' outreach efforts, within and without GHG reduction contexts.

Education

Before individual members of NYC communities undertake behavioral changes to reduce greenhouse gas emissions, they must have a clear sense of what greenhouse gases are and how they contribute to climate change, the ancillary benefits of GHG reduc-

tion actions, and which GHG reduction actions are most effective and how to implement them. These three goals constitute the first component of community outreach: community education and public awareness. Our research identified the following five basic models for providing this education:

"Viral" or "Learn-Do-Teach" Education

A frequently-encountered model for achieving the three community engagement goals is the "viral" model: seeking out volunteers with preexisting interests in GHG reduction, training them, and sending them into their communities to disseminate the information they have learned (What is Pete Street?, 2012). The model fits the method of "engaging trusted messengers" that one government behavioral study found to be a mark of success in efforts to drive demand for home energy improvements (Lawrence Berkeley National Laboratory, 2010). Durham, North Carolina is home to the nonprofit Clean Energy Durham, which used a "LEARN-DO-TEACH" model to spread knowledge about and methods for home energy savings (City of Durham, 2009). Early success of the model led to the creation of the ongoing "Pete Street" program, which teaches volunteers basic methods to reduce energy use, water use, and GHG emissions, as well as more in-depth, 18-hour workshops. These volunteers then teach others (Kincaid, 2012). Similar initiatives such as the "Carbon Coaches" program in Seattle, Washington (Sustainable West Seattle, 2012) and the energy advisors of Rotterdam in the Netherlands (Geneente Rotterdam) also disseminate energy-efficiency and emissions-reduction information throughout their respective communities.

These examples show the potential for success of the viral or learn-do-teach model: through the training of just a few motivated volunteers at the outset of a GHG reduction initiative, messages on how and why to reduce emissions can quickly spread throughout communities at minimal cost. The model engages residents that are interested in climate-related issues and most motivated to take greenhouse gas-reducing actions through self-selection: these conscientious residents are most likely to volunteer to receive the training that initiates the cycle of teaching, action, and information-sharing.

Cornell with the help of the EPA do outreach programs to bring awareness to Brooklyn roof top farming through event style education programs.

Events Education

A wider-reaching but less targeted model for educating communities involves staging neighborhood events centered on sustainability messages. Such events are staples

of the NYC nonprofit group Time's Up, which sponsors monthly bike rides in the city to encourage residents to utilize low-carbon transportation, as well as home energy improvement workshops (Time's Up). The municipal government in Copenhagen, Denmark stages events demonstrating how to integrate more sustainable practices into everyday life to stimulate community discussion of sustainability issues (City of Copenhagen, 2012).

City governments also serve as organizers of environmental education events across the globe. The City of Rome hosted an "eco-festival" to promote energy efficiency directly to residents (C40 Cities Climate Leadership Group) and the City of Los Angeles uses "summer streets" events (wherein main streets are closed to cars) to promote walking or biking as low-carbon alternative to automobile transport (Ciclavia.org).

Classroom based environmental education gives children tools and excitement to take home to their parents that will result in greater environmental awareness.

Events-based education offers the advantage of reaching large portions of community populations at one time, but could carry a high cost if the events are planned and staged solely for the purpose of GHG reduction education. Perhaps the best utilization of events-based education would be presence of the GHG reduction challenge at pre-established events, thereby minimizing cost.

Institutional Education

Some community education programs share information using established institutional channels—public schools—to spread sustainability information to households through their youngest members. NYSERDA operates the Energy $mart Students program, which trains teachers how to bring energy conservation lessons into the classroom (NYSERDA, 2011). A grant furnished by the National Aeronautics and Space Administration (NASA) funded a partnership between NYSERDA and Clarkson University in Potsdam, NY through which teachers from across the state receive updated data on climate change and assistance in developing techniques for teaching climate-related issues (Clarkson University, 2011).

The New York City Department of Education's Sustainability Coordinators could serve as key contact persons for bringing GHG reduction program information into schools across the city. The coordinators, who are appointed by school administrators and trained to strive toward sustainability goals within their schools by the Department of Education, could be best qualified to inform their fellow teachers and students about GHG reduction programs (NYC Department of Education, 2012).

Heidelberg, Germany's Campaign to Save Energy in Heidelberg Schools took a more direct approach to bringing environmental messages to students. The program involved integrating energy conservation lessons into existing curricula as well as the organization of about 20 students and teachers into "E-teams" that identified opportunities for energy savings at their schools (Beaudoin, Energy Audit "E-Teams", 2009). Their multifaceted approach took advantage of the city's access to the captive audience that was public school students. (See the focus box "Heidelberg's Community Outreach Initiative" at the end of this chapter for more information on Heidelberg's school program.)

NYC schools offer an existing network of educators and members of every community in the city. That wide reach, combined with existing sustainability programs in public schools, constitute a key opportunity to disseminate information on the community GHG reduction challenge. By incorporating information about the initiative into existing lessons on sustainability and energy efficiency, students could in turn bring that information home with them to hundreds of thousands of households across the city.

Direct Education and Promotion

Any community greenhouse gas reduction initiative should include some form of direct community education, be it a website or other medium. Simple, low-cost strategies for communicating directly with NYC residents could help boost the visibility of GHG reduction programs and encourage participation. The 100k Homes Campaign, a nonprofit aimed at providing homes for the homeless, engages its target audience through the social media platforms of Facebook and Twitter (Johnson, 2012) while in Stockholm, Sweden's "Climate-Smart Stockholmer" campaign distributes brochures to residents with step-by-step instructions on how to reduce energy use and emissions (Möller, 2011).

Grand promotional displays, like this one from the EPA, bring awareness to greenhouse gas emissions.

Direct education projects undertaken as part of the community GHG reduction challenge could reach large numbers of New Yorkers through the relatively easy and low-cost route of electronic and social media communication or the higher-cost method of direct mailing. In either case, the effectiveness of such efforts would be limited by their inability to target specific subpopulations that may be more receptive to GHG reduction initiatives and their lack of an educational intermediary that might confer greater legitimacy on the message as they pass it along.

Productive partnerships lead to more innovation, caring, and involvement. At this intersection there is the ability to build strong programs with multiple sources of insight and experience.

Educational Content and Positive Modeling

Whatever combination of strategies is employed to educate communities about the GHG reduction challenge, it should include information on (1) GHGs and why they are a problem, (2) the personal benefits that come with GHG reduction efforts (most notably, lower energy bills), and (3) actions that can reduce GHG emissions at home. To maximize participation and generate enthusiasm for the project, emphasis should be placed on the second and third elements. Practical information on how to bring about GHG reduction and the direct financial and environmental benefits those actions can bring is more likely to motivate action than a more abstract message about global climate change.

An effective way to highlight the immediate benefits of GHG reduction actions at the community level is positive modeling: showcasing how other community members cut their emissions and what they gained from it. This method combines the power of social norms and setting example behaviors to tell convincing stories that community members can emulate. This strategy should focus on early adopters of the program and influential community members whenever possible to maximize its effect (Lawrence Berkeley National Laboratory, 2010).

Partnerships

Many successful community outreach programs are the product of partnerships between two or more organizations. Their interests aligned, these partners share information and resources to maximize the scope of their programs and generate as much participation as possible. In the context of the community GHG reduction challenge, partnerships with other government agencies, businesses, and local nonprofits could provide vital financial and promotional support in various communities around NYC.

Government Partners

A number of government agencies at the state and city level are already managing community outreach initiatives with sustainability and energy-saving messages, and partnering with them could confer instant momentum to a community GHG reduction challenge. Collaboration with NYSERDA could bring with it important lessons learned from previous outreach efforts, as well as organizational advice and support.

Partnering with the smallest unit of NYC government, the Community Board, could also provide crucial support to commu-

nity GHG reduction challenges by enlisting the help of leaders who hold the attention and respect of their neighbors and providing direct access to each community's most engaged and active members.

Business Partners

Business partners in community outreach programs provide material support and access to a wide swath of community residents. Furthermore, local businesses will be included in the community GHG reduction challenge, making their participation or active partnership all the more important to the ultimate success of the program. A simple sign of participation in the window of a local convenience store could go a long way toward winning the participation of local residents. At a higher level, large corporations are often eager to provide financial support in the form of sponsorship or donated goods to sustainability initiatives in exchange for their brand being associated with environmental responsibility (Hahnfeld, 2012).

Existing business organizations could also be valuable partners in establishing and supporting the community GHG reduction challenge. New York City Business Smart advocates sustainable business practices through networking and information sharing (New York City Business Smart, 2012), and could urge its members to participate in the initiative at the community level. NYC's 66 Business Improvement Districts could also prove to be a useful network of city businesses to spread the word about and advocate participation in the community GHG reduction challenge (NYC Small Business Services, 2012).

Nonprofit Partners

"Local organizations, especially nonprofits" have been identified as key "trusted messengers" at the community level that are instrumental to the success of outreach efforts (Lawrence Berkeley National Laboratory, 2010). Enrolling environmental groups like Time's Up as partners would provide immediate access to the group's members and benefit from its years of experience in implementing environmental initiatives in the city.

Partnerships with non-environmental community groups such as parent-teacher associations (PTAs) could also provide key support in promoting community initiatives, as has been the case with certain NYSERDA programs (Schnapp, 2012). As with Community Boards, partnership with PTAs provides grounding in local communities that will be required for a successful community GHG reduction challenge.

Though not community-based, larger nonprofit groups could be useful partners as well, largely due to their own histories building coalitions to support city- or community-level programs. The Local Governments for Sustainability (ICLEI) "Green Office Challenge" in Houston, Texas, which engaged building and business owners in an attempt to make office spaces more energy efficient, involved the organization partnering with a number of trade associations, nonprofits and a corporate sponsor in Shell Oil (Lin, 2012). Joining with large umbrella organizations like ICLEI could lead to helpful partnerships with a number of other public, private, and nonprofit organizations.

