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Testimony to the New York City Council
Committee on Environmental Protection
Hearing on Int. No. 194: on the Use of Clean Heating Oil
May 28, 2010

Good morning, Chairman Gennaro and Committee Members. My name is Jason Schwartz, and I'm a legal fellow with the Institute for Policy Integrity at NYU School of Law. Policy Integrity is a non-partisan think-tank that promotes rational government policies based on balanced economic analysis.

Policy Integrity has collaborated with public health experts at NYU School of Medicine to analyze the health and environmental benefits of reducing the fine particulate matter emitted by dirty heating oil in New York City. Our full methodology is detailed in our January 2010 report, *Residual Risks*, as well as our May update, both of which have been submitted as written testimony.

Our analysis finds that a full conversion of all residential, commercial, and institutional boilers from residual oil to low-sulfur #4 oil would likely save 84 lives per year in New York City, as the result of fewer fatal heart attacks and other deaths from cardiovascular and respiratory conditions aggravated by particulate matter.

Saving lives, preventing illness, and generally improving public health delivers quantifiable benefits that can be assigned a monetary value. Not only can the cost of illness be calculated—in terms of medical resources used, lost productivity, and so forth—but individuals and society have a "willingness to pay" to avoid negative health outcomes. Government agencies routinely calculate and apply such monetary values when deciding whether to regulate a dangerous substance, to determine if the health benefits justify the economic costs.

Using conservative estimates, the net present value for a full conversion from residual oil to low-sulfur #4 from the year 2012 through 2040, is at least $7.2 billion worth of health benefits. And that figure does not reflect additional benefits from preventing hundreds of cases of chronic bronchitis (about 600), hundreds of cases of acute childhood bronchitis (about 1400), hundreds of non-fatal heart attacks (about 1650), and thousands of lost work days (about 130,000) over that thirty-year period.

Predicting the precise costs of a conversion to low-sulfur #4 is challenging, but unofficial results from one rigorous model suggest total costs from 2012 through 2040 may be a few billion dollars. Compared to $7.2 billion in calculated health benefits, including 2,439 lives saved, along with additional, valuable health and environmental effects, the benefits of that switch should easily exceed costs, by a factor of at least 2:1.

Lowering the sulfur content of heating oil is an admirable goal that will deliver undeniably important health benefits to New York City. Any action on this crucial public health threat is overdue and welcome. But lowering the sulfur content alone cannot fully address the negative impacts of dirty heating oil. Our analysis reveals that while low-sulfur fuels offer a significant improvement over the status quo, they are ultimately only a first step in the right direction;

switching to natural gas would generate the greatest health, environmental, and economic benefits for New York City.

In particular, a full conversion from residual oil to natural gas would likely save 259 lives per year, or about $22 billion worth of health benefits over a thirty-year period. Switching to natural gas would also achieve substantial greenhouse gas reductions, worth over $6 billion in climate benefits. And those tremendous benefits could be realized at a possible net financial savings to New York's citizens, thanks to the lower projected price for natural gas.

We have not conducted any extensive analysis on biodiesel. But we strongly advise the committee to consider the full lifecycle costs and benefits of fuel production. Any environmental, economic, or health gains achieved by mandating the use of biofuels in New York City must not be overwhelmed by negative environmental, economic, or health externalities generated by the production of that fuel. In other words, it is neither efficient nor wise to cut down South American rainforests to grow biofuel feedstock for New York City boilers, and such results should be avoided.

To summarize, a switch to low-sulfur fuels is clearly cost-benefit justified. While it will not deliver the same cost-savings and dramatic health benefits as natural gas, it is a step in the right direction. In either case, given the number of lives affected and the low cost of switching to cleaner fuels, swift action to wean New York City off dirty heating oil is both urgently needed and economically justified.

Thank you for the opportunity to testify on this vital public health issue.

More Residual Risks:

An Update on New York City Boilers

Institute *for* Policy Integrity
new york university school of law

Kevin R. Cromar
Jason A Schwartz
Policy Brief No. 8
May 2010

This policy brief reviews and updates initial estimates of the tremendous health and environmental benefits that could be generated if New York City switched its buildings to cleaner heating fuels. In *Residual Risk: The Unseen Costs of Using Dirty Oil in New York City Boilers* (Policy Integrity Report No. 5, January 2010), the benefits of such a conversion were calculated to include hundreds of avoided mortalities, billions of dollars worth of measurable health benefits, and substantial additional health, environmental, and welfare effects.

Using different assumptions and newly available data, this update expands on those original findings, and now concludes that:

- Switching all residential and commercial boilers from dirty residual oil to natural gas would likely save 259 lives per year. Over a thirty-year period, in excess of $22 billion worth of health benefits could be generated.
- Switching to alternatives that are not quite as clean as natural gas, such as low-sulfur #4 oil or low-sulfur #2 oil, will save lives, but not as many.
- In particular, switching all residential and commercial boilers from dirty residual oil to low-sulfur #4 oil would likely save 84 lives per year, generating at least $7.2 billion in health benefits over a thirty-year period.
- Switching all residential and commercial boilers from dirty residual oil to natural gas would deliver up to $6 billion in climate benefits over a thirty-year period—as much as taking 441,000 cars off the road.
- The benefits of lowering the sulfur content of #4 oil should easily exceed the costs, by a margin of 2:1 or more. But switching to natural gas could save New Yorkers several billion dollars in financial costs, on top of the roughly $28 billion in health and environmental benefits.

Passing laws to lower the sulfur content of heating oil is an admirable goal that will deliver undeniably important health benefits to New York City. Any action on this crucial public health threat is overdue and welcome. But politicians, building owners, and individual citizens should all bear in mind that the cleanest, most efficient option remains natural gas. Low-sulfur fuels offer a significant improvement over the status quo, but ultimately they are a second-best policy choice.

Scope of Analysis

How far should governments go to restrict residual oils?

New York's Battle Against Soot

The air we breathe is filled with soot—the more common name for particulate matter or "PM." PM is a complex and diverse mixture of acids and chemicals emitted by smokestacks, fires, and vehicle tailpipes. The smallest particles, those with diameters of less than 2.5 micrometers (about 1/30 the diameter of a human hair), are called fine particulate matter, or $PM_{2.5}$. These fine particles are small enough that they can travel deep into human lungs or even slip directly into the bloodstream.

