Synapse
Energy Economics, Inc.

Air Quality In Queens County

Opportunities for Cleaning Up the Air in Queens County and Neighboring Regions

Executive Summary

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Executive Summary

S.1 Introduction

In the interest of protecting the environment and public health of Northwest Queens, the Natural Resource Defense Council (NRDC) and the Citizens Helping Organize for a Klean Environment (CHOKE) participated in the New York State Article X permitting process for several new power plants proposed in Northwest Queens. One of their objectives was to have a study conducted to analyze the contributors to air pollution in Northwest Queens and to identify possible strategies for improving air quality and reducing risks to public health. As part of the Article X permitting process for its 250 MW Ravenswood Combined Cycle project, KeySpan committed to funding such a study as a community benefit. CHOKE and NRDC contracted with Synapse to conduct this study. The conclusions and recommendations are those of the authors but do not necessarily reflect the position of KeySpan.

One of the reasons that Queens County was chosen for this study is that it is home to many sources of air pollution. In the northwest corner of the county there currently are four large power plants, which together house 46 electric generating units. The county also contains an extensive transportation network that includes the Long Island Expressway, the Brooklyn Queens Expressway, the Grand Central Parkway, two highway bridges, a tunnel to Manhattan, and two airports, along with over 400 miles of arterial and local roads. Queens also has several large industries, and some 2.2 million residents, leading to significant economic activity which contributes to air quality problems.

While Queens contains many large sources of air pollution, it is also important to note that a significant portion of the borough's pollution arises from pollution sources located upwind. Similarly, much of the pollution generated within Queens affects the air quality of other regions located downwind of the county. Thus, this report should be informative to policymakers throughout the Northeastern US – as the air quality problems and opportunities that exist throughout this large region are inextricably linked.

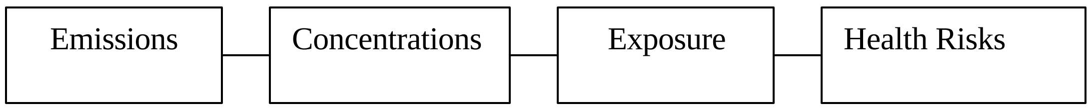
S.2 Overview of Urban Air Pollution

Framework for Assessing Pollution and Health Threats

Like most large urban areas, Queens has numerous pollutants in its air. This can make it difficult to set priorities for improving air quality, since the pollutants come from different sources, have different health effects, and are regulated differently. In addition, since much of the pollution present in Queens blows in from other places, reducing pollution emissions from sources in Queens will only partially address the air quality problem there.

It is important to distinguish between the different types of emissions and pollutants. A pollutant that is emitted and has not been transformed at all in the air is called a *primary pollutant*. A pollutant that leads to the formation of another pollutant is called a *precursor*, and the pollutant that forms as a result of the emissions of the precursor is called a *secondary pollutant*. These distinctions are important to keep in mind, since they may mean that the pollutants we control at a source are not the same as the pollutants for which we want to reduce exposures to people.

It is also useful to point out the several different steps that lead to the health threats caused by air pollution. One can visualize the pathway leading to health risks as follows:



In other words, primary pollutants are *emitted* from a source (such as a power plant or a car) and result in *concentrations* of a pollutant outdoors and indoors. The concentrations of pollutants at any one point in space and time are determined by many factors, including the transport of pollutants from many miles away, and the creation of secondary pollutants through complex chemical processes. Human *exposure* occurs when people spend time in areas with pollutant concentrations. Finally, human exposure leads to public *health risks*, if the exposure concentrations are high enough.

There are three major categories of air pollutants that lead to public health and environmental risks – criteria air pollutants, toxic air pollutants, and greenhouse gases. For each of these categories, we provide a description of the pollutants as well as a discussion of the major health risk that they create for the citizens of Queens County.

Criteria Air Pollutants Defined

In accordance with the Clean Air Act, the US EPA has set uniform, nationwide standards for six pollutants that are considered harmful to human health and the environment at high concentrations. These six *criteria pollutants* are briefly described below. For these pollutants, two types of National Ambient Air Quality Standards (NAAQS) are established. Primary standards are set to protect public health, and secondary standards protect against decreased visibility and building damage, and protect other forms of public welfare. It is important to note that being below a NAAQS does not necessarily mean that there are no health risks, especially when multiple pollutants are present.

Carbon monoxide (CO) is a colorless, odorless gas that is almost entirely due to motor vehicle exhaust in dense urban areas. It is harmful to health because it can displace oxygen in our bloodstream, reducing delivery of this vital substance to the cells of our bodies.

Nitrogen dioxide (NO_2) is a reddish-brown gas that is formed when fuel is burned. NO_2 is a precursor of both ozone and of nitrate particulate matter. Across the US, about half of the NO_2 comes from motor vehicles, with about a third from power plants. When inhaled, NO_2 can irritate and damage the cells lining the deep regions of our lungs.

Sulfur dioxide (SO_2) is a gas principally formed when fuel containing sulfur (such as coal or oil) is burned, and is a precursor of sulfate particular matter. About two-thirds of the SO_2 in the US comes from fossil-fired power plants. When inhaled, SO_2 deposits and irritates the upper regions of our lungs. SO_2 is also a major contributor to acid rain, which leads to environmental damage to aquatic and forest ecosystems.

Ozone (O_3) is a major component of smog and is a secondary pollutant, formed when nitrogen oxides (NOx, which includes NO_2) react with volatile organic compounds (VOCs) in the presence of sunlight. Ozone is a strong oxidant gas which, upon inhalation, causes damage to the sensitive cells in the deep regions of our lungs. It can lead to decreased lung functions, increased hospitalizations, and possibly increased mortality risks.

Lead (Pb) is a metal that was once principally related to motor vehicles (since tertraethyl lead was used as an antiknock agent in gasoline). Now that unleaded gasoline is used, most of the lead in the air comes from lead smelters or other industrial sources. Lead exposure results in chemical changes in the brain which can reduce intelligence.

Particulate matter is defined as any solid or liquid suspended in the air. Particulate matter can therefore contain a large number of different chemicals or substances, and can vary greatly in size. PM_{10} is the fraction of particles less than 10 μm in diameter (roughly one-seventh the width of a human hair). The US EPA has recently focused on $PM_{2.5}$, the fraction of particles less than 2.5 μm in diameter, since those smaller particles are more likely to get deeper into the lung. Particulate matter is both a primary pollutant (including fly ash, soil, sea salt, and diesel particles) and a secondary pollutant (including sulfate and nitrate particles). Exposures to particulate matter have been associated with a wide range of adverse health impacts, including respiratory symptoms, decreased lung functions, increased hospitalizations, and increased mortality risks.

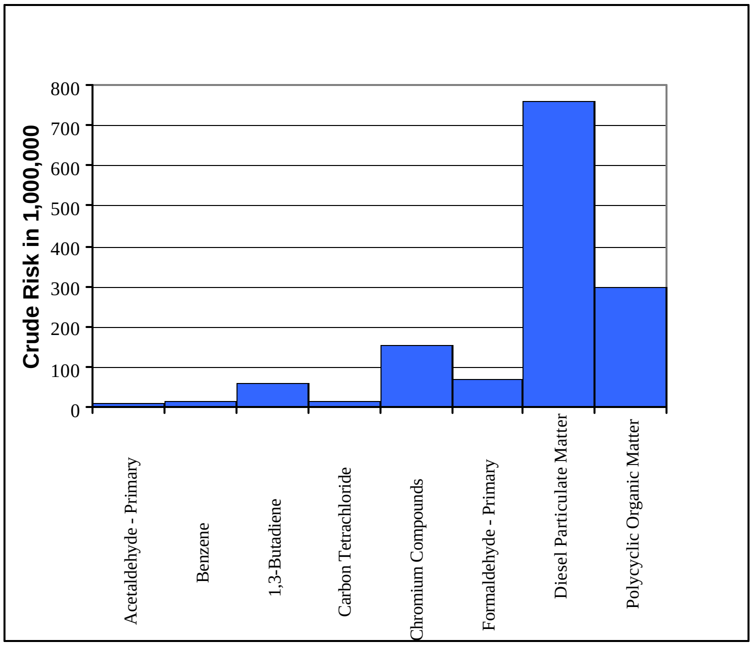
Hazardous Air Pollutants Defined

In addition to the criteria pollutants, the US EPA maintains a list of 188 toxic air pollutants, also known as hazardous air pollutants (HAPs), that are considered detrimental to human health. Unlike the criteria pollutants, HAPs do not have air quality standards, although emissions of some HAPs are regulated under the Clean Air Act. People exposed to air toxics at high levels for long time periods may have an increased chance of getting cancer, damaging their immune system, or suffering from neurological, reproductive (e.g., reduced fertility), developmental, respiratory and other health problems.