Incentives

Once New Yorkers are informed about the community GHG reduction challenge, what will motivate them to participate? Just as importantly, what will motivate them to continue participating in the long run? Strong and desirable incentives will keep residents interested and drive their continued progress toward reduced energy use and lower GHG emissions. To begin, the powerful incentive of potential savings on energy bills should be included in educational efforts within the initiative. Since residents of public housing do not pay their own utility bills, some type of targeted positive incentive may be best for motivating them. Beyond that, there are three main categories of incentives that could be part of the program: material incentives, rewards, and competition.

Material Incentives

Material incentives ideally could include items which further encourage energy efficiency or other positive behaviors, such as free compact fluorescent light bulbs. They could also include discounts and rebates on higher-ticket items, such as energy efficient appliances. In Buenos Aires, Argentina, the city bank provides low-interest loans to businesses to pay for energy efficiency upgrades (City of Buenos Aires, 2011).

Offering free or low-cost material support for energy efficiency and GHG reduction would undoubtedly boost participation in the program, but would of course amount to a substantial investment by NYC government, making it a less feasible program option than other possible incentive plans. Some funding could be made available by the state through NYSERDA, which generates funds through a tax on electricity.

Small changes, like switching to more energy efficient light bulbs, can reduce GHG emissions and help households save money.

Rewards

As an alternative to incentivizing GHG-reducing activities before the fact, the program could offer rewards to residents and businesses after their behavior changes have resulted in a verifiable drop in their emissions. A proven and fast-growing system for doing just that is operated by the private company Recyclebank, which awards points for recycling. These points can be redeemed online for discounts on products ranging from Coca-Cola to Pantene shampoo and conditioner (Recyclebank). The NYC government is currently in negotiations with Recyclebank to establish a recycling rewards program in the city (Hahnfeld, 2012). If and when an arrangement is reached, Recyclebank's recycling rewards system should be a central feature of the community GHG reduction challenge. Although it will require an up-front investment by City government, it holds potential to incentivize long-term participation in the greenhouse gas reduction challenge.

Competition

Friendly competition is often an incentive for communities and individuals to strive toward a common goal. NYSERDA organized a small-scale, two-part competition in Brooklyn in 2010, aimed at reducing emissions and energy use with positive results. The first competition gave each participating household two rankings: one based on their energy consumption reduction over the previous year and one on energy use reduction in comparison to neighbors over the span of the competition (March through May). The second competition, "Reduce the Use in District 39," involved neighbors competing for the titles of greatest reduction in energy consumption and smallest carbon footprint. In both competitions, winners were given prizes for their exemplary behavioral changes. The "Reduce the Use" competition featured City Councilman Brad Lander as a foil for energy consumption, against which participants could measure their own (Bard, Multifamily Programs, 2012).

Similar competitive challenges have occurred in Houston, Texas with the "Green Office Challenge" (Lin, 2012), London's Low Carbon Zones (Greater London Authority), and Rotterdam, Netherlands (Geneente Rotterdam).

Whatever form they take, clear and accessible incentives for community residents and businesses will be required to generate and sustain interest and participation in a community greenhouse gas reduction program.

Tools

While incentives will help keep participants interested and active within the community GHG reduction challenge, they will also need tools to demonstrate that they are making progress toward their goals. Virtual tools such as online calculators and apps can often provide the measurements needed to gauge an individual's or a community's progress toward greenhouse gas reduction goals. In addition, online and offline resources can pick up where initial education efforts left off, guiding program participants toward the most effective methods for GHG reduction.

A friendly competition between boroughs incentivize individuals to achieve a common goal.

Online Tools

Based on his experience with the NYSERDA competition in Brooklyn, Michael Freedman Schnapp, policy advisor to Councilman Lander, stated that community engagement is most effective in any neighborhood initiative that uses web-based tools (Schnapp,

2012). The simplest and most applicable tools for the community GHG reduction challenge would be an online emissions or carbon footprint calculator. Many of these calculators, like the one hosted by the Nature Conservancy (The Nature Conservancy, 2012), are free and open to the public. Others, like the City of Seattle's Carbon Calculator (Sustainable West Seattle, 2012) is designed to complement local emissions-reduction initiatives. While online calculators do not measure emissions with great accuracy, they can provide consistent means for individual households or businesses to track their own progress toward lowering energy use and cutting emissions. The city of Stockholm offers an online tool as part of its Climate Smart campaign that displays the carbon footprint of a variety of common activities and offers lower-emissions alternatives (Tricorona Green).

Other online tools that facilitate low-emissions behaviors in innovative ways could also add some fun and creativity to a community GHG reductions program. A good example of such tools is the NYC Stuff Exchange, a program run by the city to facilitate the buy-

Heidelberg's Community Outreach Initiative

In the early 1990's, the city of Heidelberg, Germany solicited the help of the Institute for Energy and Environmental Research (IFEU) to assist with energy planning for the city. (Beaudoin, Mayor's Training Program Case Study: Energy Audit E-Teams in Heidelberg, Germany, 2009). In 1995, IFEU and the city created the "Campaign to Save Energy in Heidelberg Schools" which involved both students and faculty. Four schools were chosen to integrate "energy education" as part of their math, art and physics curricula.

This campaign effectively incorporated the four pillars of community engagement: partnership, education, tools, and incentives.

- **Partnership:** The city formed a partnership between IFEU and primary and secondary schools to ensure proper implementation of the program.
- **Education:** The curricula taught students how to measure and improve energy efficiency. Energy Information Boards provided information to educate students about energy use.
- **Tools:** The city provided "E-Teams" comprising 10-20 students and faculty equipment to measure electricity consumption for auditing the schools' energy efficiency. The city also used "smart meters" to track energy and monetary savings from reducing
- **Incentives:** Participating schools were allowed to keep a portion of the money saved by the school district, allocating some to energy efficiency projects. "E-Teams" also awarded points for classrooms with energy-efficient behaviors.

ing, selling, and donating of used items (City of New York, 2012). The initiative could recommend that participants use the exchange and its mobile apps to reduce their GHG emissions by diverting some of their waste from landfills.

Offline Tools

Tried and true, simple brochures and pamphlets are still useful tools for directing people toward GHG-reducing activities. Scorecards like those used to determine progress in Houston's Green Office challenge are downloadable files that participants can fill out and use to evaluate their progress offline (Lin, 2012). NYSERDA's "Energy Action at Home" brochure, available for download from its website, offers a complete but concise list of actions New Yorkers can take to reduce their energy usage (NYSERDA, 2011). Similarly, the NYC Department of Environmental Protection (DEP) offers the Water Saver's Workbook for download from its website (NYC DEP, 2012), with information sheets and worksheets that help inform New Yorkers about how much water they use and how to reduce their usage.

Whether in online, downloadable, or physical form, tools that allow participants to track their greenhouse gas reduction progress or offer suggestions for how to reduce their emissions will make for a robust community program and help support long-term interest and participation. All participant tools will require intense marketing and promotional support at the outset of the program, as research has indicated that tools released with little promotion behind them suffer very low utilization rates (Taylor N. , 2012) (Hahnfeld, 2012).

Additional Considerations

Application of these four key elements must be accompanied by consideration of two main limiting factors. First, considering the diversity of NYC's population, outreach initiatives must be conducted in a variety of languages and outreach strategies must be flexible enough to allow for tailoring to the cultural character of specific neighborhoods. Second, efforts should be made to equalize outreach across all socioeconomic levels of the city's population, ensuring that poor and minority communities have equal access to the program. Most notably, this should involve alternative participation opportunities for households without home computers or Internet access, as most of the community engagement methods outlined here are Web-based. A Web-tool that can be downloaded as a free "app" or easily navigated on a smart phone would greatly improve access since many low-income groups access the Internet primarily through mobile devices (Illinois Legal Aid Online, 2011). Optional phone participation could be added to NYC's existing 311 system

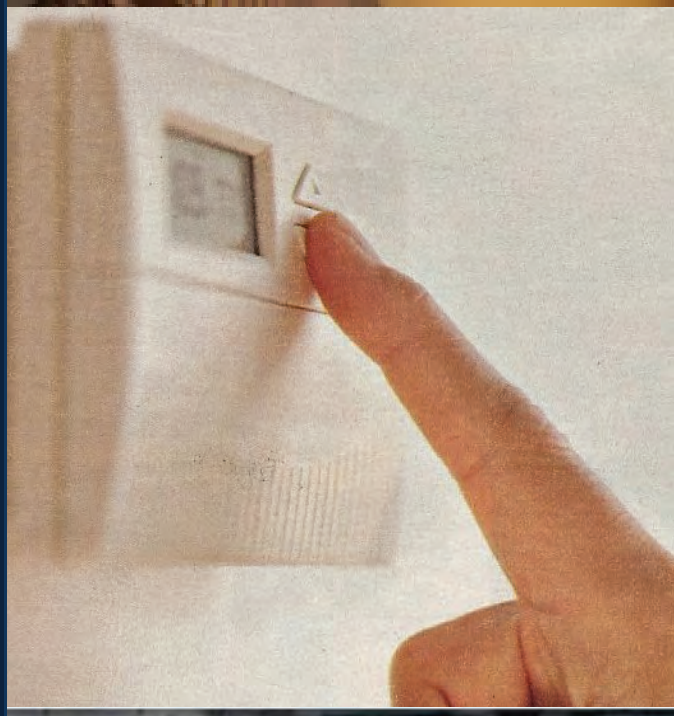
311 offers participation alternative for those without internet access.

or established through a separate toll-free number, as is offered by Recyclebank's recycling rewards programs (Hahnfeld, 2012).

Conclusions

The ideal approach to community engagement in the community GHG reduction challenge would integrate education, partnerships, incentives, and tools to involve the maximum number of New Yorkers in the initiative. Combined with considerations of diverse community needs (such as languages spoken and socioeconomic status), the four elements should be able to reach a wide variety of New Yorkers, from schoolchildren to recent immigrants to owners and operators of delis.