The cardiovascular and respiratory ailments experienced by people exposed to elevated soot concentrations are comparable to those expected for a non-smoker who lives with a smoker. The more costly health consequences include heart attacks, chronic bronchitis, childhood acute bronchitis, thousands of lost work days, and, ultimately, premature death.

Three years ago, Mayor Bloomberg's administration recognized that the soot emitted by burning dirty heating oil in residential and commercial building was a particularly dangerous but controllable form of pollution.[1] So-called "residual oils," also known as #6 or #4 oil, emit noticeably more fine particulate matter than the fuel known as #2 distillate oil; natural gas is considerably cleaner still. By switching from residual oil to cleaner fuel, many negative health effects can be avoided. A switch would also reduce the emission of other pollutants, like sulfur dioxide (a culprit behind acid rain) and carbon dioxide (a potent heat-trapping gas with climate implications).[2]

In recent months, both the New York State legislature and New York City government have actively explored lowering the sulfur content of either #4 or #2 oil, as a way to cut soot emissions.[3] Both fuel types already have some legal restrictions placed on their sulfur content,[4] but those levels could be tightened further. Given this new focus on low-sulfur fuel as an alternative to traditional residual oil, it is important to take a second look at the comparative health benefits of all available policy options. Additionally, as discussed below, it is now possible to recalibrate initial estimates using different assumptions and datasets.

This update confirms and expands on the original findings of *Residual Risk: The Unseen Costs of Using Dirty Oil in New York City Boilers*. Specifically, switching all residential and commercial boilers from residual oil to natural gas as quickly as possible would generate the greatest health and environmental benefits for New York City and its residents. Lowering the sulfur content of heating oil will achieve important public health gains compared to the status quo, but such action alone cannot fully address the premature mortalities and negative climate impacts caused by the combustion of dirty heating oil in New York City.

Regulating Residual Oil Will Save Lives

This policy brief starts by examining the comparative emissions for the new fuel options under discussion: low-sulfur #2 and low-sulfur #4.[5] Total particulate matter emissions are included since they are often considered by policymakers, but emissions of fine particulate matter ($PM_{2.5}$) are much more significant from a public health perspective. As evident from Table 1, lowering the sulfur content of heating oil does effectively reduce the overall emission of particulate matter; but the biggest payoff in terms of reducing fine particulate matter comes from switching residual oil customers over to natural gas.

Table 1. Comparison of Emissions for PM and $PM_{2.5}$ by Fuel Type[6]

Fuel	PM (lbs/million BTUs)	Percent Reduction	$PM_{2.5}$ (lbs/million BTUs)	Percent Reduction
#6 oil	0.0497	0.0%	0.0190	0.0%
#4 oil	0.0366	26.3%	0.0171	10.0%
#4, low-sulfur	0.0309	37.8%	0.0156	18.1%
#2 oil	0.0236	52.6%	0.0152	20.1%
#2, low-sulfur	0.0121	75.6%	0.0121	36.2%
Natural gas	0.00745	85.0%	0.00745	60.9%

Heating fuel is not the only source of particulate matter in New York City. Though it is a key local source, a majority of New York's soot actually comes from non-local sources, such as out-of-state power plants.[7] Determining how a switch to cleaner heating fuels would affect New Yorkers' health requires first calculating how much soot in New York City's air can be traced back specifically to residual oil. Then, by plugging in the emissions factors from Table 1, the decreased exposure levels for the population of New York City can be estimated. From decreased exposure levels, health benefits can be predicted in terms of fewer fatal heart attacks, fewer respiratory ailments, fewer work days lost, and so forth.

Various methodologies can be used to calculate the portion of ambient $PM_{2.5}$ attributable to heating oil emissions. Below, Table 2 presents three sets of estimates for the number of lives saved, based on three different methodologies. The first updates the original and novel methods used in *Residual Risk*.[8] That report developed an innovative approach, made possible by two special characteristics of residual oil: first, its emissions are high in nickel, making residual oil easy to trace; and second, its use varies widely from winter to summer. Comparing heating season and non-heating season nickel concentrations, in conjunction with other factors, creates a picture of what New York City's air would be like if residual oil were phased out. This update adjusts that methodology with slightly less conservative assumptions, for example on the most likely emissions factor for #2 distillate oil.

The second methodology presented in Table 2 is a compilation of three independent "source apportionment" studies, each of which employed rigorous analysis of source emissions profiles and other data to estimate what portion of New York City soot is due to heating oil sources.[9] The third methodology utilizes newly available data from the New York City Community Air Survey, which monitored air quality and pollution concentration levels across the city.[10]
Each methodology has its own strengths and shortcomings,[11] but the three separate estimation techniques—using different monitoring data and methodologies—all generate roughly the same numbers for annual avoided mortalities. That consistency suggests that the estimated range of health benefits is accurate. Table 2 shows these estimates of the lives that could be saved each year by converting from residual oil to cleaner fuel types. 95% confidence intervals for the mortality estimates are presented in parentheses—a statistical tool that indicates the reliability and precision of the estimates.

Table 2. Annual Avoided Mortalities due to $PM_{2.5}$ Reductions, by Fuel Conversion and Methodology

	Annual Avoided Mortalities (95% CI)		
Scenario	*Residual Risks*, updated	Source Apportionment Compilation	NYCCAS
All residual oil converted to #4 fuel	26.7 (14-39)	34.8 (19-51)	36.3 (20-53)
All residual oil converted to low-sulfur #4 fuel	61.8 (33-90)	80.7 (43-118)	84.1 (45-123)
All residual oil converted to #2 fuel	62.8 (34-92)	82.1 (44-120)	85.5 (46-125)
All residual oil converted to low-sulfur #2 fuel[12]	113.3 (61-166)	147.9 (80-216)	154.2 (83-225)
All residual oil converted to natural gas	190.2 (102-278)	248.3 (134-363)	258.8 (139-378)