US EPA has constructed a list of 34 hazardous air pollutants (33 air toxics and diesel particulate matter) that constitute the greatest public health threat in urban areas. We have further reduced the list to those that create the greatest health risk in Queens. We use estimated concentrations of air toxics in Queens and published cancer risks of these 34 air toxics to pick a subset of pollutants that require closer scrutiny.

Figure S.1 shows the eight pollutants most likely to significantly contribute to cancer risk in Queens, along with their approximate cancer risk rates. In descending order of importance, they are diesel particulate matter, polycyclic organic matter (POM), chromium compounds, formaldehyde, 1,3- butadiene, benzene, carbon tetrachloride, and acetaldehyde. As indicated in the table, the cancer risk from diesel particulate matter is greater than that for all the other eight HAPs combined.

Figure S.1 Estimated Cancer Risks Of Top Eight Air Toxics In Queens



Greenhouse Gases Defined

GHGs include carbon dioxide (CO_2), methane, nitrous oxide, and multiple other pollutants. CO_2 is the greenhouse gas of most concern because of the large volumes of CO_2 emissions relative to other GHGs. While, some of the other GHGs have greater "global warming potential" per unit volume, they are emitted in much smaller volumes.

Although they do not affect human health directly, greenhouse gases (GHGs) contribute to global climate change and associated health problems. Global climate change models predict that worldwide daily mortality and morbidity due to extreme heat events could significantly increase in this century, especially among elderly poor who often have pre-existing health conditions and may lack air conditioning or access to air conditioned spaces. Projected increases in frequency and duration of extreme heat events will exacerbate the "urban heat island effect," which raises daily urban temperatures up to 10 degrees Fahrenheit higher than the surrounding suburbs/exurbs, especially during the nighttime hours.

Other health impacts of climate change include increased rates of secondary air pollutant formation (e.g., O_3 and some $PM_{2.5}$ components), incidence of vector-borne and water-borne diseases, and possibly increased frequency and severity of storms. By as early as the 2020s, there could be significant increases in the sea level in the New York area.

Sea-level rise, combined with more frequent droughts and floods, will pose a significant challenge to urban transportation and drinking water delivery infrastructure. While the vulnerability of Queens to these impacts has not yet been specifically assessed, its highly urbanized structure and extensive coastline suggest a high degree of risk.

S.3 Air Quality and Health Risks in Queens

Criteria Pollutant Levels in Queens

Evaluation of air quality requires analysis of specific data on pollutant concentrations in the air. The air quality in Queens is monitored on a regular basis for a number of pollutants, and data are readily available for these pollutants. The six criteria air pollutants are monitored at numerous locations on a regular basis to evaluate whether the air meets federally mandated ambient air quality standards. Most of these pollutants are measured on a continuous basis, either with daily or hourly average concentrations.

In the past decade, ambient levels for all six criteria pollutants have decreased nationally. However, progress has been slowest for ozone and small particulate matter. Limited progress on the ozone front is largely due to emissions of precursor gases from power plants, especially those in the Midwestern US, and motor vehicles. The highest concentrations of ozone are generally in areas downwind of major urban areas. Limited progress on small particulate matter is due to both vehicle emissions and sulfur dioxide emissions from coal-fired power plants. Concentrations of small particulate matter are particularly high in the Eastern US.

Air quality in Queens itself can be evaluated in comparison to federally mandated ambient air quality standards, air quality indices and other measures. Unhealthy air conditions, as measured using air quality indices, have decreased in the New York metropolitan area in the last decade. For example, sulfur dioxide concentrations in New York City are now well below federal standards, and the EPA has recently redesignated the city to be in attainment of carbon monoxide standards.

However, New York City and Queens County are still burdened with significant air quality problems. Environmental Defense has ranked Queens among the worst 10% of US Counties in terms of its exposure to criteria air pollutants. The greatest remaining threats are caused by ozone and particulate matter, both of which can have severe health impacts. The US EPA has determined that the NY metropolitan area, including Queens is in "severe nonattainment" for ozone; Queens is one of the two city boroughs that violates federal standards. Based on monitoring data, EPA expects that when $PM_{2.5}$ designations are made, most of New York City, including large parts of Queens, will be defined as non-attainment areas.

It is important to note that compliance with National Ambient Air Quality Standards is not necessarily sufficient to eliminate public health risks from air pollution. There is ample evidence of health risks at concentrations below those national standards, especially for particulate matter.

Hazardous Air Pollutant Levels in Queens

Unlike criteria pollutants, data on emissions and air concentrations are more limited for hazardous air pollutants. While individual sources must meet specific emissions standards for certain toxics, there are no air quality standards for air toxics. Estimates of air toxics exposures require alternative data sources and estimation methods than can be used for criteria pollutants.

Based on modeling, ambient air toxics concentrations of several air toxics in Queens derive primarily from on-road mobile sources (cars, trucks, buses) and off-road mobile sources (including airplanes, airports, and trains). Because there are no ambient air quality standards for these pollutants, the importance of the concentrations is best understood in reference to the estimated health risks described above.

For both criteria pollutants and air toxics, it is important to recognize that ambient air pollution concentrations do not necessarily represent the levels of air pollution to which people are exposed. This is due in part to the fact that, on average, Americans spend 90 percent of their time indoors. As a result, indoor exposure, because of either indoor sources or penetration of pollution from outdoors, can be an important source of health impacts. Personal exposure can therefore be considered a combination of exposures from both outside (i.e., ambient) sources and indoor sources. Numerous studies over the past 25 years indicate that for most pollutants, especially VOCs, NO_2 and particulates, personal exposures exceed ambient concentrations. For ozone, personal exposures are usually lower than ambient concentrations.

Moreover, despite the limitations of ambient air quality data, there is a strong correlation between outdoor air pollution levels and certain health outcomes. Epidemiological studies tell us that on days when air pollution levels are high, more people get sick or die. Such correlations lead to the ambient air quality standards set by EPA. Although we have a limited ability to know who is at highest risk because of our lack of personal exposure data and knowledge about population susceptibility, we can still draw population-wide inferences as long as average personal exposures increase when outdoor levels increase. For pollutants that penetrate indoors, even to a limited degree, this is indeed the case.

Greenhouse Gas Contributions From Queens

Information on emissions from specific greenhouse gas sources is limited at present, since GHGs are not currently regulated by federal or state laws. As such, GHG emissions reporting is entirely voluntary and often covers only greenhouse gas reduction efforts, rather than describing overall operational emission inventories.

Americans as a whole contribute far more to climate change on a per-capita basis than the rest of the world's people. The US is responsible for roughly one quarter of the total world's GHG emissions, even though we have only four percent of the world population, indicating that the average American generates 8 times as many greenhouse gases as the average non-American.

New York State is responsible for roughly four percent of US GHG emissions, but has more than 6 percent of the US population, and thus has a slightly lower per-capita green house gas emission rate than the rest of the US. Nonetheless, Queens produces large volumes of CO_2 emissions. For example, the power plants in Queens County produce roughly 15 percent of all the CO_2 emissions from all the power plants in New York State while accounting for about 15 percent of the State's electric capacity. Thus, Queens provides an important opportunity regarding New York City's and New York State's efforts to address global warming.