RECOMMENDED ACTIONS & CONCLUSION



RECOMMENDED ACTIONS

In light of the findings described in the preceding three chapters, we have developed specific recommendations for the planning and implementation of the community greenhouse gas reduction challenge. We evaluated options based on their potential for GHG emission reductions, institutional and political feasibility, measurability, access to data-driven results, equity, simplicity and ease of participation, and their potential to drive or be driven by individual behavioral choices.

Summary

The following recommendations describe an inter-borough challenge to reduce greenhouse gas emissions from electrical and other energy consumption by residents and small businesses in New York City.

The city's five boroughs would serve as the main boundaries for the competition, with each borough competing against the others to achieve the greatest per-capita percentage reduction in emissions over the course of the challenge. Zip code boundaries would serve as the main geographical units for the purposes of data collection, which would be conducted by the Mayor's Office through a challenge website.

The measurement of emissions and emissions reductions would be carried out primarily through the measurement of buildings' energy (electricity, natural gas, and heating oil) consumption, converted to units of carbon dioxide equivalent. The Mayor's Office would collect energy consumption data at the zip code level from utilities and aggregate them to determine borough totals. Both the zip code level and borough level data would be presented for comparison on the challenge website. The website would also include tools for participants to report relevant data on their individual energy consumption and other emissions-relevant behavioral choices. Participants could use this self-reported data to track their own progress during the challenge and compare it to that of others around the city.

To alert city communities about the challenge, inform them how to reduce their emissions, and motivate them to participate, the website would serve as a central resource. The site would include a points system through which participants would receive points for taking emissions-reducing actions, which could be redeemed for free or discounted goods. At the outset of the challenge, the Mayor's Office would run an aggressive advertising campaign across all available media to generate interest in and excitement about the challenge. Following the initial promotional campaign and launch of the challenge website, the Mayor's Office would present the challenge to the Borough Boards and, with funding from NYSERDA, hire community engagement coordinators for each borough. These engagement coordinators would take on the responsibility of promoting the program in all the communities of their assigned boroughs, working with Community Boards to tailor strategies and messaging whenever possible. The coordinators would

report their findings and progress back to Borough Boards, helping to identify best practices. At the same time, Borough Board members would serve as public representatives of the challenge, promoting participation at public and media events in their boroughs.

At the conclusion of the challenge, the Mayor's Office would announce whether or not each borough reached the predetermined percentage per capita GHG emissions reduction goal. The borough with the greatest reduction would in turn be recognized by the Mayor's Office and given a reward, such as a public concert or street fair. Additionally, Borough Boards would recognize the zip code that achieved the greatest reduction within the borough and determine an appropriate reward.

Website Design and Structure

As the community GHG reduction challenge website would function as a medium for data collection, information dissemination, and participatory motivation, we recommend its design and construction be the first step in the creation of the challenge.

The main page of the website would provide data collection, organization, and tracking. The page would be organized into three tabs, each representing a level of energy and emissions data relevant to the challenge: individual (household), zip code, and borough. On the individual tab, participants could submit information about their own emissions-related activities (kilowatt-hours of electricity consumed, miles walked or cycled, etc.). The Mayor's Office could approximate emissions reductions based on submitted data by using existing online calculators that relate CO_2 equivalents to changes in behavior. These calculators would convert all of the aforementioned data into CO_2e emissions and calculate their monetary cost. The calculator features would ideally include graphing functions so that users could see visual representations of the changes in emissions and cost savings realized through their conservation efforts. Under this tab, users could find both GHG and dollar savings that have resulted from their reported energy use reductions. CO_2e reductions could be translated into measurements that average New Yorkers understand, such as number of cars on the road, the average city resident's emissions per day, etc. Although the calculators would generate imprecise data, they would still provide estimated reductions at the individual level. Participants who input their energy bill information would be accurate data sources at the individual level. Information entered under

A web based platform will allow community members to input their consumption data as well as track the progress of their zip code and borough.

Using zip codes allows for the collection of utility data to measure progress .

the individual tab would be the basis for a points-based incentive system, which would increase voluntary reporting and provide the Mayor's Office with more concrete data.

Under the zip code tab, the Mayor's Office would upload the latest GHG reduction information calculated from energy consumption data collected from utilities, allowing participants to track their own zip code's emission reduction progress along with their household's. The zip code tab would also host information about the number of challenge participants, informing users about how many of their friends and neighbors are involved and providing additional incentives to promote the challenge to other residents. Although the zip code-level data would provide a more accurate picture of progress by zip code, it might discourage participants if the results are not as impressive as they might have hoped. For this reason, the individual tab would be the landing tab for the data page, which would encourage participants to pay closer attention to their more detailed and more visually pleasing individual data and emissions reduction progress.

The borough tab would be home to the tracking of borough-level emissions, which would be aggregated from zip code-level emissions data by the Mayor's Office. This tab would display the current standings in the borough challenge, ranking each borough according to percentage reduction per capita based on cumulative data collected over the duration of the challenge so far.

In addition to the three tabs for data collection and display, the challenge website would include a page with detailed information on how participants can effectively reduce their GHG emissions. The page would list everyday measures New Yorkers can take––from choosing public transit over driving to installing compact fluorescent light bulbs—to decrease their contribution to community emissions. The measures would be divided into different levels that correspond to users' levels of commitment to GHG reduction; as levels of actions ascend, participants' potential actions would require greater effort. Users would have to complete the first level of

ConEd has many energy saving tips for individuals on their website.

improvements and accumulate a certain number of points in order to move on to the next highest level, and so on to the highest level that would require maximum effort from users. This page would also provide seasonally relevant tips about reducing energy consumption, including links to other information sources such as NYSERDA and ConEd energy-saving websites.

The website would also include a page where participants could share their successes and other experiences related to the challenge. The user-generated content could include descriptions of benefits (such as lower electrical bills) realized through emissions reduction efforts and stories about recruiting family, friends, and neighbors to participate in the challenge. Uploading images and videos and writing blogs that tell participants' stories would be a way for users to prove that they are taking the advice offered on the website, and could allow them to accumulate points as well. Encouraging New Yorkers to tell their stories would be a great way to establish social norms of community GHG reduction as well as model success, two important components of effective community outreach schemes (Lawrence Berkeley National Laboratory, 2010).

The overall design of the website would offer support to the two main types of participants in the initiative—small business and individuals. It would also integrate demographic considerations, such as age of and language spoken by the user to direct appropriate users to sections of the website targeting children that might include games and puzzles, or to educational materials in languages other than English. The pages that users would be directed to would depend on their answers to demographic questions on the platform's home page or registration page. These questions would be few in number and easily answerable to reduce the amount of work users would need to complete to begin participating in the challenge.

To address the issue of some New Yorkers' lack of home Internet access, The Mayor's Office could use 311 as an information resource. In this vein, smart phones provide an optimal bridge in closing the digital divide that exists between socio-economic and ethnic groups (Legal Services National Technology Assistance Project). Due to this opportunity as well as the potential for allowing users to access the challenge's online platform on the go, the challenge website should be optimized for access through mobile devices or be supplemented by a mobile application that would allow users to log in and access self-auditing tools and calculators through their smart phones.

Web tools and phone apps give individuals access to information.

Promoting the Challenge

Concurrently with the design and construction of the website, we recommend that the Mayor's Office plan and execute a citywide campaign to raise awareness about the competition and drive participation in challenge. The campaign could incorporate visual advertising in the model of ConEd's "Power of Green" campaign, which included ads in city subways providing tips for customers to help them reduce electricity consumption (Edison Electric Institute, 2012). Social media platforms such as Twitter and Facebook could also be used to increase public awareness and participation in the challenge at zero or low cost.

The campaign would also be introduced and discussed in NYC public schools, as children are often considered a key trigger to changing families' behaviors. In order to reach children and communities, establishing partnerships with local nonprofit organizations or influential members of the community, including church officials who are interested in environmental issues, could be an efficient and effective promotional strategy.

The Mayor's Office could also reach out to New York City's 59 Community Boards for assistance in promoting the initiative. Program managers from OLTPS could conduct training sessions with one member from each Community Board in the "Learn-Do-Teach" educational model. Using a member of the Community Board as a vehicle for information dissemination and engagement in a community satisfies the "trusted messenger" aspect of this model as well. In addition, Community Boards receive funding from sources other than the city government. The Community Boards could thus be key partners, not only in spreading information, but also in providing additional funding for the initiative.

Business Improvement Districts (BIDs) could also be powerful allies in promoting the

challenge. New York's BIDs provide close to $100 million in programs and services to help small businesses succeed. BID partnerships with the Mayor's Office as part of the community GHG challenge could be the perfect opportunity to establish energy efficiency and/or emissions reduction awards. Separately or in cooperation with BIDs, the Mayor's Office would design a logo representing the challenge that could be displayed by participating local businesses. The logo would offer the dual benefits of boosting a business's eco-conscious image in the eyes of consumers and promoting the initiative to community members that frequent the business. This model was used in Durham, North Carolina where participants of an emissions reduction program received signs to put on their lawn or in their windows (Freid, 2012).

Identifying green local champions will help promote the challenge and spearhead local initiatives.

The Mayor's Office could also seek out local "champions" to promote the challenge, identified either through the Environmental Committee at the City Council level or through a survey conducted to identify 'green' leaders in New York. These champions could garner support for the initiative, as Councilman Brad Lander did for the District 39 Challenge conducted by NYSERDA (Schnapp, 2012).

Funding and Administration

Shortly after the initial phases of the challenge have begun, the Mayor's Office would establish the administrative structure for the challenge. This process would begin with the Mayor's Office requesting funding for the community GHG reduction challenge from NYSERDA's ratepayer-supported energy efficiency fund (or could take place at the outset of the challenge if funds are required to support website construction and the initial promotional campaign). The Mayor's Office would present the challenge and its parameters to the city's Borough Boards, which would administer the challenge at the borough level. NYSERDA funding would be used to hire community engagement coordinators to manage outreach efforts in each borough. Ideally, funding would be sufficient to support a full-scale outreach program, with 59 engagement coordinators, one assigned to each of the city's Community Board districts. In the absence of such funding, a smaller number of coordinators (between one and five per bor-

ough) would be hired. This type of funding would require a major commitment from NYSERDA and would likely require the personal commitment of the Mayor and the Governor.