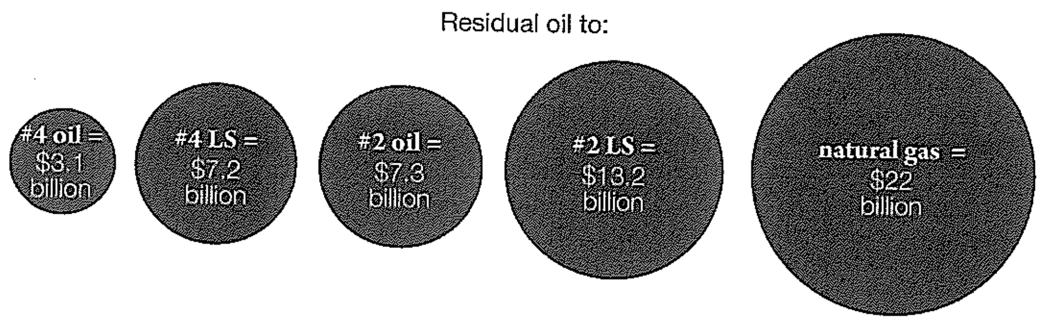
As evident from these calculations, a full conversion from traditional residual oil to low-sulfur #4 oil could be an important step in delivering health benefits. But switching to natural gas will likely save three times as many lives per year. If all residential and commercial boilers were converted from residual oil to low-sulfur #4 starting in 2012, by the year 2040, approximately 2,439 lives would be saved. Over that same time period, a full conversion to natural gas would have saved about 7,505 lives.

Improving Community Health Delivers Significant Monetized Benefits

Saving lives, preventing illness, and generally improving public health delivers significant, quantifiable benefits that can be assigned a monetary value. Not only can the cost of illness be calculated—in terms of medical resources used, lost productivity (such as lost wages) during illness, and so forth—but individuals and society as a whole have a "willingness to pay" to avoid negative health outcomes. Government agencies routinely calculate and apply such monetary values when deciding whether to regulate a dangerous substance, to determine if the health benefits justify the economic costs of regulation.

Using conservative estimates for the monetized value of health outcomes, along with a conservative 7% discount rate, the net present value of health benefits generated from 2012 through 2040 can be calculated.[13] For a full conversion from residual oil to low-sulfur #4 oil, at least $7.2 billion worth of health benefits will be generated over that period. For a full conversion to natural gas, in excess of $22 billion worth of health benefits would be generated over the same time.

Figure 1. Cumulative Monetary Health Benefits due to $PM_{2.5}$ Reductions, from 2012 through 2040



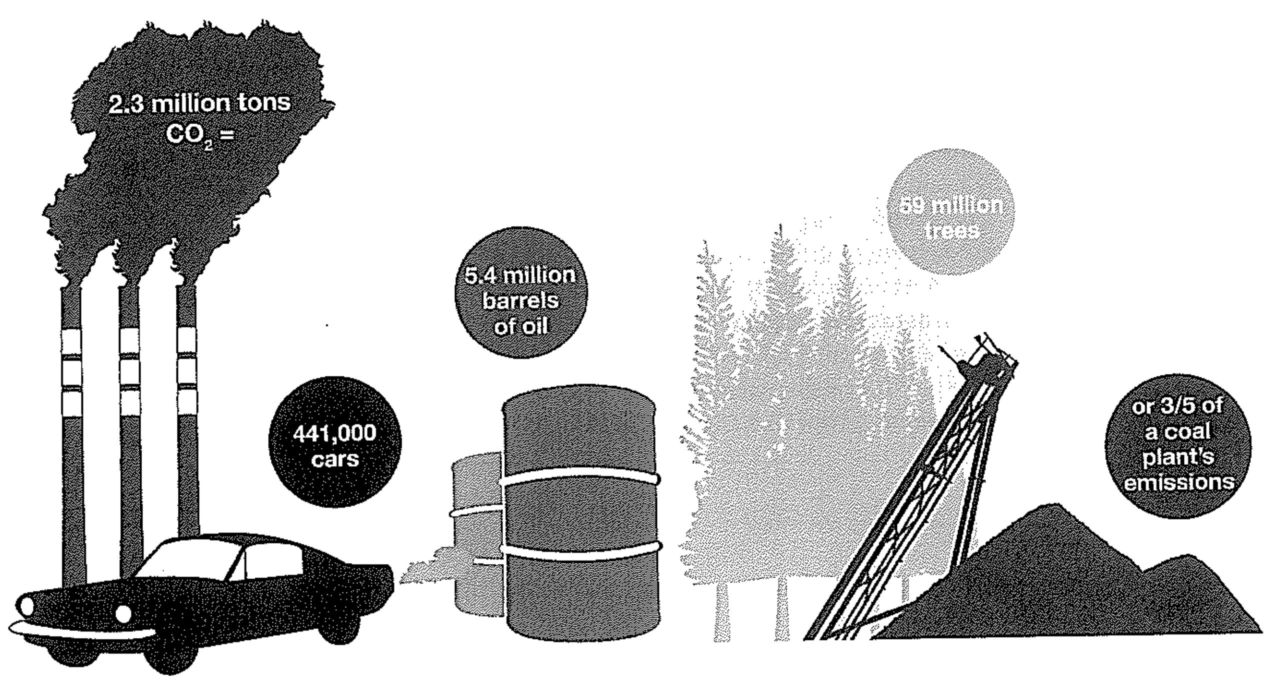
This update has focused on premature mortalities. But fine particulate matter has many other negative and costly health impacts: non-fatal heart attacks, chronic bronchitis, childhood acute bronchitis, asthma, pneumonia, hospital admissions, and lost work days. Moreover, these estimates do not take into account the potential effects of particle composition on increased mortality. Residual oil emissions contain especially high nickel and vanadium concentrations, which may present additional hazards to human health. The potential role of such particle composition effects was discussed in greater detail in *Residual Risks*, but the issue needs further study. It is safe to say, however, that the health benefits calculated here are low estimates for the total health and economic value from switching New York City over to cleaner heating fuels.

Regulating Residual Oil Benefits the Environment

In addition to its high soot levels, residual oil also emits more carbon dioxide—the greenhouse gas most responsible for global climate change—than cleaner fuels like natural gas. New data allows more precise calculation of the climate benefits generated by a full conversion from residual oil to natural gas in New York City boilers. In particular, the mayor's office has provided unofficial estimates of how much residual oil is burned in New York City's residential and commercial boilers ever year.[14]

When combined with the carbon dioxide emissions factors for various fuel types,[15] this data suggests that switching all residual oil to natural gas would save about 2,309,000 metric tons of carbon dioxide each year: the same as taking 441,000 cars off the road; or saving 5.4 million barrels of oil; or planting 59 million new trees; or eliminating three-fifths of the emissions from a typical coal-fired power plant.[16] Low-sulfur fuels may have some climate benefits compared to traditional residual oils, but not nearly on the scale of converting to natural gas.