The NY State Energy Research and Development Authority forecasts that overall GHG emissions in the state will increase by 12% by 2010. This significant increase in emissions, coupled with Queens' substantial contribution to New York State GHG emissions, suggests that the reduction of greenhouse gases should be a high priority in improving air quality in Queens.

The Pollutants that Create the Greatest Health Risks In Queens

In order to identify opportunities for improving the air quality in Queens County and neighboring regions, it is useful to identify those pollutants that create the greatest health risks in Queens. Here we make a broad comparison of the health risks posed by the different criteria pollutants, hazardous air pollutants and greenhouse gases.

Ozone and particulate matter are the two criteria pollutants that currently pose the greatest health risk, both because of their toxicity and because levels of other criteria pollutants have been more greatly reduced in recent years. Thus, we focus our quantitative analysis here on just these two criteria pollutants. Also, remember that we have narrowed the EPA's list of priority air toxics down to eight HAPs that are of most importance to cancer risks in Queens.

In order to rank the health risks of ozone, particulate matter and HAPs, we analyze the premature deaths that might occur in Queens as a result of each pollutant. We assume hypothetically that concentrations of each pollutant are decreased by 10% across all of Queens, and we calculate the resulting reduction in premature deaths. This approach will only capture a fraction of the health benefits due to reduced concentrations, because it does not address health impacts beyond premature deaths. Nonetheless, it provides a useful methodology for creating priorities across the pollutant types.

We estimate that a 10% reduction of the eight priority HAP emissions in Queens would result in four fewer cancers (and associated premature deaths) per year in Queens. We also estimate that a 10% reduction in ozone concentrations would result in roughly 30 fewer premature deaths per year in Queens. Finally, we estimate that a 10% reduction in $PM_{2.5}$ concentrations (to be distinguished from emissions) would result in over 100 fewer premature deaths per year in Queens.

Thus, the health threat from ozone appears to be roughly a factor of ten greater than that of HAPs, and the health threat of $PM_{2.5}$ appears to be roughly a factor of three greater than that of ozone, when ranked on the basis of premature deaths. From this perspective, public policies to reduce air emissions should focus first on $PM_{2.5}$, and then on ozone, with less emphasis on HAPs.

We have not ranked greenhouse gases alongside the other pollutants in this study, due to the long-term timeframe and unpredictable nature of global warming impacts on public health. Nevertheless, it is clear that the potentially dramatic effects of global warming, both in Queens and elsewhere in the world, dictate that greenhouse gases receive substantial attention when addressing air pollution and air quality in Queens and the neighboring regions.

Factors Affecting Air Quality – Transport of Particulates and Ozone

There are a variety of factors that influence air pollution concentrations in a given area. These factors include not only the sources of air pollution and their locations, but also weather-related factors that influence how far pollutants travel and how they change in the air.

Particulate matter consists of many different chemicals and contains components that are directly emitted (primary particles), and components that are formed through reactions in the atmosphere (secondary particles). The most prevalent particle types are sulfate and nitrate particles (which constitute about half of the fine particulates on the East Coast), and elemental and organic carbon (which constitute about one third of the fine particulates on the East Coast).

Concentrations of different forms of particulate matter are determined by a variety of factors. The maximum concentrations associated with any given emission source are generally fairly close to the source. This effect is particularly strong for sources that emit primary particles, such as highways. The effect is reduced for sources that emit primarily precursor gases that will form into small particles, such as power plants. Tall emission stacks on power plants can mean that emissions occur high in the air and can travel long distances before being deposited. However, an individual living near a source will be at greater risk than an individual living hundreds of miles away, because of where the concentration is highest.

Ozone is formed most intensively during the summer months through reaction of NO_x, VOCs, and sunlight. In New York, as for much of the East Coast, the Ozone Season is designated as May 1 through September 30 of each year. This is the period during which ozone formation causes the most significant air pollution problems and health impacts.

Both ozone and particulate matter (and their precursors) can travel long distances in the atmosphere. As a result, pollutant concentrations in a particular area can be affected by sources far away. This characteristic is important in Queens due to meteorological conditions. Queens, and the rest of the New York City area, is affected by weather systems that move from west to east across the country. This predominant west to east weather movement transports air emissions from power plants in the Midwest (as well as other areas to the south and west). The transported pollutants significantly affect pollutant concentrations in the New York area.

S.4 Sources of Emissions Affecting Air Quality in Queens

Introduction and Caveats

Identifying the local sources of emissions that contribute to air quality problems in Queens is a difficult task. First, there is little reliable information to indicate the primary sources of some of the key emissions in Queens. We have reviewed several different data sources only to find that they are incomplete, inconsistent, or not based on data specific to Queens. Second, the formation of pollutants and the transport of pollutants into and out of Queens is a complex process that is difficult to analyze, and yet will have significant implications for the ambient air quality in Queens.

Nonetheless, here we broadly indicate those sources of emissions that are likely to have the greatest impact on the air quality in Queens. While we do not identify many of the specific sources of emissions, we indicate those sectors and those types of sources that are likely to have the greatest impact.

The US EPA recommends dividing sources of air emissions into four main categories, listed below. We use these categories throughout this report to describe the general types of sources in Queens

- Large stationary sources. Sometimes referred to as point sources, large stationary sources are those that emit at least 100 tons per year of any regulated pollutant. This category includes electric power plants, manufacturing, refineries, and steel mills.
- Area sources. This category includes all smaller stationary sources of emissions, such as residential and commercial furnaces and boilers, waste incinerators and miscellaneous small combustion sources. This category also includes non-combustion area sources such as gas stations and dry cleaners.
- On-road mobile sources. This category includes all transportation vehicles that travel on roads, including cars, taxies, buses, trucks, etc., using both diesel fuel and gasoline.
- Off-road mobile sources. This category includes all transportation vehicles that travel off-roads, such as airplanes, marine transportation, recreational vehicles, industrial, construction and mining equipment, using both diesel fuel and gasoline.

Sources of Particulate Matter

Several factors discussed above pertaining to the formation and transport of particulate matter, allow us to make only broad conclusions about the relative impact in Queens of the various sources of particulate matter. We believe that the sources that contribute to ambient particulate matter concentrations in Queens can be described as follows:

- Sources *outside* the metropolitan area contributes the largest portion of ambient of particulate matter in Queens. Much of this transported particulate matter comes from power plants and other industries in upwind states.

- Of the remaining ambient particulate matter in Queens, a large part comes from sources *within* Queens. Most of this particulate matter consists of primary emissions from the transportation sector, the electricity sector, and the area sources (i.e., residential and commercial boilers) within Queens, largely in the PM 2.5 category. Other sources include fugitive dust and natural sources such as suspended salt particles from the ocean and Long Island Sound, which consists mostly of coarser material.
- Another large portion of ambient particulate matter in Queens comes from similar sources *in other parts of the metropolitan area*. Compared with particulate matter from Queens sources, a larger proportion of the particulate matter in this category is secondary rather than primary.

Sources of Ozone and Ozone Precursors

Again, several factors discussed above pertaining to the formation and transport of ozone allow us to make only broad conclusions about the relative impact in Queens of the various sources of ozone. We believe that the sources that contribute to ambient ozone concentrations in Queens can be described as follows:

- Sources *outside* the metropolitan area contribute the largest portion of ambient ozone in Queens. Much of this ozone and ozone precursors come from power plants and other industries in upwind states. Ozone levels are highest in Queens and the Bronx, relative to the rest of New York City, because they are more directly downwind of Northern New Jersey, Newark, and Manhattan.
- Of the remaining ambient ozone in Queens, a large part comes from sources *within* Queens. Most of this ozone is due to ozone precursors from the transportation sector, the electricity sector, and the area sources (i.e., residential and commercial boilers) within Queens.
- Another large portion of ambient ozone in Queens comes from sources in *other parts of the metropolitan area*. Most of this ozone is likely to be due to precursors from the transportation sector, the electricity sector, and area sources.