Once informed about the challenge and how it works, Borough Boards would begin promoting the challenge in their boroughs, using advertising and events to generate borough pride and maximize interest. Borough Boards receive designated funds from the city budget for program implementation and might therefore be able to provide additional funding for the challenge (NYC.gov, 2012) (New York City Council, 2012). Borough Presidents could serve as advocates and trusted messengers for the challenge, as could Community Board chairpersons. In addition to the Borough Presidents, other trusted messengers, like NYC celebrities or residents who participated in the NYSERDA pilot challenge could be identified and enlisted to tell success stories of GHG emissions reduction and disseminate information whenever possible.

Regardless of the number of engagement coordinators hired for the challenge, they would work closely with the Community Boards in their assigned boroughs. The Community Boards have both a neighborhood presence and local knowledge that could help facilitate the engagement component of the challenge through tailoring of strategies to best communicate with local populations. The boards are aware of the needs and attitudes of their constituents and have relationships with prominent organizations and institutions serving the community, which could be leveraged to support outreach efforts. As engagement efforts continued over the course of the program, coordinators would report progress, successes, and obstacles to Borough Boards to help identify borough-wide best practices.

An additional option for promotion and administration of the challenge that could be used in combination with or in place of engagement coordinators' efforts would be for The Mayor's Office to select local "challenge champions" known to be active in environmental initiatives throughout New York City. The New York League of Conservation Voters has rated New York City Council members on their green voting record (New York League of Conservation Voters, 2012). These scores could be used to identify appropriate individuals to act as challenge champions.

Under this administrative structure, the Mayor's Office would focus on overarching programmatic goals: data tracking, design, funding solicitation, and working with Borough Boards to coordinate outreach and partnering.

Participation

Our recommendations target individuals, and our recommended online platform for the initiative would therefore focus on private households and small businesses. Although corporations and larger commercial buildings have large carbon footprints as well, making changes in their operations is not usually an option at the local level, as these kinds of decisions are generally made at the corporate level. They would thus not be included in this challenge, which would focus, within the com-

mercial sector, on smaller businesses owned by NYC residents.

As previously described, participation would take place mainly through the challenge website, specifically on the data page's individual tab. At the individual level, the initiative should include rewards and incentives to keep participants motivated and active. We recommend that the Mayor's Office implement a point-based system in which different activities and behaviors yield points that are redeemable for various rewards made available through strategic partnerships and program sponsorship. Rewards should be consistent with the challenge's GHG reduction goals in order to encourage users to keep reducing their CO_2 emissions. For example, free compact fluorescent light bulbs or free energy audits could be appropriate rewards, as both were well-received by communities in Los Angeles (Murphy, 2010). These incentives could be used to encourage people to continue participation in the challenge and to address the "single action bias" that could lead participants to lose interest after completing a single step in the challenge even though there are multiple steps involved (Lawrence Berkeley National Laboratory, 2010).

Although building energy use would be the focus of the challenge, opportunities for participants to report transportation-based emissions reductions could be part of the challenge as well, as transportation comprises 20 percent of NYC greenhouse gas emissions

Transportation Challenge

The goal of a Transportation Challenge would be to reduce vehicular transit miles in favor of public transportation, biking, or walking. Individuals would report reduced vehicular and transit miles and miles transitioned to more eco-friendly alternatives and would receive points for each vehicular mile replaced. Tracking could be performed by challenge participants using odometer readings over time, with the goal of reducing monthly averages of miles driven. Double points could be assigned to pedestrian or cycling mile replacements because they are zero emission modes of transport, while choosing public transportation—though still reducing emissions—is still associated with some greenhouse gas emissions. The transportation challenge would be a perfect venue for events-based education and promotion, strategic partnerships, and modeling success with trusted messengers. Incentives could include free "total fit pedometers" to track miles biked and walked as well as point reward trade-ins for discounts on items such as athletic gear. The Transportation Challenge would have specific targets and milestones, each associated with escalating rewards. A good model rewards program is provided by Stonyfield Yogurt, whose website is easy to navigate for tracking points and obtaining rewards (Stonyfield Yogurt). Effective promotion tools for this category include marketing and strategic partnerships with private companies willing to provide tradable rewards, as well as nonprofits to engage communities and sponsor promotional events and help increase participation.

(Dickinson & Tenorio, 2011). Changes in transportation are hard to measure and difficult to assign to a particular community, since transportation and its resulting emissions are by nature transitory. However, tools for evaluating the emissions impact of current behaviors could be useful for encouraging changes, while self-reporting tools could be used to estimate and track emissions changes in this sector. The challenge could encourage transportation changes by providing tools for estimating and self-tracking of reductions, and awarding points for reduced vehicle travel. As with individual energy consumption information, self-reported transportation data would not be included in the zip code and borough tallies for the purpose of the challenge due to their lack of precision. However, more precise measurements of transportation emissions reduction could be considered in future iterations of the challenge to make data more complete by including both of the top emissions-producing sectors in the city.

Whatever behaviors are included in the community GHG reduction challenge, participation by residents and small businesses, primarily through the challenge website, would be driven and sustained by a combination of promotion at the city, borough, and Community Board district levels, tools for participants to use in tracking their progress, and enticing incentives won through a points-based rewards system.

Data Tracking

Over the course of the challenge, the Mayor's Office would take primary responsibility for tracking each zip code and borough's progress in GHG emissions reduction. The Mayor's Office would compile emissions data based on zip code-level energy consumption statistics and update progress on the challenge website at regular (e.g. monthly) intervals to keep participants, engagement coordinators, and Borough Boards up to date on the accomplishments of the challenge. Self-reported data on energy use and transportation choices could be included in emissions measurements, but we recommend they be excluded until more precise and verifiable sources are available in those categories.

Challenge Duration

Both a short-term intensive program of three months and a yearlong challenge are strong options for the challenge's duration. Organizers of NYSERDA's Home Performance with Energy Star Community Pilot Program found it difficult to maintain public excitement over a yearlong period (Williams, 2012) and it might be more realistic to keep people's interest for a shorter period. Because summer and winter are the seasons of highest energy use with the greatest opportunity for reductions, a three-month intensive challenge could be held during one of these seasons. The challenge website could provide seasonally relevant tips for achieving optimal energy efficiency within homes. As seasons change, new challenges could be implemented and these energy-saving tips could be updated to reflect the nature of the current challenge.

Examining the NYSERDA Neighborhood Challenge Model

NYSERDA's 2010 neighborhood energy reduction challenge in Brooklyn began as "Sustainable Kensington Windsor Terrace Neighbors," based on the premise of households reducing energy use and comparing reduction progress to that of their neighbors. The data that provided the foundation for the challenge was based on the energy usage of each household, and adjusted for the number of residents in each household. The aim of the initiative was not only to reduce consumption, but also to test NYSERDA's internal processes to see if could they run a program of this kind. Because of this, the structure of the program was relatively informal; they used survey monkey to collect information, and asked participants to submit their 15-digit ConEd account numbers and a program manager used the account information to retrieve consumption data for each participating household every month.

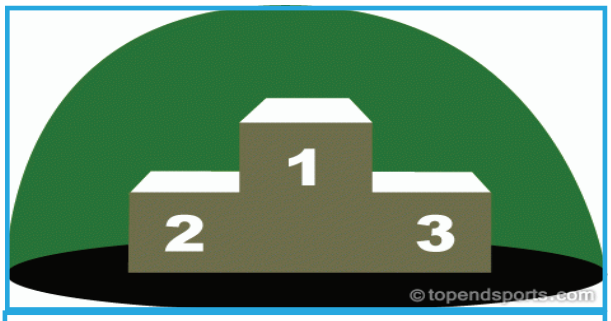
In order to increase outreach and collect data in a more efficient way, NYSERDA reached out to ConEd to involve the utility in the second phase of the initiative. NYSERDA also collaborated with councilmember Brad Lander of District 39, who joined the program as a co-host. The program was thereafter extended to six other Brooklyn neighborhoods in District 39 (Cobble Hill, Carroll Gardens, Park Slope, Windsor Terrace, Kensington, and Borough Park). They also focused on local organizations in the neighborhoods, such as parent-teacher associations and running clubs to encourage participation in the challenge. Each month, ConEd plugged consumption data from the160 participating into a report and shared analysis of the data showing leaders in consumption reduction. Winners of the competition were rewarded for the smallest footprint achieved, as well as the greatest reduction. All participants received two monthly communications: a monthly update and a newsletter, which included tips on energy efficiency and did-you-know information based on household characteristics as well as local volunteer opportunities. The newsletter also gave the progression in energy consumption of Brad Lander, so that people could see how they were doing compared to him every month.

One limitation of the challenge was that the data collected was not scientifically rigorous. NYSERDA wanted to see if consumption could be affected by a competitive challenge. Interestingly, it turned out that participants were actually more motivated to see how their usage compared to their own historic usage, rather than that of their neighbors. The strengths of the challenge stemmed mostly from the social cooperation that was built in the program. Although it was hard to keep people involved for 12 months, the initiative was a success and it showed that NYSERDA could effectively implement this type of program.

A yearlong program would be more aligned with the challenge's overarching goal of significant and long-term emissions reductions. This could consist of a series of focused three-month challenges or a yearlong challenge that does not split the year into different seasons with different focuses. In both cases, we see benefits to an annual program. Although a yearlong program might be more challenging as far as holding participants' interest, it has the potential to yield longer-term results, with participation in each season. If emissions-reducing behavioral changes are encouraged and monitored over a longer time period, they are more likely to become part of people's everyday lives, and to be continued beyond the duration of the community GHG reduction challenge.

Challenge Winners

The central feature of the community GHG initiative would be competition between boroughs for the greatest emissions reduction over the course of the initiative. To account for variations in zip code and borough populations, per capita percentage reductions of GHG emissions reduction would be used as the rubric for the competition.