Figure 2. Equivalent Climate Benefits of Phasing Out Residual Oil in New York Ciy



Environmental Benefits Carry Real Economic Value

Cutting carbon dioxide will mitigate the speed and severity of the myriad impacts of climate change on the environment, the economy, public health, and national security. Such benefits can be approximated by the "social cost of carbon" (SCC), which assigns a specific monetary value to the marginal impact over time of an additional ton of carbon dioxide emissions. SCC estimates take into consideration such factors as net agricultural productivity loss, human health effects, property damage from sea level rise, and changes in ecosystem services.

While all current SCC estimates involve a great deal of uncertainty and incompleteness that likely results in significant underestimation, federal agencies have recently settled on a relatively consistent and updated range of SCC figures.[17] Despite the high potential for underestimation, these figures provide a good starting point for analyzing the benefits of reducing greenhouse gas emissions.

In the year 2012, a full conversion from residual oil to natural gas would deliver about $50 million worth of climate benefits according to the federal government's central SCC estimate, but possibly as much as $150 million using the upper SCC estimate. However, SCC values grow every year, because future emissions are expected to produce larger climate-related damage as the earth's physical and economic systems become more stressed. Therefore, calculated through the year 2040, the climate benefits of switching from residual oil to natural gas could total over $6 billion.[18]

The Economic Case for Action

Updated cost-benefit comparisons justify restricting residual oils

Low-Sulfur Fuels Help, But Natural Gas Is More Cost-Benefit Justified

The mayor's office has been developing a detailed cost-estimation model, which has been informally reviewed by representatives from industry and the advocacy community.[19] Unofficial results from the model suggest that the long-term capital and operating costs of converting residual oil to low-sulfur #4 in the year 2012 through 2040 could be a few billion dollars. But compared to the $7.2 billion in calculated health benefits, including 2,439 lives saved, along with additional, valuable health and environmental effects, the benefits of that switch should easily exceed the costs, by a factor of at least 2:1.

More impressively, the same model predicts that the long-term capital and operating costs of converting to natural gas through the year 2040 could be negative, thanks to the lower projected price of natural gas versus residual oil. In other words, the city and its residents could *save several billion dollars* by switching to a cleaner fuel. Those financial savings come on top of the $22 billion in calculated health benefits, including 7,505 lives saved, and $6 billion in climate benefits expected from such a switch.

While a switch to low-sulfur fuels is clearly cost-benefit justified, it will not deliver the same cost-savings and dramatic health benefits as natural gas.

New York Should Take Swift Action

Several thousand lives could be saved, a significant number of heart attacks and childhood bronchitis cases could be avoided, and considerable climate benefits could be achieved if New York City switched from residual oil to cleaner fuels. Lowering the sulfur content of heating oil will achieve important public health gains compared to the status quo, but such action alone cannot fully address the premature mortalities and negative climate impacts caused by the combustion of dirty heating oil in New York City. Instead, switching all residential and commercial boilers from residual oil to natural gas as quickly as possible would generate the greatest health and environmental benefits for New York City and its residents.

In either case, given the number of lives affected and the low cost of switching to cleaner fuels, this update confirms that taking swift action to wean New York City off dirty heating oil is both urgently needed and economically justified.

Notes

[1] *See* City of New York, PlaNYC: A Greener, Greater New York 127 (2007).

[2] See Kevin R. Cromar & Jason A Schwartz, *Residual Risk: The Unseen Costs of Using Dirty Oil in New York City Boilers* (Policy Integrity Report No. 5, January 2010) for more background on residual oil and the health and environmental effects of fine particulate matter.

[3] *See, e.g.*, New York City Council Int. No. 194 § 10 (2010) (proposed by council members Gennaro et al.) (lowering the sulfur content of #4 heating oil); New York State S. 1145-A (2009) (proposing to lower the sulfur content of #2 heating oil).

[4] For example, a New York City law dating from 1971, which was subsequently incorporated into state regulations, restricts the sulfur content of heating oil. *See* N.Y. Comp. Codes R. & Regs. tit. 6 § 225-1.2 (d) (1985).

[5] *See* U.S. Envtl. Prot. Agency, No. AP-42-ED-5, Compilation of Air Pollutant Emission Factors: Vol. 1—Stationary Point and Area Sources (1995). Primary PM and $PM_{2.5}$ emission factors for fuel oil combustion are derived from *id.*, tlbs. 1.3-1, 1.3-2, and 1.3-7. Emission factors for #4 (and low-sulfur #4) are calculated as the average of #6 and #2 (and low-sulfur #2) emission factors. Calculations assume 150,000 BTUs per gallon and 140,000 BTUs per gallon for #6 and #2, respectively. Sulfur content for #6 is 3000 ppm, or 0.3% by weight. Unlike #6, direct calculation of emission factors for #2 based on sulfur content is not available. However, the "residential furnace" emission factor in Table 1.3-1 provides a reasonable estimate of the filterable portion of low-sulfur #2, based on the anticipated decrease in primary emissions as a result reducing sulfur content by nearly 2000 ppm, or 0.2% by weight. Therefore, the calculated primary emission factors for low-sulfur #4 and low-sulfur #2 are representative of a sulfur content of approximately 1500 ppm and <100 ppm, respectively.

[6] *See id.*

[7] *See* PlaNYC, *supra* note 1, at 120.

[8] The monitoring data comes from R.E. Peltier & M. Lippmann, *Residual Oil Combustion: Distributions of Airborne Nickel and Vanadium within New York City*, J Expo. Sci. Envtl. Epidemiol. (2009). The portion of the nickel and fine particulate matter attributable to commercial, institutional, and residential residual heating oil combustion was determined by seasonal differencing, as outlined in *Residual Risks, supra* note 2. The main strength of this approach is the monitoring locations which, while few in number, were operated for many weeks in both the heating and non-heating seasons, providing detailed information on the ambient pollution attributable to heating season residual oil combustion. However, this approach does not account for summertime residual oil emissions from commercial, institutional, and residential sources; and it has poor spatial resolution results in underestimate of fine particulate matter from residual oil combustion, especially in New York and Queens counties.