Sources of Hazardous Air Pollutants (HAPs)

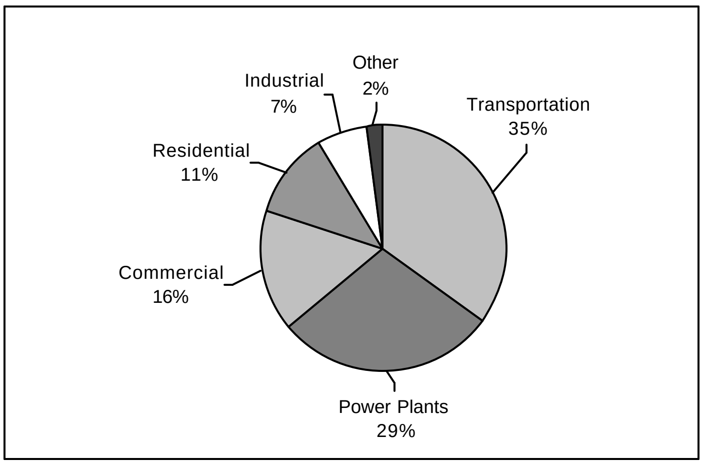
The transportation sector is by far the largest contributor to the health risks created by hazardous air pollutants in Queens. Diesel particulate emissions pose a health risk greater than all of the other seven priority HAPs combined (as described above), and almost all of the diesel particulate emissions are caused by on-road and off-road mobile sources. Furthermore, the transportation sector is responsible for the majority of the emissions of several of the other HAPs, including formaldehyde, benzene, and acetaldehyde.

The power plants in Queens emit several types of HAPs, but they tend to contribute very small portions of the total contributions in the county. For example, roughly three percent of the total chromium compounds emitted in Queens comes from the power plants, and much less than one percent of the polycyclic organic matter (POM) emissions are from power plants. Furthermore, since emissions of these HAPs from sources outside of Queens can contribute to concentrations in Queens, these power plants contribute a relatively small amount to ambient HAP concentrations in Queens. Other HAP emissions from power plants, such as mercury, arsenic, manganese and nickel compounds, were not identified as among the top priority HAPs in Queens, but may have important non-cancer health implications.

Sources of Greenhouse Gases

Figure S.2 provide a breakdown of the sources of CO_2 emissions for the entire state of New York. It indicates that the transportation sector makes the largest contribution to emissions (35%), followed by the electricity sector (29%).

Figure S.2 Sources of CO_2 Emissions in New York State



The breakdown of CO_2 sources in Queens County may be different than that presented for New York State above. Because of the high concentrations of both roadways and power plants in Queens, there may be even greater contributions from the transportation and electricity sectors.

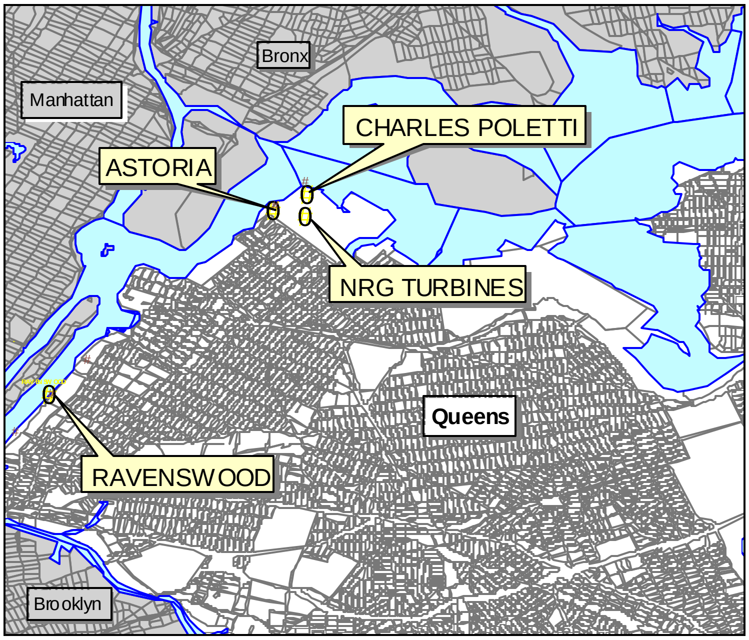
S.5 Reducing Emissions from the Electricity Sector

New York City, like the rest of the nation, gets its electricity from a regional network of interconnected power plants and transmission lines. This means that the residents and businesses of each borough are not served exclusively by power plants within that borough. Rather, the electricity from all the power plants in the Northeast region is commingled in the regional transmission grid. Queens is one of the counties with a large amount of generating capacity relative to its electricity needs, and it consistently exports its surplus electricity to other users in New York City.

Currently, there are four large power plants in Queens, which together house 46 electric generating units. Eight of these are large steam generating units, and 38 are small combustion turbines. All four of these plants are in a small section of Northwest Queens (Astoria). Figure S.3 shows the location of these four facilities in Northwest Queens.

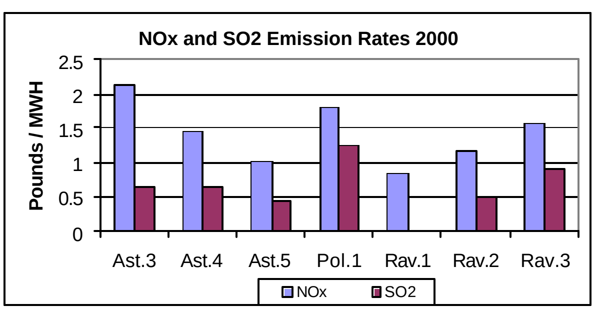
The concentration of generating capacity in Northwest Queens is exceptionally high for such a densely populated area. In addition, this community includes a high percentage of low-income people and persons of color. These demographics suggest that "environmental justice" concepts and policies should be taken into account when considering options for addressing air quality in Queens and in considering the siting of further sources of air pollution.

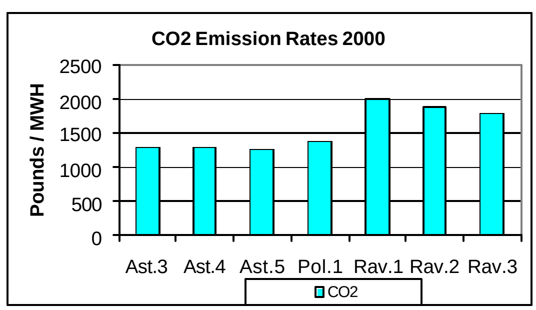
Figure S.3 The Four Power Plants in Northwest Queens



The steam generating units in Queens are responsible for large percent of the NO_x, SO_2 and CO_2 emitted in Queens. Figure S.4 shows the emission-rates in pounds per megawatt hour produced from these generating units in 2000. It should be noted that the average emission rates of these Queens plants are lower than both the New York State and National averages primarily due to the use of lower-emission fossil fuels (e.g. natural gas and oil, instead of coal).

Figure S.4 2000 Emission Rates from Steam Electric Plants in Queens





As previously mentioned, some Queens generators are already undergoing changes that will result in lower emission rates, such as the Air Quality Improvement Program at the Ravenswood Station that when completed in 2003 will reduce the NO_X emission rate by about 20 percent. At the same time, other older generating units in Queens continue to be of concern, including the recently restarted Astoria Unit 20 plant.

We develop two scenarios to identify the opportunities for reducing emissions from the power plants in Queens. The Base Case scenario is a forecast of power plant operation and emissions assuming "business-as-usual" practices, i.e., without major changes to address air emissions. The Clean Air Plan scenario is a forecast of the electricity sector with several important modifications designed to reduce air emissions.

For the Base Case scenario, we assume that none of the existing generating units in Queens is retired during the study period and that 250 MW of new combined-cycle combustion turbine (CCCT) capacity is added by the end of 2004. Thus, we assume that 250 MW of the currently proposed new CCCT capacity will be installed before 2005, absent the Clean Air Plan. For the purposes of assessing air emissions in Queens it is not necessary to predict which of the currently-proposed projects this will be, or exactly where it will be located within Queens.