Challenge winners will be both inter- and intra- borough so as to keep competition friendly and engage all possible participants.

In addition to competition between boroughs (and zip codes) to achieve the greatest reductions in emissions, per capita percentage reduction targets would be set for zip codes and boroughs, allowing for communities to achieve success by reaching reduction targets, even if they do not win the competition aspect of the challenge.

Winners of the challenge competition would be chosen at the zip code and borough levels according to utility data-based emissions reduction numbers. By excluding individual, self-reported behavior statistics, the zip code and borough winners would be based on hard data that is reported directly from utilities like ConEd and National Grid. Following recognition of the winning borough by the Mayor's Office and of winning zip codes by Borough Boards, the winners would receive prizes. Awards could come in the form of public events, such as street fairs or free concerts or material rewards, such as free energy-efficient appliances for winners of a challenge lottery.

Expanding NYSERDA's Neighborhood Challenges

The program outlined above represents our primary recommendation that may or may not be feasible to implement within the timeframe established for the challenge. Therefore, we offer a secondary recommendation: implementing a smaller-scale initiative based on NYSERDA's neighborhood energy efficiency challenge that might be more easily

implementable at a city level since they have been previously carried out.

The goal of both NYSERDA's challenges was for participating households to reduce their energy consumption and compare their progress to each other over time. (See the design option focus feature "Examining the NYSERDA Neighborhood Challenge Model.") In order to measure use and track progress, NYSERDA collected and analyzed monthly utility data for each participating household. This proved to be an effective strategy for engaging New Yorkers and reducing household emissions (Gordon, 2010).

The NYSERDA behavioral initiatives were run at a much smaller scale than the full-scale, borough-based initiative we have recommended. Therefore, a citywide challenge modeled after the NYSERDA initiatives could consist of a first phase pilot program that identifies target neighborhoods in each borough and participants who are willing to disclose their utility data. Pursuing this option would allow the Mayor's Office to learn about the unique challenges and opportunities in different boroughs, establish a GHG reduction foothold and identify champions. Pilot program participants could represent their boroughs while fellow borough residents support them as they share their triumphs and tribulations throughout the pilot challenge.

However, before a pilot program could be scaled up to a full borough challenge that targets all NYC citizens, some key issues would need to be addressed. The first would be the need for disaggregated energy consumption and other GHG emissions-relevant data. In the NYSERDA programs, ConEd provided an excel sheet every month with the consumption data from all the participants, but this model is most likely not feasible at the city level due to the heavy time and resource demands it would place on utilities. However, expanding an existing program would offer the benefits of lessons learned from the pilot initiative and the presence of basic program infrastructure. We therefore recommend the collection of energy data at the zip code level be combined with other elements of the NYSERDA programs if this alternative recommendation is implemented.

Long-Term Considerations of Data Availability

Whatever structure is chosen for the community GHG reduction challenge, its success will ultimately depend upon the availability of disaggregated data from utilities like ConEd. The most significant challenge in devising the above-presented options was the limitation of data availability. Although zip code-level data provides an acceptable statistical resolution for the program, they are not ideally precise. In order to create an emissions-reduction initiative based upon maximally accurate data, we recommend that OLTPS identify and collaborate with stakeholders to lobby the New York State Public Services Commission in pursuit of a mandate that New York City utilities update their data collection infrastructure to be able to provide geo-coded, disaggregated data at a higher resolution than zip-codes, while still protecting customers' private information.

Implementation: First Steps

1. Begin design and construction of challenge website that includes systems for presenting data, tracking reductions, participant blogs, videos, uploading photos, distributing information, tools for participants, and redeeming rewards.
2. Secure financial support through NYSERDA energy efficiency fund as necessary.
3. Work with Borough Boards to establish administration and communication processes and an implementation timeline.
4. Hire community engagement coordinators to assign to each borough.
5. Reach out to strategic partners to establish redeemable rewards point systems and perform community outreach and education. Possible partners include Business Improvement Districts, nonprofits, schools, trusted messengers/community leaders, and corporate sponsors.
6. Develop point-based tracking and rewards system for individual participants, offering rewards provided by business partners of the challenge.
7. Inform New Yorkers and build anticipation of the challenge with a marketing campaign that models success with trusted messengers—possibly from a pilot initiative—prior to and during the citywide initiative.

CONCLUSION

Our research has indicated that a successful community greenhouse gas reduction initiative in New York City should include comprehensive and complementary plans for the boundaries, measurements, and community engagement aspects of the initiative at its outset. We found the lack of access to high-resolution data on energy consumption to be the single largest barrier to the implementation of a community GHG reduction challenge that would achieve optimal levels of accuracy and reliability. With this in mind, we strongly recommend that the Mayor's Office pursue access to such data, be it through utilities, the New York State Public Service Commission, or through other avenues. Nevertheless, we believe the options we have presented to surmount the obstacle of data access are sufficient to provide the foundation of a robust and effective community greenhouse gas emissions reduction challenge.

APPENDICES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10024
10029
10021
10019
W 110th St
W 96th St
W 86th St
W 79th St
E 96th St
E 65th St
Manhattan Valley
Upper West Side
East Harlem
Manhattan Island
West Side
Broadway
Hudson
New York
Central Park
Hell's Kitchen


Low
emission
ZONE

APPENDIX A - Evaluation of GHG Emissions Reduction Sources in NYC, 2005-2010

Below is a chart of the analysis of the areas of effects on greenhouse gas emissions in New York City between 2005 and 2010. The "Net Effect" is the difference between the emissions calculated in 2010 and the emissions of the base-year, 2005. In order to look at the magnitude of reductions (or increases) between these two periods, we divided the Net Effect by the baseline of 2005 emissions and multiplied it by 100 to determine the Percentage of Change. This will help us determine which areas have improved (or worsened) the most from the beginning of reduction and monitoring efforts. The last two columns categorize each area of effect by its "type" of driver (whether it is driven by consumption, production on the utility end, or externally such as weather) and if it is driven by individual behavior/decision-making. We then compared the decreases, increases, net impact, the 2010 estimate and the individual behavior numbers to the 2005 baseline. Lastly, we looked at these numbers as a percent of net impact to determine how much of individually driven areas constituted the net decrease from 2005.

Area of Effect	Net Effect (mil. metric tons of CO2e)	2005 Emissions	Percentage of Change	Type of Effect (External, Consumption, Utilities)	Caused by Individual Behavior/Decisions?
Mild Winter	-1.1	N/A		External	No
Less Electricity Use Per Person	-0.68	20.04	-3.39	Consumption	Yes
Less Heating Fuel Use Per Person	-0.21	10.4	-2.02	Consumption	Yes
Reduced Vehicle Use	-0.12	7.64	-1.57	Consumption	Yes
Reduced Solidwaste Export Emissions	-0.05	0.14	-35.71	Consumption	Yes
Improved Streetlight Efficiency	-0.03	0.13	-23.08	Consumption	No
Reduced Solid Waste Generation	-0.18	1.57	-11.46	Consumption	Yes
Improved Landfill Methane Capture	-0.02	0.12	-16.67	Utility	No
More Efficient Electricty Generation/Cleaner Imported Electricity	-5.06	N/A		Utility	No
More Efficient Steam Generation	-0.56	2.23	-25.11	Utility	No
Reduced SF6 Emissions	-1.79	2.04	-87.75	Utility	No
Increase in Population/Buildings	2.34	N/A		External	No
Warmer Summer	0.08	N/A		External	No
Increase Transit Service	0.09	1.65	5.45	Consumption	Yes
Increased WWTP Methane Released	0.06	0.225	26.67	Utility	No

Table 1: Analysis of NYC Citywide Emissions Reductions, 2005-2010 (Dickinson and Tenorio 2011).

APPENDIX B—Detailed Description of Four of London's Ten Low Carbon Zones

1) Muswell Hill low carbon zone (in the borough of Haringey)

The Muswell Hill low carbon zone encompasses a cross section of the local neighborhood, including businesses, private and council owned housing, community buildings, schools, faith groups, and a library. Haringey is well on track towards achieving its carbon reduction target. The area was chosen as a LCZ because of strong local support for the initiative. The approach has been innovative and constructive, reflecting both the council's commitment to climate change mitigation and the active participation of an engaged local community, led by Muswell Hill Sustainability Group. The group is active in the management of the zone and has brought through 15 volunteers to act as community champions. Key challenges faced by the Muswell Hill low carbon zone includes a thermally inefficient and old housing stock, planning constraints due to the presence of a Conservation Area and high levels of private car use.

Activities:

- The zone's domestic retrofit project in is proving popular. This is almost certainly due to the trusted social marketing that these volunteers provide. Haringey is looking to evaluate formally the success of this approach and to quantify the carbon saving worth of the indirect emissions projects (waste, food, travel) they are delivering. Together, these are providing some key learning for the other zones and the LCZ programme as a whole.
- En10ergy, a community owned social enterprise company launched and has recruited around 100 members. This organisation has developed a photovoltaic (PV) array installed at the local Marks & Spencer on leased roof space, selling electricity back to the store. It has set up a bulk-buying group for more expensive measures (boilers, solar thermal and PV) and the uptake of these measures is expected to accelerate as a result. It is looking to use any revenues to re-invest in energy efficiency.
- Haringey has been successful in a bid to DECC's Low Carbon Communities Fund, providing over £300k towards PV arrays installed on three schools and a zero-carbon teaching cabin, the Living Ark. This has been complemented by energy efficiency improvements at the schools and also at Muswell Hill Community Centre and Muswell Hill Library utilising the Council's Sustainable Investment Fund.
- The council is looking to bring forward a loan scheme in the zone in 2011-12 and is working through the internal funding options. This could bring between £200-500k of additional investment to the zone (London.gov.uk n.d.).

2) Archway low carbon zone (in the borough of Islington)

Archway is the largest zone and the carbon savings to date have been significant. A range of advice, support and discounts are available to residents and businesses in the zone to provide incentives for carbon saving practices. This includes free energy visits for homes and businesses with free, simple energy saving measures being offered.