[9] The compilation was made from three separate source apportionment studies of New York City: R. Lall, *A Source Apportionment and Time-Series Health Analysis of Fine Particle Air Pollution in New York City* (NYU School of Medicine, Ph.D. thesis, 2008); K. Ito, N. Xue & G. Thurston, *Spatial Variation of $PM_{2.5}$ Chemical Species and Source-Apportioned Mass Concentrations in New York City*, 28 Atmoshperic Environment 5269–5282 (2004); Y. Qin, E. Kim & P. Hopke, *The Concentrations and Sources of PM2.5 in Metropolitan New York City*, 40 Atmospheric Environment S312-S332 (2006). Monitoring data was from the EPA's Speciation Trends Network and was adjusted for a decrease in nickel concentrations observed over the past eight years. The portion of fine particulate matter attributable to commercial, institutional, and residential residual heating oil combustion was determined from the U.S. EPA 2005 National Emissions Inventory for New York, Bronx, and Queens Counties. Kings County health benefits were included from *Residual Risks*. Compiling three separate source apportionment studies strengthens the confidence in exposure estimate. But using the National Emissions Inventory to determine source proportions may not fully represent the pollutant contributions from area sources such as building emissions.

[10] Monitoring data was obtained from the New York City Community Air Study, as presented by the City of New York during a March 3, 2010 stakeholder meeting on heating oil. The calculated, heating season NYCCAS nickel concentrations were approximately 20% and 70% higher than the monitored concentrations from the Peltier and Lippmann study for Bronx and New York Counties, respectively, *see supra* note 8. The discrepancy in monitored values is likely due to the increased number of monitoring sites in the areas with the highest nickel concentrations

in the NYCCAS study. The concentrations were nearly identical for Queens and Kings Counties in the two studies. While the monitored values were the same in Queens County, the increased number of monitors in the NYCCAS study resulted in higher estimates of county-wide fine particle concentrations than was possible in *Residual Risks* using the Peltier and Lippmann data. The methodology used in calculating health benefits is described in *Residual Risks, supra* note 2. The large number of monitoring locations provided improves spatial resolution of ambient nickel concentrations, especially in New York and Queens Counties. But this methodology does not account for non-heating season residual oil emissions from commercial, industrial, and residential buildings.

11 *See supra* notes 8-10.

12 Estimates only represent the health benefits of converting current residual oil use to low-sulfur #2. Additional health benefits would occur due to conversion of current #2 fuel customers to low-sulfur #2.

13 The U.S. EPA recommends a central "value of statistical life" estimate of $7.0 million (2006$). Nat'l Ctr. for Evntl. Econ., U.S. Envtl. Prot. Agency, Guidelines for Preparing Economic Analysis 7-6 (Sept. 12, 2008) (unpublished external review draft). Though several biases and potentials for underestimation are built in to the EPA's methodology for calculating the VSL, *see* RICHARD L. REVESZ & MICHAEL A. LIVERMORE, RETAKING RATIONALITY (2008), that value is used in this update. An inflation rate was calculated from Bureau of Labor Statistics data, but is conservative because inflation has been unusually flat since 2008. A 7% discount rate was chosen to be consistent with cost estimates presented *infra*.

14 Data presented by the City of New York during a March 3, 2010 stakeholder meeting on heating oil. When estimated BTUs are combined for sole #6/#4 boilers and for primary #6/#4 boilers, approximately 70 trillion BTUs worth of #6 oil and approximately 25 trillion BTUs worth of #4 oil is combusted in New York City annually.

15 Data for carbon dioxide emission factors comes from Energy Info. Admin., U.S. Dept. of Energy, Fuel Emission Factors, http://www.eia.doe.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls (last visited Jan. 19, 2010).

16 *See* EPA, Greenhouse Gas Equivalencies Calculator, http://www.epa.gov/rdee/energy-resources/calculator.html (last visited May 20, 2010).

17 *See* INTERAGENCY WORKING GROUP ON THE SOCIAL COST OF CARBON, SOCIAL COST OF CARBON FOR REGULATORY IMPACT ANALYSIS UNDER EXECUTIVE ORDER 12866 (2010) (listing $21 as the central estimate for 2010, and $64 as the upper estimate).

18 Based on approximately a 2% growth rate in the SCC, as recommended by *id.* No discount rate is applied to climate benefits. For the economic, legal, and ethical reasons not to discount in the climate context, see REVESZ & LIVERMORE, *supra* note 13.

19 Model presented by the City of New York during a March 3, 2010 stakeholder meeting on heating oil.

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Institute for Policy Integrity • New York University School of Law
245 Sullivan Street, Suite 472 • New York, New York 10012 • www.policyintegrity.org

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Residual Risks

The Unseen Costs of Using Dirty Oil In New York City Boilers

Kevin R. Cromar
Jason A Schwartz
Report No. 5
January 2010

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New York University School of Law
245 Sullivan Street, Suite 472
New York, New York 10012

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Executive Summary

New Yorkers breathe in a lot of pollution. Most people know smog from cars and buses is a major culprit, but a significant amount of dangerous air pollution may be coming from the buildings we live and work in. In some cases, the fumes can contribute to pollution-related deaths.

In the basements of many big residential, commercial, and institutional buildings—several thousand apartment complexes, schools, shopping centers, and the like in Manhattan, Brooklyn, Queens, and the Bronx—boilers are burning a dirty fuel to heat their units. This type of oil, referred to as "residual" because it is essentially the leftovers from the petroleum distillation process, releases soot and toxic chemicals into the air which, over time, can lead to cardiovascular disease, asthma, and even premature death.

This Report analyses the health, environmental, and economic benefits of switching away from this dirty fuel to cleaner alternatives, such as natural gas. Citywide, residential, commercial, and institutional boilers that burn residual oil contribute as much as 29% of all locally-generated, wintertime soot. Converting those sites to natural gas could decrease their contribution to soot concentrations by a minimum of 60%—decreasing how much soot New Yorkers breathe in.

The results of conversion would be hundreds of avoided mortalities, billions of dollars worth of measurable health benefits, and substantial additional health, environmental, and welfare effects. Residual oil exposes New Yorkers to a dangerous level of risk; this Report hopes to encourage and inform attempts to eliminate the unseen costs of using dirty oil in New York City boilers.

Lives Saved and Measurable Health Benefits

Because the small particles in soot can travel deep into lungs and even slip directly into the bloodstream, soot is at least partially responsible for many negative health outcomes. The increased health risks experienced by individuals exposed to elevated soot concentrations are comparable to those expected for a non-smoker who lives with a smoker.