For the Clean Air Plan, we modify the Base Case scenario with the following three features:

- Implementation of aggressive energy efficiency measures throughout New York City. We estimate that roughly ten percent of the city's energy load could be saved by 2010 through cost-effective efficiency measures. This would require an annual investment of $131 million, but would result in annual energy savings of $264 million, for a *net savings* of roughly $133 million per year.
- Installation of 50 MW of solar photovoltaics systems throughout New York City, roughly equivalent to 0.5% of the total generation capacity in the city in 2010. This solar power would provide emission-free electricity, assist with transmission and distribution congestion in the city, and provide power during the most expensive hours and seasons of the day – during the summer peak demand periods.
- The retirement of older, inefficient power plants by 2005, including the retirement of Poletti Unit 1; Astoria Units 2, 3 and 4; and Ravenswood Units 1 and 2.[1]
- The installation or repowering of several new units in Queens, including one 500 MW CCCT and two 900 MW CCCTs, resulting in 2,300 MW of new, efficient, gas-fired combined cycle power plants.

Emission Reductions from the Clean Air Plan

The Clean Air Plan results in substantial reductions in emissions from the Queens power plants, as indicated in Table S.1 and Figure S.5 below. These reductions are particularly vital in view of the expected enormous increase 48% by 2010 in electricity generation

[1] Given the current status of newly-permitted facilities, it is unlikely that these existing facilities would be retired by 2005. Thus, the benefits that our analysis shows for 2005 would actually be achieved in a later year (e.g., 2007), whenever these units are retired.

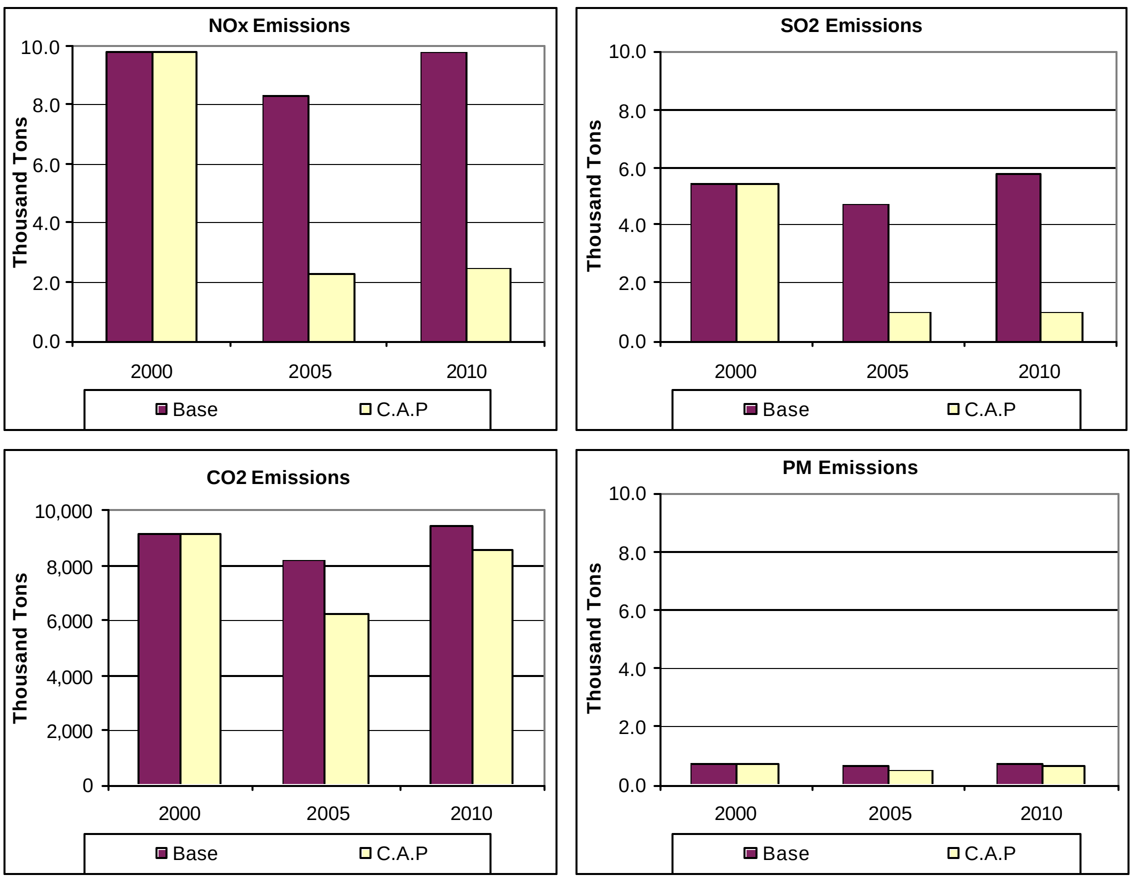
from Queens power plants (48% by 2010), due to the construction of new power plants that will provide increased power to New York City and the region.

Table S.1 Annual Emission Reductions at Queens Power Plants from the Clean Air Plan

	2005	2010
NO_x Reductions (%)	73%	75%
NO_x Reductions (tons)	6,050	7,300
SO_2 Reductions (%)	80%	83%
SO_2 Reductions (tons)	3,760	4,780
CO_2 Reductions (%)	23%	9%
CO_2 Reductions (tons)	1,907,000	895,000
$PM_{2.5}$ Reductions (%)	27%	12%
$PM_{2.5}$ Reductions (tons)	175	91

Emission reductions are relative to the business-as-usual emissions in the relevant years.

Figure S.5 Emissions from Queens Power Plants: Base Case and Clean Air Plan



The NO_X reductions are due to the replacement of the steam generators in Queens with CCCTs with advanced NO_x emission controls. The SO_2 reductions are almost entirely the result of changes in fuel use; because there is negligible sulfur in natural gas, replacing oil combustion with gas combustion reduces SO_2 emissions to near-zero levels. Percentage reductions in CO_2 and $PM_{2.5}$ are not as pronounced as those in NO_x and SO_2

because, while new CCCTs have very low NO_x and SO_2 emission rates, their CO_2 and $PM_{2.5}$ emission rates are more significant.

The Clean Air Plan will also result in significant reductions of emissions in regions outside of Queens. As noted previously, emissions reductions from power plants located outside of Queens can and often will result in air quality improvements in Queens. Table S.2 presents a summary of emissions reductions achieved by the Clean Air Plan in the entire Northeast region.

Table S.2 Annual Emission Reductions at Northeast Power Plants from the Clean Air Plan

	2005	2010
NO_x Reductions (tons)	9,350	15,460
SO_2 Reductions (tons)	13,150	26,240
CO_2 Reductions (tons)	4,324,000	7,078,000

A comparison of the tonnage reductions in Tables S.1 and S.2 demonstrates that a large portion – and in many cases the majority – of emission reductions from the Clean Air Plan occur outside of Queens. This occurs for several reasons: (a) the increased generation in Queens due to the new power plants reduces the emissions from dirtier, less-efficient power plants elsewhere, (b) the efficiency efforts significantly reduce generation from other power plants in the region, and (c) the PV slightly reduces generation from other plants in the region. While these results emphasize the need for regional solutions to address the air quality in Queens, significant reductions can still be realized from efforts at Queens plants.

S.6 Reducing Emissions from the Transportation Sector

Our analysis of the transportation sector assesses (a) current use of roads and vehicles in Northwest Queens; (b) anticipated future use of roads and vehicles under a Base Case scenario; and (c) anticipated future use of roads and vehicles under several different transportation policy scenarios. We evaluate policies that could reduce emissions from the transportation sector by reducing the use of vehicles, reducing the emissions per mile of travel, or both.