Activities:

- A mix of community-led engagement by members of the Better Archway Forum (who are 'nudged' with small payments to door-knock) and home visits and events run through Groundwork's 'energy doctor' scheme have been the catalyst for activity in the street properties. Over 500 residents have been contacted and over 300 households have received the 'energy doctor' (enhanced easy measures and advice) service.
- Over 900 cavity walls have been insulated to date in social homes in the zone.
- The council originally expected a large number of loft insulations (provided free with GLA subsidy). However an unexpectedly large number of loft conversions has reduced uptake and we have worked with Islington to redesign the scheme to offer a mix of measures that will still deliver the expected carbon savings. This is proving successful.
- Audits, advice and low energy lighting are being offered to businesses in the zone. GLA funding is provided for discounted low energy lighting and this is proving popular. The project is further enhanced by the deployment of an e-monitoring tool that allows the council to monitor actual consumption and provide ongoing bespoke advice. This is now being rolled out across four more zones.
- A wide variety of awareness raising events, ranging from Islington's annual car free day, practical curtain lining and draught proofing workshops to Archway's Low Carbon Juke-box - using pedal power to generate music (London.gov.uk n.d.)

Figure A: Map of Archway LCZ (Islington.gov.uk n.d.)**.**

3) Barking Tow Centre low carbon zone (in the borough of Barking & Dagenham)

Since it was declared a low carbon zone, the council has worked hard to inspire, lead, guide and ultimately embed the principles of sustainability into the town centre.

Activities:

- Barking has secured a good Community Energy Saving Programme (CESP) deal with British Gas (BG) that will deliver a mix of external solid wall insulation, loft insulation and boiler replacements to homes in the zone over the next six months. Our £120k contribution to these works is matched by £145k from BG and £100k from Barking. This will deliver 4.2 per cent carbon savings against the zone baseline.
- Decent Homes retrofit projects have also been delivered in the zone saving 2.6 per cent against the baseline. A major 'climate adaptation' project on two 17-storey tower blocks is underway that will deliver a further 4.7 per cent. This will deliver energy and water savings and cut the risk of overheating and flooding. The investment in mitigation and adaptation works on these projects is estimated to be around £10m.
- St Joseph's RC Primary School has been given a solar photovoltaic (PV) array to provide low carbon electricity free of charge. Ripple Hall community centre has a council funded retrofit and PV project planned for the coming year and council funding is secured for this. Barking is now looking to use the FIT to put PV on all its community buildings and schools, including two schools in the zone.
- The local community is engaged and over 300 residents have received a mix of easy measures, advice, benefits checks, 'grow-your-own' seeds and car-club allowances and offers of free insulation. Match funding from energy suppliers maximises the value of investment and makes this is a zero cost offer for all households in the zone.
- A particular success has been the training of three local long-term unemployed residents to become Home Energy Assessors. Two have since gone on to full-time jobs, undertaking the assessments in the zone and now in the wider borough.
- The SME audit and advice project was late in starting due to procurement issues and was slow in taking off. However, recent engagement with the local shopping centre as the facilitator of engagement with its SMEs is proving productive and Barking is confident it will support enough businesses to meet that element of the carbon target (London.gov.uk n.d.).

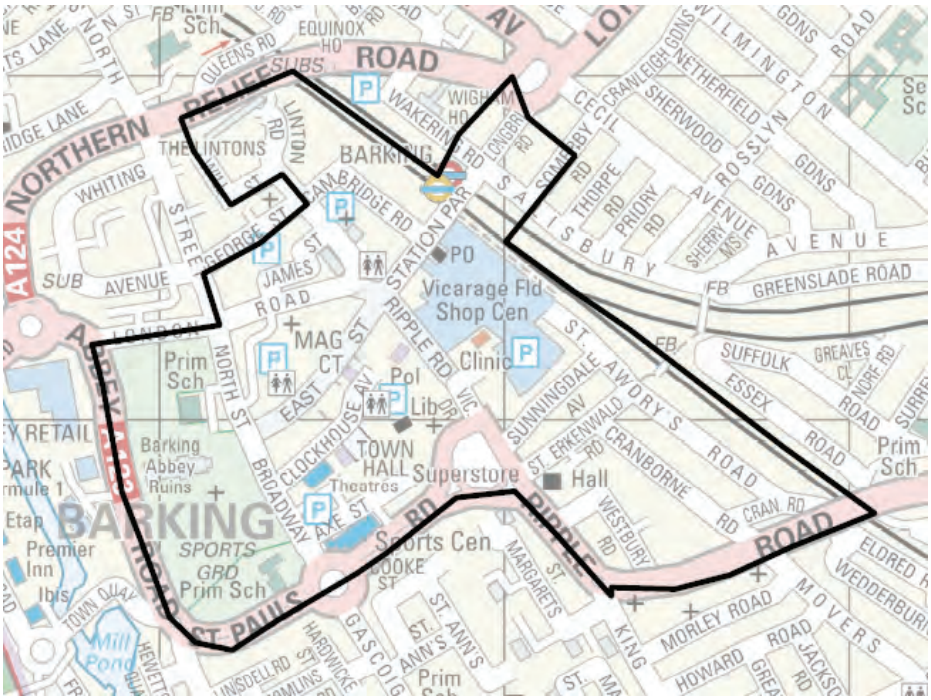

Figure B: Map of Barking LCZ (Barking-Dagenham.gov.uk n.d.)**.**

4) Ham and Petersham low carbon zone (in the borough of Richmond)

The villages of Ham and Petersham are positioned together next to Richmond Park within a bend of the River Thames. It is an area of contrast, with high levels of affluence cheek-by-jowl with relative disadvantage. The zone's focus is on delivering measures to a core area of 500 homes, plus schools and community buildings within a wider community of over 3,000 homes.

Activities:

- Residents of the zone are offered Green Homes Assessments including a range of offers from simple measures to more expensive ones. A local environmental charity and a community group are carrying out an innovative communications campaign. Thermal imaging, e-monitoring, street champions and local workshops have been brought together with activity in local schools. Interest levels in the offer are high and the simple measures and advice package has been rolled out effectively.
- In addition to Carbon Reduction Emissions Target (CERT) funding, British Gas are providing PV for free to the schools and community buildings via their 'Green Streets' project to a value of £100k. The council is match funding £165k towards the more expensive domestic measures.
- GLA is match funding an analysis of the feasibility and funding model for the potential micro-hydro energy scheme on the Thames at Teddington Lock. The ambition is that if it generates profit, this will be recycled towards community-scale energy saving projects (London.gov.uk n.d.)

APPENDIX C—Community Districts and Neighborhoods for the Five Boroughs

Figure C: Map of NYC's 59 Community Districts (NYC DCP)**.**

The above map is found of the NYC Department of City Planning website and is interactive – if you move your cursor over any of the Community Districts, it lists the neighborhoods in that district. Below is a list of the neighborhoods in each Community Districts.

STATEN ISLAND

Community District 1

Arlington
Castleton Corners
Clifton
Elm Park
Fox Hills
Graniteville
Grymes Hill
Howland Hook
Livingston
Mariner's Harbor
New Brighton
Old Place
Park Hill
Port Ivory
Port Richmond
Randall Manor
Rosebank
Shore Acres
Silver Lake
St. George
Stapleton
Sunnyside
Tompkinsville
Ward Hill
West Brighton
West New Brighton
Westerleigh
Willowbrook*

Community District 2

Arrochar
Bloomfield
Bulls Head
Chelsea
Concord
Dongan Hills
Egbertville
Emerson Hill
Grant City
Grasmere
Heartland Village
Lighthouse Hill
Manor Heights
Midland Beach
New Dorp
New Dorp Beach
New Springville
Old Town
South Beach
Travis
Todt Hill
Willowbrook*

Community District 3

Annadale
Arden Heights
Bay Terrace
Butler Manor
Charleston
Eltingville
Great Kills
Greenridge
Huguenot
Oakwood
Oakwood Beach
Pleasant Plains
Prince's Bay
Richmond Town
Richmond Valley
Rossville
Sandy Ground
Tottenville
Woodrow

MANHAT-TAN

Community District 1

Battery Park City
Civic Center
Ellis Island
Financial District
Governors Island
Liberty Island
South Street Seaport
Tribeca
Wall Street
World Trade Center

Community District 2

Greenwich Village
Hudson Square
Little Italy
NoHo*
SoHo
South Village
West Village

Community District 3

Chinatown
East Village
Lower East Side
NoHo*
Two Bridges

Community District 4

Chelsea
Clinton
Hudson Yards

Community District 5

Flatiron
Gramercy Park*
Herald Square
Midtown
Midtown South
Murray Hill*
Times Square
Union Square

Community District 6

Beekman Place
Gramercy Park*
Murray Hill*
Peter Cooper Village
Stuyvesant Town
Sutton Place
Tudor City