This analysis estimates that full conversion from residual oil to natural gas could help New York City avoid a minimum of 73 to 188 mortalities each year. In addition, a switchover would prevent thousands of lost work days, significantly reduce the incidence of chronic bronchitis and non-fatal heart attacks, and lower the rate of childhood acute bronchitis by about 115 cases per year.

The faster these pollutants are reduced, the more lives are saved. For example, over a twenty-year period, if full conversion takes all twenty years, a minimum of nearly 600 mortalities will be avoided. For each year earlier that full conversion is implemented, a minimum of 10 additional mortalities will be avoided over that same twenty-year period. However, actual avoided mortalities could reach as high as 1,540 over twenty years, with 28 additional avoided mortalities for every year quicker that full conversion is achieved.

By way of comparison, total homicides in New York City have averaged about 540 per year over the last several years.[1] New York City had about 300 motor vehicle-related deaths in 2007,[2] and an average of 105 U.S. soldiers have died in Afghanistan each year since the conflict began in 2001.[3]

For the purposes of comparing the benefits of phasing out residual oil to potential costs, the health benefits can be given a monetary value, applying $6.9 million as a widely-accepted value for a statistical life. Using that and other conservative estimates, phasing residual oil out over a twenty-year period will generate about $5.3 billion worth of health benefits. For every year earlier that full conversion occurs, about $111 million in additional cumulative health benefits can be expected.

Particle Composition and Additional Health Benefits

Every source of soot emits a slightly different mix of chemicals and particles. Residual oil has notably high concentrations of nickel, a toxic heavy metal. Scientists believe high nickel levels may be even more linked to premature mortality than other types of soot pollution.

All the health benefits measured above stem from what amounts to a 1.5% reduction in New York City's total soot concentrations, ignoring any effects of nickel. By contrast, phasing out residual oil could reduce New York City's nickel concentrations by roughly 27%. Unfortunately, the precise health benefits of reducing nickel exposure cannot be quantified. But based on current scientific understanding, reducing nickel should result in extremely significant health benefits on top of those already calculated purely from reducing soot concentrations.

Additionally, residual oil emits more coarse particles, more sulfur dioxide, and more nitric oxides than other fuel alternatives. Reductions in these pollutants may also lead to improvements in public health, even though these potential effects are not quantified here.

Greenhouse Gases and Environmental Benefits

Residual oil also emits more carbon dioxide and elemental carbon than other fuel alternatives, both of which are potent greenhouse gases. Cutting greenhouse gas emissions will mitigate the speed and severity of global warming. Though no precise benefit can be quantified, switching a single large apartment building from residual oil to natural gas could cut nearly 300 metric tons of carbon dioxide each year. Citywide, the climate benefits of switching to cleaner fuels could easily total into the hundreds of millions dollars annually.

Switching boilers over to cleaner fuel types will also help increase national energy security, protect the natural and built environments from soot, and achieve cost-savings for energy consumers.

Methodology and Conservative Estimates

This analysis uses an innovative approach to calculate how much soot in New York City's ambient air can be traced back to the burning of residual oil in certain buildings. This methodology is made possible by two special characteristics of residual oil: (1) its emissions are high in nickel, and (2) its use varies widely from winter to summer. By comparing heating season and non-heating season nickel concentrations, in conjunction with other factors, we can determine what the air would be like if residual oil were phased out.

By relying directly on monitoring data available for nickel, this methodology entails much less uncertainty than a model-based approach. Furthermore, the generally conservative assumptions and methodologies employed will likely result in an overall underestimation of the actual impacts of residual oil use. In other words, all results reported here are conservative.

Cost Comparison and Conclusion

While this Report does not quantify the costs of phasing out residual oil, a qualitative comparison of costs and benefits is instructive. Likely capital costs of switching boilers will be one-time expenses that may at least partially overlap with inevitable replacement and maintenance costs for boilers. The annual operating costs are speculative, but most predictions suggest switching from residual oil to natural gas could be a cheaper option for consumers. Moreover, consumers may enjoy some additional efficiency gains and cost-savings from conversion.

By contrast, the quantitative and qualitative benefits of phasing out residual oil are annual, real, and significant, including potentially hundreds of avoided mortalities and billions of dollars in better health outcomes for New Yorkers. And while the speed of conversion might increase costs, policymakers should consider whether those costs are justified by the increased benefits of quicker conversion: as many as 28 additional mortalities avoided and $111 million in additional benefits for every year earlier that full conversion is achieved. Hopefully, both New York's citizens and its politicians will keep these findings in mind when making decisions about phasing out residual oil, whether those decisions are voluntary or regulatory in nature.

Introduction

New York City's Battle Against Soot

Of the many air pollutants that plague urban environments like New York City, fine particulate matter is among the most common and most visible: indeed, its more popular label—"soot"—is practically synonymous with pollution itself, and the title quickly conjures up images of smokestacks spewing filth and blackening the skies. Unfortunately, the specific sources, health effects, and costs imposed on New York City by particulate matter remain much more hidden.

This Report uncovers the portion of ambient particulate matter pollution that can be traced back to the residential and commercial boilers in New York City that burn the dirtiest type of heating fuel, called "residual oil." Next, the Report identifies the myriad health effects and other negative consequences owing to the combustion of residual oil. Finally, this Report calculates the monetary benefits of phasing out residual oil and converting to cleaner fuel types.

The continued use of residual oil exposes New Yorkers to a dangerous and costly level of risk. Through its analysis, this Report hopes to encourage and inform attempts to eliminate the unseen costs of using dirty oil in New York City boilers.

What Is Particulate Matter?