The transportation sector study focuses on a 17 square-mile area within Northwest Queens. This area is about 16 percent of the entire Queens County in land area, and contains 25 percent of the population, as well as roughly a third of the expressway miles and a fifth of the arterials and local roads in the county. About one quarter of the total vehicle miles traveled in Queens County were over these roads. In 2000, passenger vehicles accounted for 86 percent of the vehicle miles traveled, commercial vans for eight percent, and large trucks and buses for six percent.

Base Case Emission Forecast

Emissions from the transportation sector in the future will be influenced by three factors: (1) vehicle miles traveled, (2) types of vehicles, and (3) emission rates of vehicles.

During the 1990s, vehicle miles traveled in Queens increased by one-sixth (16.6 percent). The New York State DOT projects a 7.1 percent increase between 2000 and 2005 in Queens County, and an additional 5.7 percent increase by 2010.

Although vehicle use in Queens has been on the rise, emissions of criteria pollutants from vehicles have declined markedly on a per-mile basis over the past several decades, and that trend is expected to continue. Per-mile emissions of volatile organic compounds, carbon monoxide, and nitrogen oxides from vehicles have all decreased on average about 75 percent in the last thirty years. Progress has been less pronounced, however, for two pollutants: particulate emissions from heavy trucks and carbon dioxide emissions from all vehicles.

Over the next 5-10 years, emissions of all of the "conventional" automotive pollutants (VOCs, CO, NO_x, and particulates) are projected to decrease significantly in Northwest Queens, as indicated in Table S.3. These emission reductions will result from developments and policies already in place, including ongoing improvements in engine technology, conversion to cleaner grades of diesel fuel, and large-scale adoption of clean engine and fuel measures by New York City Transit and other bus operators.

The lone but significant exception to these anticipated reductions is that vehicular emissions of CO_2 are expected to increase significantly between 2000 and 2010. This anticipated increase is a product of several factors: an expected 13% increase in vehicle miles traveled; the continuing switch of passenger travel from sedans to less-efficient sport utility vehicles; and the further reduction in fuel efficiency from higher levels of traffic congestion on area roads and highways.

Table S.3 Base Case Changes in Automotive Emissions in Study Area

Pollutant	2005	2010
Volatile Organic Compounds (VOCs)	– 28%	– 51%
Carbon Monoxide (CO)	– 21%	– 33%
Nitrogen Oxides (NOx)	– 24%	– 48%
Particulates (PM-10)	– 14%	– 25%
Fine Particulates (PM-2.5)	– 24%	– 38%
Carbon Dioxide (CO2)	+ 9%	+ 18%

Figures in table denote estimated changes in emissions relative to 2000 from present trends (declining emission factors but rising vehicle miles traveled), absent the pricing or tailpipe/fuel measures discussed directly below.

Our study analyzes several measures to reduce vehicular emissions even further, and to address the potential increase in CO_2 emissions. These measures fall within two broad categories: pricing measures and measures to address heavy-duty diesel vehicles.

Pricing Measures

Cents Per Mile Insurance. Under conventional auto insurance, drivers pay for insurance on a lump-sum basis, and their premiums bear little relationship to the number of miles they drive. An alternative method of charging insurance is to make insurance premiums proportionate to mileage. "Cents-per-mile insurance" would rearrange, not increase, the overall cost of car use, by shifting to a *variable* cost the auto insurance payments that drivers now pay as a *fixed* cost. This cost shift would create a powerful incentive among drivers to economize on driving. Whereas drivers currently save little or nothing on their insurance costs by driving less, cents-per-mile insurance would effectively let drivers pocket 10 cents on average for each mile they did not drive. We estimate that a mandatory cents-per-mile insurance policy could reduce vehicle miles traveled in 2010 by 8.6%. The reduced miles traveled would result in emission reductions of roughly 11% to 15% in 2010, relative to the Base Case emissions in that year. (The emission reductions from all the pricing measures are summarized in Table S.4 below.)

VMT Fees and Weight-Distance Fees. VMT fees charge all motor vehicles a fixed amount per mile driven. Weight-distance fees are a variation on VMT fees in which vehicles are charged per ton-mile, so that two vehicles driven the same amount pay in proportion to their respective weights. This added feature better captures the emissions effects of VMT by different types of vehicles, and appears to be an excellent way to equalize the greater contribution to pollution, especially CO_2, from the increased use of SUVs. We estimate that VMT fees of 10¢ per mile in 2010 would reduce vehicle miles traveled in that year by 8-12%, resulting in emission reductions of 12-16%. Weight-distance fees would have an even greater impact on emissions, because they have a greater influence on high-emission trucks. We estimate that weight-distance fees would reduce emissions from roughly 16-21%.

Bridge Tolls. There is a strong possibility that the bridges connecting Manhattan to Queens and Brooklyn, which have been free to motorists for some 90 years, may again be tolled in the near future, using electronic metering that obviates the need for space-consuming, pollution-generating toll plazas. We estimate that tolls on the East River bridges would result in a roughly 2.8% reduction in vehicle-miles traveled in Northwest Queens in 2010, leading to roughly 6-8% reduction in emissions in that year.

Gasoline Taxes*:* The various transportation policies addressed here will at best only slow, rather than reverse, the increase in vehicular emissions of CO_2. A more targeted policy will be necessary to reduce CO_2 emissions in order to address global warming concerns. An increased gasoline tax could be such a policy. We estimates that a $1/gallon boost in gasoline taxes by 2010 would reduce passenger-vehicle miles traveled by 6.5% and taxi and truck miles traveled by 3.0-3.3%. This reduction in miles traveled, combined with the further effect of customers purchasing more efficient vehicles, would turn an expected 18% *increase* in vehicular CO_2 emissions of into a 25% *reduction*.

Under present policies that "under-price" driving, the increase in vehicular traffic forecast for Northwest Queens will translate into more stop-and-go travel and slower average speeds, both of which tend to raise per-mile and per-vehicle emissions of pollutants. Conversely, this phenomenon creates an opportunity for the pricing measures summarized above to reduce emissions in two ways: directly, by reducing the numbers of miles driven and vehicles on the road; and indirectly, by helping to maintain smoother and faster traffic flows and thus keeping per-mile emission rates from rising.

Our analysis demonstrates that area-wide or even city-wide pricing strategies offer significant opportunities for reducing air pollution and carbon dioxide emissions on a large scale. The effects of the various pricing strategies on emissions in 2010 are summarized in Table S.4

Table S.4 Estimated Changes in Vehicular Emissions in 2010, Relative to 2010 Baseline

	VOCs	PM-2.5	CO2
Cents-per-mile insurance	– 15%	– 11%	– 11%
VMT fees	– 16%	– 13%	– 12%
Weight-distance charges	– 21%	– 19%	– 16%
Gasoline tax increase	– 14%	– 11%	– 25%
Bridge tolls	– 8%	– 6%	– 6%

Emission changes are relative to 2010 baseline. Reductions in CO are similar to those for VOCs; similarly for PM-10 with respect to PM-2.5. NOx reductions tend to be roughly half of those for VOCs.

Measures to Address Heavy-Duty Diesel Vehicles

Heavy-duty diesel vehicles (HDDVs), including mostly 18-wheelers and transit buses, account for only four percent of VMT in the study area but produce 40 percent of vehicular emissions of particulate matter and half of the fine particulates. Currently, a typical HDDV emits particulates at about 20 times the rate of a passenger sedan, and emits fine particulates at around 30 times the rate of a passenger sedan. Because of their disproportionate contribution to emissions, because they are fewer in number than private automobiles, and because they have longer lifetimes than passenger cars or trucks, heavy-duty diesel vehicles are a prime target for emission-control efforts.

Two tailpipe and/or fuel measures are considered here to achieve emission reductions from heavy-duty diesel vehicles. One involves increased use by heavy trucks and transit buses of diesel particulate filters (DPF's); the other accelerates and expands conversion of some of these vehicles to compressed natural gas (CNG) fuel. Both measures would have a modest effect on overall emissions from motor vehicles in the study area, reducing particulate emissions by only 5-8% in 2010, and affecting other pollutants little or not at all. Both measures are extremely effective where used, but they appear to be applicable to only a very small fraction of the vehicle fleet in the study area.