Turtle Bay

Community District 7

Lincoln Square

Manhattan Valley

Upper West Side

Community District 8

Carnegie Hill

Lenox Hill

Roosevelt Island

Upper East Side

Yorkville

Community District 9

Hamilton Heights

Harlem*

Manhattanville

Morningside Heights

West Harlem

Community District 10

Central Harlem

Harlem*

Community District 11

East Harlem

Harlem*

Randalls Island

Wards Island

Community District 12

Inwood

Washington Heights

THE BRONX

Community District 1

Melrose*

Mott Haven

Port Morris

Community District 2

Hunts Point

Longwood

Community District 3

Claremont

Crotona Park East

Melrose*

Morrisania

Community District 4

Concourse

Concourse Village

East Concourse

Highbridge

Mount Eden

West Concourse

Community District 5

Fordham*

Moris Heights

Mount Hope

University Heights*

Community District 6

Bathgate

Belmont

Bronx Park South

East Tremont

West Farms

Community District 7

Bedford Park

Fordham*

Kingsbridge Heights

Norwood

University Heights*

Community District 8

Fieldstone

Kingsbridge

Marble Hill

North Riverdale

Riverdale

Spuyten Duyvil

Community District 9

Bronx River

Castle Hill

Clason Point

Harding Park

Parkchester

Soundview

Soundview-Bruckner

Unionport

Community District 10

City Island

Co-op City

Country Club

Edgewater Park

Pelham Bay

Schuylerville

Throgs Neck

Village of Baychester

Westchester Square

Community District 11

Bronxdale

Indian Village

Laconia

Morris Park

Pelham Gardens

Pelham Parkway

Van Nest

Community District 12

Baychester
Eastchester

Edenwald

Olinville

Wakefield

Williamsbridge

Woodlawn

QUEENS

Community District 1

Astoria

Astoria Heights

Dutch Kills

Long Island City*

Ravenswood

Rikers Island

Steinway

Community District 2

Blissville

Hunters Point

Long Island City*

Sunnyside

Sunnyside Gardens

Woodside

Community District 3

East Elmhurst

Jackson Heights

North Corona

Community District 4

Corona

Corona Heights

Elmhurst

Lefrak City

South Corona

Community District 5

Glendale

Maspeth

Middle Village

Ridgewood

Community District 6

Forest Hills

Forest Hills Gardens

Rego Park

Community District 7

Auburndale*

Bay Terrace

Beechhurst

Clearview

College Point

Downtown Flushing

Flushing

Kissena Park

Malba

Murray Hill*

Queensboro Hill

Waldheim

Whitestone

Community District 8

Briarwood

Fresh Meadows

Hillcrest

Jamaica Estates

Jamaica Hills

Jamaica*

Kew Gardens Hills

Pomonok

Utopia

Community District 9

Kew Gardens

Ozone Park*

Richmond Hill

Woodhaven

Community District 10

Howard Beach

Lindenwood

Old Howard Beach

Ozone Park*

South Ozone Park

Community District 11

Auburndale*

Bayside

Douglaston

Hollis Hills

Little Neck

Oakland Gardens

Community District 12

Hollis

Jamaica Center

Jamaica*

North Springfield Gardens

Rochdale

South Jamaica

St. Albans

Community District 13

Bellaire

Bellerose

Brookville

Cambria Heights

Floral Park

Glen Oaks

Laurelton

New Hyde Park

Queens Village

Rosedale

Springfield Gardens

Community District 14

Averne

Bayswater

Belle Harbor

Breezy Point

Broad Channel

Edgemere

Far Rockaway

Hammels

Mott Creek

Neponsit

Rockaway Park

The Rockaways

Roxbury

Seaside

Somerville

BROOKLYN

Community District 1

East Williamsburg

Greenpoint

Northside

Southside

Williamsburg

Community District 2

Boerum Hill

Brooklyn Heights

Brooklyn Navy Yard

Clinton Hill

Downtown Brooklyn

Dumbo

Farragut Houses

Fort Greene

Fulton Ferry

Vinegar Hill

Community District 12

Community District 3

Bedford-Stuyvesant

Stuyvesant Heights

Tompkins Park North

Community District 4

Bushwick

Community District 5

Broadway Junction*

City Line

Cypress Hills

East New York

Highland Park

New Lots

Spring Creek

Starett City

Community District 6

Carroll Gardens

Cobble Hill

Gowanus

Park Slope

Red Hook

South Slope

Community District 7

Industry City

Sunset Park

Windsor Terrace

Community District 8

Crown Heights

Prospect Heights

Weeksville

Community District 9

Crown Heights South

Prospect Lefferts

Prospect Lefferts Gardens

Wingate

Community District 10

Bay Ridge
Dyker Heights

Fort Hamilton

Community District 11

Bath Beach

Bensonhurst

Gravesend*

Mapleton

Community District 12

Borough Park

Kensington

Ocean Parkway*

Community District 13

Brighton Beach

Coney Island

Gravesend*

Homecrest*

Sea Gate

West Brighton

Community District 14

Ditmas Park

Flatbush*

Manhattan Terrace

Midwood

Ocean Parkway*

Prospect Park South

Community District 15

Gerritsen Beach

Gravesend*

Homecrest*

Kings Highway

Manhattan Beach

Plumb Beach

Sheepshead Bay

Community District 16

Broadway Junction*

Brownsville

Ocean Hill

Community District 17

East Flatbush

Farragut

Flatbush*

Northeast Flatbush

Remsen Village

Rugby

Community District 18

Bergen Beach

Canarsie

Flatlands

Georgetown

Marine Park

Mill Basin

Mill Island

Paerdegat Basin

**These neighborhoods are in more than one community district.*

APPENDIX D—New York City Postal Zip Codes

Borough	Neighborhood	ZIP Codes
Bronx (25)	Crotona - Tremont	10453, 10457, 10460
	Fordham - Bronx Park	10458, 10467, 10468
	High Bridge - Morrisania	10451, 10452, 10456
	Hunts Point - Mott Haven	10454, 10455, 10459, 10474
	Kingsbridge - Riverdale	10463, 10471
	Northeast Bronx	10466, 10469, 10470, 10475
	Pelham - Throgs Neck	10461, 10462,10464, 10465, 10472, 10473
Brooklyn (37)	Bedford Stuyvesant - Crown Heights	11212, 11213, 11216, 11233, 11238
	Bensonhurst - Bay Ridge	11209, 11214, 11228
	Borough Park	11204, 11218, 11219, 11230
	Canarsie - Flatlands	11234, 11236, 11239
	Coney Island - Sheepshead Bay	11223, 11224, 11229, 11235
	Downtown - Heights - Slope	11201, 11205, 11215, 11217, 11231
	East Flatbush - Flatbush	11203, 11210, 11225, 11226
	East New York	11207, 11208
	Greenpoint	11211, 11222
	Sunset Park	11220, 11232
	Williamsburg - Bushwick	11206, 11221, 11237
Manhattan (41)	Central Harlem - Morningside Heights	10026, 10027, 10030, 10037, 10039
	Chelsea - Clinton	10001, 10011, 10018, 10019, 10020, 10036
	East Harlem	10029, 10035
	Gramercy Park - Murray Hill	10010, 10016, 10017, 10022
	Greenwich Village - Soho	10012, 10013, 10014
	Lower Manhattan	10004, 10005, 10006, 10007, 10038, 10280
	Union Square - Lower East Side	10002, 10003, 10009
	Upper East Side	10021, 10028, 10044, 10128
	Upper West Side	10023, 10024, 10025
	Washington Heights - Inwood	10031, 10032, 10033, 10034, 10040

Queens (61)	Bayside - Little Neck	11361, 11362, 11363, 11364
	Flushing - Clearview	11354, 11355, 11356, 11357, 11358, 11359, 11360
	Fresh Meadows	11365, 11366, 11367
	Jamaica	11412, 11423, 11432, 11433, 11434, 11435, 11436
	Long Island City - Astoria	11101, 11102, 11103, 11104, 11105, 11106
	Ridgewood - Forest Hills	11374, 11375, 11379, 11385
	Rockaway	11691, 11692, 11693, 11694, 11695, 11697
	Southeast Queens	11004, 11005, 11411, 11413, 11422, 11426, 11427, 11428, 11429
	Southwest Queens	11414, 11415, 11416, 11417, 11418, 11419, 11420, 11421
	West Queens	11368, 11369, 11370, 11372, 11373, 11377, 11378
Staten Island (12)	Port Richmond	10302, 10303, 10310
	South Beach - Tottenville	10306, 10307, 10308, 10309, 10312
	Stapleton - St. George	10301, 10304, 10305
	Willowbrook	10314

Table 2: Zip codes for each of the five boroughs, with neighborhood names (NY DOH)**.**