The air we breathe is filled with fine particles, called particulate matter or "PM." PM is a complex and diverse mixture of extremely tiny particles and liquids suspended in the air.[4] The smallest of these particles, those with diameters of less than 2.5 micrometers (about 1/30 the diameter of a human hair), are called fine particulate matter, or $PM_{2.5}$.[5] The heterogeneous nature of fine particulate matter is explained by the variety of independent sources, both local and non-local, that contribute to ambient air pollution: smokestacks, fires, and vehicle tailpipes all emit the various acids and chemicals that make up $PM_{2.5}$.[6]

These fine particles are small enough that they can travel deep into human lungs, reaching the bronchial and alveolar regions; they can even slip directly into the bloodstream.[7] The small size of the particles allows them to hang in the air and be transported to areas far from where they were generated.[8] In fact, most models estimate that the majority of $PM_{2.5}$ in New York City's atmosphere at any given time was emitted by out-of-state sources, such as Midwestern power plants.[9]

The health risks from the long-term inhalation and deposition of $PM_{2.5}$ are severe: impaired respiratory function, altered cardiovascular function, and premature death.[10] The increased health risks experienced by individuals exposed to elevated $PM_{2.5}$ concentrations are comparable to those expected for a non-smoker who lives with a smoker.[11]

Currently, over 60 million people, or approximately one in five Americans, live in areas with elevated levels of fine particulate matter—including New York City.[12] The federal government sets limits for maximum allowable daily and annual concentrations for $PM_{2.5}$,[13] but New York City lags behind much of the country in controlling soot, and the City has never attained the federal limits.[14]

Starting in 2007 with an effort called *PlaNYC*, New York City began work on a new approach to combat fine particulate matter and other persistent environmental threats. The City is painfully aware that many principal sources of particulate matter are non-local and so beyond its reach.[15] The largest local sources of $PM_{2.5}$ include heating fuel, transportation, power plants, and industrial processes.[16] The City developed a four-pronged strategy for $PM_{2.5}$: cut emissions from cars, trucks, and buses; cut emissions from off-road vehicles; set new standards for buildings; and enhance local green spaces.[17] While the City has already achieved some success with some of its initiatives, many other key proposals have been delayed or faltered. Most publicly, Mayor Bloomberg's plans for an all-hybrid, lower-polluting taxi fleet have been tied up in litigation,[18] and his effort to reduce transportation emissions and traffic through congestion pricing were stymied by the state legislature.[19] That leaves heating oil as one of the largest sources of particulate matter that the City can still try to control.

What Is Residual Oil?

A wide range of buildings, from single-family homes to large industrial facilities, use boilers to generate heat and set water temperature. Boilers typically burn either natural gas or petroleum-based heating oils as fuel.[20] Heating oil is classified into six types—numbered one through six—based on composition, boiling point, and viscosity: at higher numbers, the fuel is more viscous and emits more pollutants, but also tends to be cheaper. In fact, the heaviest oils are so viscous that they are near solid at room temperature and resemble tar or asphalt.[21]

When large buildings are densely located—as they are in New York City—the economics for delivery and use of the heaviest heating oil (#6) can encourage and perpetuate its selection as a fuel for combustion in boilers. As a result, while a great majority of residential, commercial, and institutional buildings both nationwide and in New York City have opted to use natural gas or the cleaner, lighter #2 "distillate" oil, a good number of buildings in the City continue to burn #6 "residual" oil.[22] As the name implies, #6 residual oil is often thought of as the "leftover" oil from the process of refining and distilling petroleum.[23]

Some older boilers may lack the necessary equipment to effectively process and burn anything but #6 residual oil or the slightly lighter blend of #6 residual and #2 distillate, known as #4. Buildings' fuel choices may also be restricted by the availability of natural gas. Unlike heating oil, which can be delivered by truck, natural gas is typically delivered by a local utility to a building via pipeline; if the necessary infrastructure is not yet in place, buildings do not use natural gas. On the other hand, natural gas infrastructure is expanding, and many newer boilers have "dual fuel" capability, meaning they can burn residual oil, distillate oil, or natural gas.[24]

New York does have some regulations in place controlling the use of heating oils. In particular, a New York City law dating from 1971, which was subsequently incorporated into state regulations, restricts the sulfur content of heating oil.[25] The City also issues permits for residential, commercial, and institutional boilers of certain sizes.[26] Nevertheless, there is no comprehensive database collecting information on how much residual oil is burned every year in the City. That lack of data potentially complicates any calculation of the health impacts of residual oil. This Report uses a unique methodology to overcome that difficulty.

What Is Our Methodology?

Residual oil emits more than just generic particulate matter—indeed, there is no such thing, since every independent source of particulate matter has its own composition and its own signature for $PM_{2.5}$ emissions. Besides emitting several other harmful pollutants, residual oil has a unique elemental composition for its $PM_{2.5}$ emissions: it emits a high level of nickel and vanadium particles. Also, though residual oil is used to heat water year-round, significantly more is used during the winter months, when space heating is necessary. Given seasonal fluctuations and the unique profile for nickel emissions, this Report can approximate the proportion of particulate matter attributable to the use of residual oil in commercial, institutional, and residential heating boilers. This Report will focus on commercial, institutional, and residential boilers, or CIR boilers, since the use of residual oil in industrial sources is much less seasonal, and since industrial sources are less likely to be the subject of potential regulation. Throughout the Report, calculations for #6 residual oil will include the portion of #6 mixed in to #4 blends. Based on those estimates, the quantitative health benefits of phasing out residual oil can also be determined.

Every year, some buildings will voluntarily switch from residual oil to cleaner fuels, for economic or other reasons. If New York City were to pass a regulation restricting the use of residual oil, the process of conversion could be sped up considerably. This Report does not attempt to estimate a baseline rate of voluntary conversion away from residual oil or to predict precise conversion rates under any particular hypothetical regulation. However, this analysis does explore four different time-conversion scenarios and demonstrates that the speed and manner of conversion significantly impacts the magnitude of annual health benefits. Hopefully, both New York's citizens and its politicians will keep the findings of this Report in mind when making decisions about phasing out residual oil, whether those decisions are voluntary or regulatory in nature.

Chapter One

Residual Oil is a Key Local Source of Fine Particulate Matter

This analysis uses an innovative approach to calculate how much fine particulate matter in New York City's ambient air can be traced back to the burning of residual oil at commercial, institutional, and residential (CIR) sites. This methodology is made possible by two special characteristics of residual oil: (1) its $PM_{2.5}$ emissions are high in nickel, and (2) its use has a strong seasonal variation. By comparing heating season and non-heating season nickel concentrations, in conjunction with elemental source profiles and EPA emission factors, this Chapter determines the $PM_{2.5}$ reductions possible if residual oil were phased out. Specifically, CIR residual oil use contributes on average about 3% of all measured fine particulate matter citywide—or roughly 29% of locally-generated wintertime concentrations.[27] Converting CIR sources from residual oil entirely to #2 distillate oil would reduce their $PM_{2.5}$ contributions by at least 18%; full conversion to natural gas would reduce their contributions by 60%.