We also estimate potential emission reductions under different emission control scenarios that reflect different usages of low sulfur diesel fuel, diesel particulate filters, and compressed natural gas. We modeled a Base Case (business-as-usual) scenario, a "dump dirty diesel" (DDD) scenario (which includes higher levels of ultra-low sulfur fuel use and diesel particulate filter use than the Base Case scenario), and a "compressed natural gas" (CNG) scenario (which includes higher levels of compressed natural gas use than the Base Case scenario). Our key findings are:

- VOC emissions fall significantly in any event; the DDD and CNG strategies accelerate the reductions only modestly beyond the Base Case, by one-half to one percentage point.
- CO emissions are barely affected by the DDD and CNG strategies, reflecting the fact that CO is overwhelmingly produced by ordinary cars and trucks rather than by heavy-duty diesel vehicles.
- The significant decline in NOx emissions in the Base Case – around 25% in 2005 and 50% in 2010 – can be accelerated slightly, by 1 to 1.5 percentage points – through a strategy to convert more transit buses and some 18-wheelers to CNG.

- Both the DDD and CNG strategies can noticeably affect particulate emissions, reducing them by 3-5 percentage points more than would otherwise occur in the Base Case through the ongoing improvement in engine and emissions-control technology for cars, gasoline-burning trucks and HDDVs.

These impacts may appear small, reflecting the fact that heavy-duty diesel vehicles account for only a small percentage, a little under 4%, of all vehicle miles traveled in the Northwest Queens study area. Nevertheless, either or both of the DPF and CNG measures are worth pursuing because of their ease of implementation and high degree of public acceptability (they would be applied to a relatively small number of buses and 18-wheelers) and their effectiveness in reducing particulate emissions, particularly in industrialized areas with unusually high concentrations of heavy trucks.

S.7 Reducing Emissions from Major Sources and Area Sources

Ideally, this report would have analyzed opportunities for reducing emissions from other "major sources" and "area sources" as well as power plants and mobile sources. Including other major and area sources would provide a complete picture of the contributors to air emissions in Queens County. These other sources may also have a greater impact since the emissions may be closer to ground level than power plants that tend to have very tall emission stacks. However, after assessing the availability and quality of the data for major and area sources, we have concluded that such an analysis is not possible within the scope of this study.

There are two primary sources of emissions data for Queens: the NY DEC and the US EPA. The existing emissions data for the major and area sources in Queens raise several concerns. The largest questions around the emissions inventories arise from the fact that, for most sources, the DEC and EPA estimates of emissions differ significantly. In general, we find that the data available are so unreliable that we are not able to conduct analyses of how these emissions might change over time, nor how these emissions could be reduced through specific public policies.

Nonetheless, major sources and area sources clearly contribute significant portions to some of the key pollution emissions in Queens – especially NO_X, particulate matter, and CO_2. There may also be some significant emissions of hazardous air pollutants that are concentrated in a few major sources. These sources, and opportunities for reducing their emissions, should be given considerable attention in future efforts to study air quality in Queens and other urban areas.

S.8 Potential Improvements to Air Quality in Queens

The final piece of our analysis was to prepare rough estimates of the air quality benefits that might be expected from the emission reduction measures that we studied for the electricity and transportation sectors. We limit our analysis to $PM_{2.5}$ emissions and ambient concentrations, because of the importance of this pollutant on health impacts in Queens.

Local Sources

One important step in this analysis is to identify the extent to which local sources of PM emissions contribute to the ambient concentration of $PM_{2.5}$ in Queens. Recall that the largest portion of $PM_{2.5}$ concentrations in Queens is probably due the transformation and transport of precursor emissions from tens or even hundreds of miles away. By comparing the chemical components that make up $PM_{2.5}$, and the levels of these components that are monitored at several locations around the state, we are able to approximate the extent to which long-range transport of $PM_{2.5}$ and its precursors are likely to affect the ambient concentrations in Queens.

We find that primary emissions from local sources in Queens likely add no more than about 2 to 4 µg/m³ to the overall $PM_{2.5}$ concentration measured at community monitors. This less than one third of the overall $PM_{2.5}$ concentrations in Queens, suggesting that at least two thirds of $PM_{2.5}$ concentrations in Queens are due to $PM_{2.5}$ blown in from upwind regions and, to a much lesser extent, to secondary $PM_{2.5}$ from precursors emitted in Queens. The same conclusion is likely to apply to the contribution of ozone and ozone precursors transported into the area from sources upwind.

The Electricity Sector

To assess the air pollution impacts of our proposals to reduce emissions from the electricity and transportation sectors, we calculate expected pollutant concentrations in Queens using a standard EPA dispersion model. Given the uncertainties involved in our projection of emissions and the absence of an estimate of the contribution of secondary pollution effects, these calculations can only provide a rough guide.

The results of our analysis of the electricity sector are summarized in Table S.5. Under our Base Case scenario, additional demand for electricity over the next ten years would result in an increase of $PM_{2.5}$ emissions from 702 tons to about 745 tons per year. This corresponds to an increase in the maximum annual $PM_{2.5}$ concentration of about 0.04 µg/m³.

Under our Clean Air Plan assumptions, emissions will decrease to about 656 tons per year, and the maximum annual $PM_{2.5}$ concentration in Queens would decrease by about 0.09 µg/m³. The Efficiency Option, which includes all the energy efficiency measures but none of the photovoltaics or supply-side measures, would have similar impacts.

Table S.5 Summary of $PM_{2.5}$ Impacts From the Electricity Sector

	Current 2002	Base Case 2010	Clean Air Plan 2010	Efficiency Option 2010
Annual $PM_{2.5}$ Emissions (ton)	702	745	656	644
Maximum Concentrations (µg/m³)	0.68	0.72	0.63	0.62
Average Concentrations (µg/m³)	0.09	0.09	0.08	0.08

Measurement in Queens have been as high as 16 µg/m³ while the Federal standard in 15 µg/m³

The Transportation Sector

The results of our analysis of the transportation sector are summarized in Table S.6. Currently the 500 tons of $PM_{2.5}$ per year directly emitted from mobile sources in Queens, together with emissions of similar magnitude in the Bronx, Brooklyn, and Manhattan, causes an average (not maximum) annual $PM_{2.5}$ concentration increment in Queens of about 0.86 µg/m³ at community monitors.

We expect regulations adopted by EPA to cut $PM_{2.5}$ motor vehicle emissions by at least one-third over the next ten years. This would lead to a decrease in $PM_{2.5}$ concentrations in Queens of 0.3 to 0.4 µg/m³ at community monitors.

For this purpose we have identified a Clean Air Plan for the transportation sector, which includes a combination of weight-distance charges with either the Dump Dirty Diesel or CNG options. (Recall that weight-distance charges are estimated to result in the greatest amount of emission reductions in criteria pollutants.) We estimate that this Plan would result in a reduction of roughly 0.12 µg/m³ in $PM_{2.5}$ concentrations in 2010, relative to the Base Case.

Table S.6 Summary of $PM_{2.5}$ Impacts From the Mobile Source Sector

	Current 2002	Base Case 2010	Clean Air Plan 2010
Annual $PM_{2.5}$ Emissions (tons)	500	275	210
Average Concentrations (µg/m³)	0.86	0.48	0.36

Measurement in Queens have been as high as 16 µg/m³ while the Federal standard in 15 µg/m³

Conclusions Regarding the Potential Air Quality Improvements

To summarize, the combination of the policies that we recommend for both the electricity and the mobile source sectors would mean a reduction in 2010 $PM_{2.5}$ concentrations of approximately 0.21 µg/m³, relative to Base Case concentrations in 2010. For comparison, recall that some air quality monitors in Queens now have readings as high as 16 µg/m³, and that the federal standard is set at 15 µg/m³. Thus, the $PM_{2.5}$ emission reductions we identify for sources in Queens will have a moderate impact on $PM_{2.5}$ concentrations in Queens.