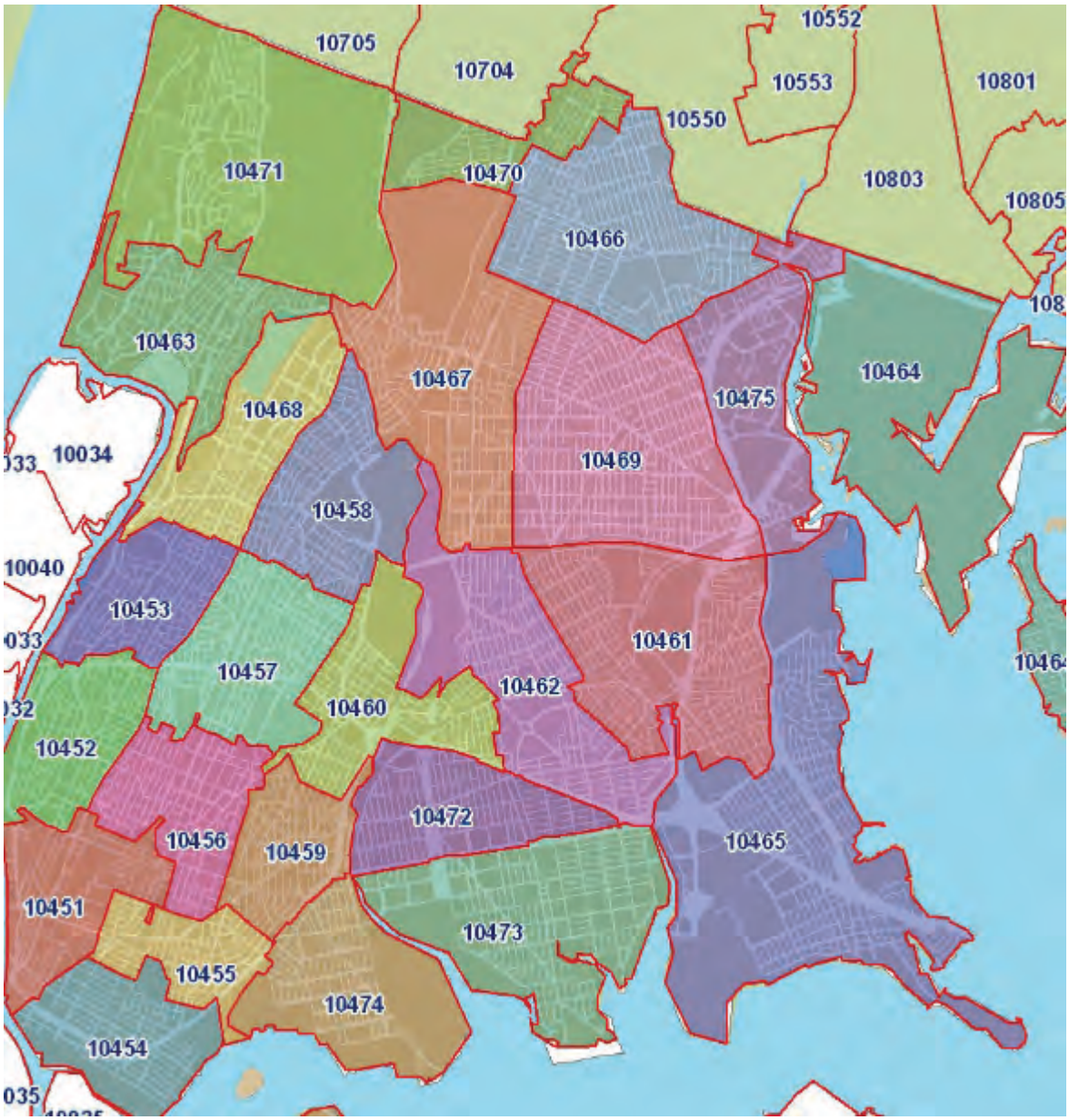

Figure D: Bronx Zip Code Map

Figure E: Brooklyn Zip Code Map

Figure F: Manhattan Zip Code Map

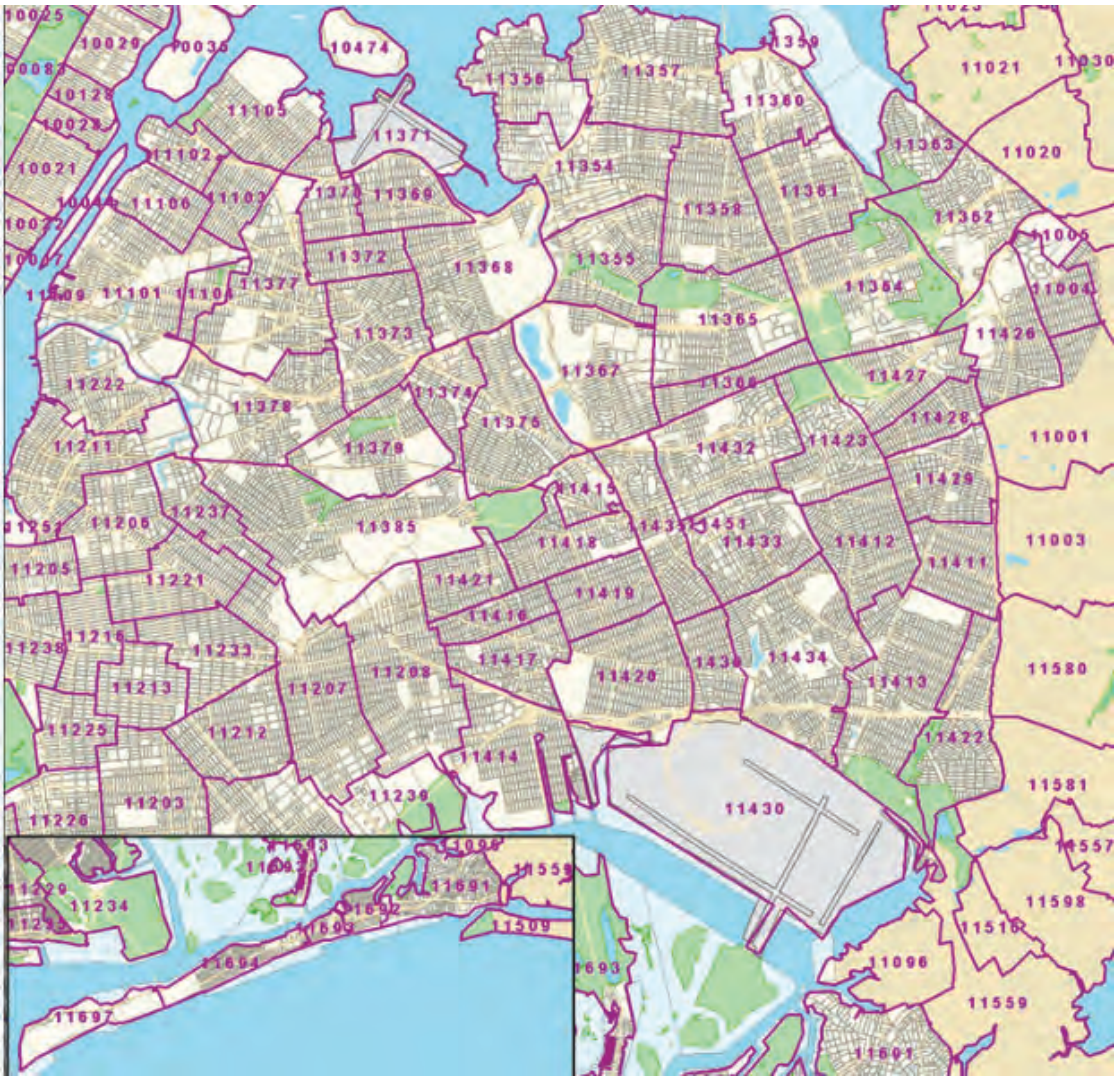

Figure G: Queens Zip Code Map

Figure H: Staten Island Zip Code Map

All maps from: http://www.unhp.org/crg/indy-maps.html#zipanchor

APPENDIX E—Online Resources

The Gainesville Green website allows visitors to compare their home energy use to that of their neighbors. The idea is that this helps homeowners conserve energy through education and competition. The site calculates relevant comparisons for home energy use and displays detailed information about household performance. Users are given various options to view, analyze, and understand how they use energy and compare with their peers. Building and consumption data are imported from several freely available government sources.

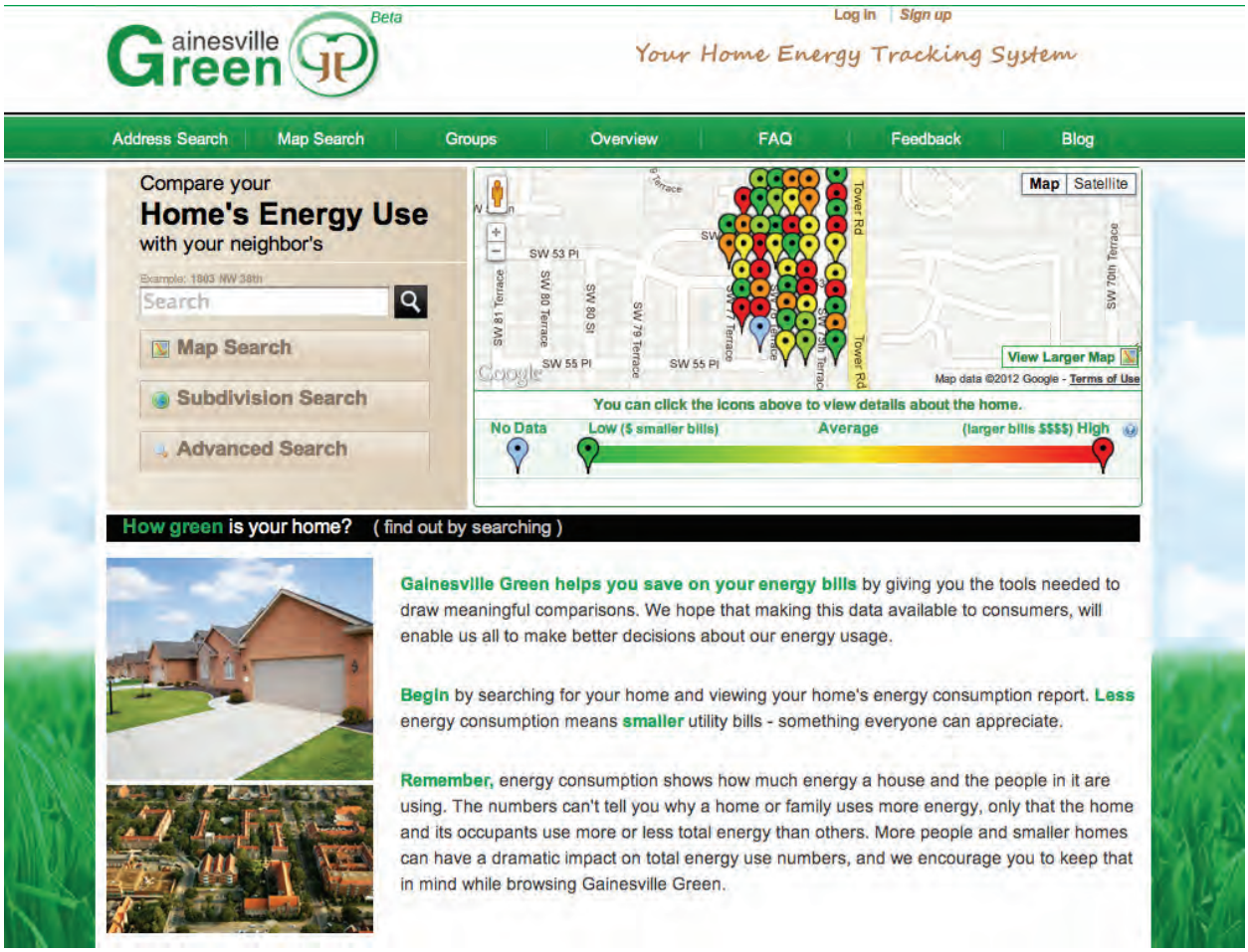

Figure I: Gainesville Green Website

http://gainesville-green.com/

Stockholm's Klimatsmart website is a detailed portal with information and resources for users interested in learning more about low-emissions lifestyle tips, businesses, events and much more.

Figure J: Stockholm's Climate Smart (Klimatsmart) website

http://www.klimatsmart.se/

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