The air quality improvements might be greater at specific locations most affected by heavy traffic, including areas near major highways. However these improvements alone would be unlikely to reduce the current background $PM_{2.5}$ concentration (16 µg/m³) to below the federal standard (15 µg/m³).

Another way to think of the air quality benefits is relative to the current concentrations. The combination of the policies that we recommend in both the electricity and the mobile source sectors would mean a reduction in 2010 $PM_{2.5}$ concentrations in Queens of approximately 0.55 µg/m³.

While this reduction may appear to be a relatively modest improvement in air quality, it may be significant enough to assist Queens in achieving compliance with the federal standard. Furthermore, the health literature for $PM_{2.5}$ implies that even the relatively small reductions estimated here would provide significant reduced mortality and morbidity effects in Queens. As described in Chapter 3, a reduction of 1.5 $\mu g/m^3$ is estimated to avoid roughly 100 premature deaths per year and avoid numerous other health impacts. Similarly, a reduction of 0.55 $\mu g/m^3$ can be expected to avoid roughly 37 premature deaths per year within Queens, as well as additional premature deaths in populations outside of Queens.

These conclusions on local air quality impacts also suggest that we should take a broad view of pollution control in order to aggressively reduce ambient concentrations in Queens. Controlling sources in Queens will have benefits far greater than the benefits for the population of Queens, and controlling sources well outside of Queens will substantially improve the air quality in Queens.

S.9 Policies to Address the Key Air Emissions

Our findings above suggest that the greatest improvements to air quality in Queens will result from policies targeted to (a) power plants in regions upwind of Queens, and (b) mobile sources inside Queens and New York City. Since many of the health threats in Queens are due to pollution sources outside of Queens, policies must support efforts to control sources in upwind states, such as the several multi-pollutant bills being discussed on the federal level. Policies must also address sources in New York City, as well as in New York State.

At the same time, it is important to address pollution emissions within Queens as well. Many of these emissions do impact the air quality in Queens, and they have a significant impact on the air quality in downwind regions. Queens can act as a model for both upwind and downwind cities, counties, and states – to demonstrate that everyone has a responsibility to address their own air emissions in order to improve air quality for all in the greater Northeast region.

There are many policies that can be used to address the air quality problems in Queens County and the neighboring regions. Here we list those policies that should receive top priority from local and state policy-makers.

Policies to Improve the Efficiency With Which Energy Is Consumed

1) New York State should establish appliance efficiency standards, above and beyond those established by the federal government, as proposed in the recent study from the Northeast Energy Efficiency Partnership (NEEP 2002).

2) New York State should seek a waiver from the central air conditioning standard (SEER 12) recently determined by the US DOE. The New York standard should instead be set at a SEER 13.

3) The existing system benefits charge, used to collect revenue from all New York State electricity customers for energy efficiency programs, should be at least doubled.

4) All federal, state, city and local government agencies should conduct biennial studies to identify efficiency measures that can be implemented at their buildings and facilities. These agencies should be required to implement all cost-effective efficiency measures identified, in order to both save taxpayer dollars spent on long-term energy costs and to reduce the environmental impacts of energy use.

5) The New York Public Service Commission should require electric distribution utilities to "decouple" their revenues from their sales, in order to provide them with the proper financial incentives to promote energy efficiency and distributed generation resources.

6) Architects and builders should be encouraged to adopt green building practices, and to have their building certified using the Leadership in Energy and Environmental Design (LEED) standards established by the US Green Buildings Council.

Policies to Promote the Construction of New, Clean, Efficient Power Plants

7) The New York Public Service Commission should give the distribution utilities a clear mandate to purchase long-term power supplies through a "portfolio management" approach. Under this policy, utilities would sign long-term contracts to support the construction of efficient power plants, but they would also factor in energy efficiency opportunities when determining the appropriate amount of power to contract for.

8) New York State should establish a renewable portfolio standard (RPS), which requires all retail electric suppliers to maintain a certain percentage of new, clean renewable resources in their portfolio of generation sources. The RPS should include a target of 10% renewable generation within ten years, and 20% within 20 years. A specific portion of the RPS should be set aside to promote the development of photovoltaics, in order to encourage the development of renewable resources in urban areas such as Queens.

9) The existing net metering law that currently includes residential solar applications should be expanded to commercial and industrial solar applications, wind turbines, and clean biomass technologies.

10) The New York Public Service Commission should adopt several policies to promote the installation of clean, distributed generation (DG) technologies, including:

- policies that require distribution companies to adopt uniform safety and quality standards for DG technologies;
- policies that require distribution companies to utilize simple standardized procedures for reviewing and approving applications by customers to connect their DG technologies to the electricity grid;
- policies that ensure that utilities do not impose needless and burdensome charges on owners of DG technologies.

11) The New York Department of Environmental Conservation should adopt regulations to ensure that all forms of distributed generation technologies meet stringent air emission standards.

12) New York State should offer tax and other incentives to existing generators to encourage repowering of older, less efficient units.

Policies to Limit Pollution Emissions

13) The New York Legislature should establish a CO_2 standard for vehicles similar to that recently adopted in California. That measure requires automobile makers to achieve the "maximum feasible reduction" in greenhouse gasses for cars and light-duty trucks in model year 2009 and beyond.

14) New York State should promote the adoption of a national, regional or state cap on CO_2 emissions from power plants, and allow power plant owners to trade CO_2 emission allowances within the total cap.

15) The New York Department of Environmental Conservation should establish New York-specific ambient air quality standards for $PM_{2.5}$.

16) New York State should support efforts to establish multi-pollutant regulations to reduce transport of pollutants from upwind sources.

Policies to Promote Environmental Justice

17) Environmental justice issues should be addressed in a comprehensive and equitable fashion through the NY DEC guidance document on environmental justice and permitting (CP-29). Furthermore, when the Article X power plant siting law is reauthorized, it should include all appropriate procedures to address environmental justice issues.

18) When new power plants and other major sources of emissions are proposed to be sited within Queens, the siting and review process should (a) allow for early public input; (b) ensure that there are no disproportionate impacts on low-income populations and people of color; and (c) ensure that the project does not overburden any one community, relative to the benefits provided to that community.

Policies to Address the Transportation Sector

19) New York State should adopt a "cents-per-mile" insurance policy, whereby car-insurance providers would sell their service by the mile rather than by the year.

20) New York State should implement vehicle miles traveled fees, which charge all motor vehicles a fixed amount per mile driven. The best candidate, in terms of efficacy and equity, is weight-distance fees that charge per *ton-mile*, so that two

vehicles driven the same amount pay in proportion to their respective weights, and two vehicles of equal size pay in proportion to their usage.

21) New York State should increase gasoline taxes to induce motorists to purchase and use more-efficient vehicles. Most of the revenues should be rebated to the state's citizens on an equal per-capita basis, to promote equity, although a portion could be reserved to finance other measures to reduce vehicular emissions.

22) New York State should require Heavy-Duty Diesel Vehicles to reduce emissions through use of ultra-low-sulfur fuels and compressed natural gas.

23) New York State should require all heavy-duty construction vehicles to use ultra low-sulfur diesel fuel, and to be fitted with either diesel oxidation catalysts or particulate filters.

24) New York State car dealers should be provided with information and financial incentives to promote the sale of efficient vehicles.

25) New York City should implement tolls at the Queensboro Bridge and the other "free" East River crossings, using high-speed collection systems to obviate the need for toll plazas.

26) New York City should implement policies to reduce truck idling, including establishment of facilities at truck stops to provide air conditioning and electricity for trucks to use instead of their own engines.

27) The Metropolitan Transportation Authority and New York City Transportation Department should accelerate plans to convert diesel bus fleets to cleaner fuels such as compressed natural gas (CNG).

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Synapse Energy Economics is a research and consulting firm that specializes in energy, economic and environmental topics. Synapse provides research, testimony, reports and regulatory support to consumer advocates, environmental organizations, regulatory commissions, federal and state agencies, and others. For more information on Synapse, see www.synapse-energy.com.

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