A. Source Apportionment

Fine particulate matter ($PM_{2.5}$) is a complex and heterogeneous mixture of water droplets, acids such as sulfates and nitrates, elemental carbon, organic chemicals, metals, and other microscopic solids. Each independent source of $PM_{2.5}$—from interstate power plant emissions to local vehicle emissions—makes a unique contribution to the concentration of various elements in the ambient particulate matter in New York City. For example, emissions from residual oil are uniquely identified by their high nickel (Ni) and vanadium (V) content.[28] By identifying such source emissions profiles, it is possible to determine the mass of $PM_{2.5}$ attributable to each separate source, a practice known as source apportionment.

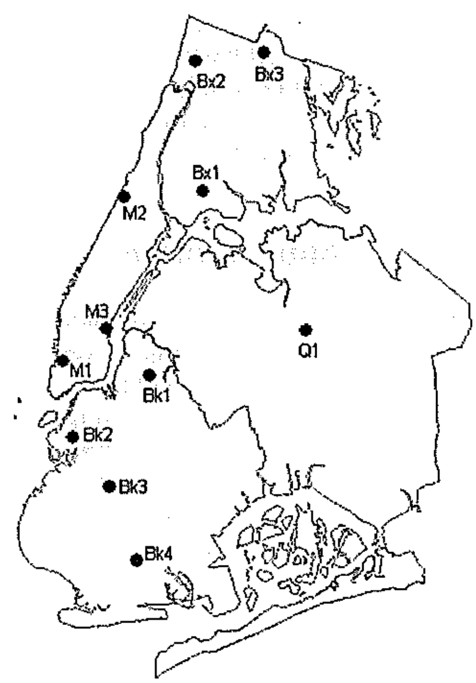
A recent source apportionment study used a standard Positive Matrix Factorization technique (PMF-2; see Appendix A for more detail) to determine the elemental source profiles for each of the sources that contributes to $PM_{2.5}$ in New York City.[29] The New York City-specific source profile (elemental fraction of source mass) for residual oil is a ratio of 0.0065 for Ni.[30] By applying such elemental source profiles to measurements of ambient Ni concentrations, the $PM_{2.5}$ mass due to burning residual oil can be determined. In other words, ambient Ni concentrations divided by the source profile value for residual oil equals the $PM_{2.5}$ mass attributable to residual oil burning.

B. Ambient Nickel Concentrations

A number of different sources contribute to the average annual ambient nickel concentrations in New York City: regional long-range transport; emissions from nearby ports and marine vessels; burning of residual oil for electrical generation or industrial processes; and the use of residual oil for heating purposes in commercial, institutional, and residential (CIR) buildings.[31] Of these sources, the use of residual oil for CIR heating is subject to the greatest seasonal variations, with peaks during the winter heating season and lower emissions during the non-heating summer months.[32] Nickel emissions due to marine sources, utilities, industries, and background sources vary slightly throughout the year but do not exhibit the same level of seasonal variation.[33] Therefore, it is possible to closely estimate the fraction of annual nickel concentrations attributable to CIR heating by considering the difference in winter and summer nickel concentrations.

In 2000, the U.S. EPA established the Speciation Trends Network (STN) to monitor and determine the composition of $PM_{2.5}$ in urban areas. New York City currently has three STN sites that provide detailed data on the chemical composition of ambient $PM_{2.5}$, including ambient nickel concentrations. Additionally, a recent pilot study measured summer- and winter-time nickel concentrations at eight sites across the four largest boroughs in New York City from 2007-2008.[34] The locations of the three EPA STN sites and the eight additional monitoring locations are shown in Figure 1.[35] Currently, there is a lack of air monitoring data on $PM_{2.5}$ composition in the borough of Staten Island.

Figure 1. Map of Monitor Locations.



While the STN sites provide year-round data, the pilot study only took measurements during specific months: January through March and May through July.[36] Those periods do not encompass the full heating and non-heating seasons in New York City. Therefore, some additional analysis is necessary to convert the pilot study's measurements into data representative of the full heating and non-heating seasons. Examining several years of data from STN sites, a standard regression analysis indicates that the high nickel concentrations observed during the heating season last for approximately 3.85 months of the year (not just the three winter months the pilot study measured).[37] These results can be translated into time-weighted values, which were tested on data from the three STN sites and then were applied to the other eight sampling sites to determine annual averages for all 11 locations.

For each air monitoring site, the portion of annual nickel concentrations attributable to the combustion of residual oil by CIR buildings is determined by first taking the difference between nickel concentrations during the pilot study-defined heating and non-heating seasons, and then multiplying that difference by the time-weighted value for the full heating season (3.85/12). Table 1 shows the pilot study-defined heating and non-heating average nickel concentrations, the calculated annual average nickel concentrations, and the portion of the annual nickel concentrations attributable to CIR use of residual oil.

Table 1. Nickel Concentrations by Monitoring Location.

	Ni Concentrations (ng/m³)				
Site	Heating Season	Non-Heating Season	Calculated Annual Average	Heating Minus Non-Heating Season	Annual Ni Attributable to CIR Residual Oil Use
Bx1	19.8	7.7	11.6	12.1	3.9
Bx2	17.7	5.2	9.2	12.5	4.0
Bx3	24.6	15.1	18.1	9.5	3.1
M1	13.0	4.5	7.2	8.5	2.7
M2	11.6	7.3	8.7	4.3	1.4
M3	19.9	12.5	14.9	7.4	2.4
Bk1	7.4	4.3	5.3	3.1	1.0
Bk2	13.5	3.0	6.4	10.5	3.4
Bk3	7.4	6.1	6.5	1.3	0.4
Bk4	6.3	6.3	6.3	0.0	0.0
Q1	16.2	3.9	7.8	12.3	4.0

Calculating the portion of annual nickel concentrations attributable to CIR residual oil combustion by comparing the heating and non-heating nickel concentrations has several important biases to consider. First, this approach fails to account for the use of residual oil by CIR sources to heat water during the non-heating season, which results in excluding the non-heating season emissions from these sources and *underestimating* their heating season contributions.

Secondly, some power plants near New York City are "load-following" or "peak-operating" plants, meaning they only operate during summer months when energy demand is the highest.[38] While most of these high demand-only power plants are gas powered, some do use residual oil as a secondary fuel—especially when natural gas demand is particularly high.[39] The increased residual oil use from these sources during the summer months also results in *underestimating* the heating season contributions to ambient nickel concentrations due to CIR use of residual oil.

Lastly, there is also a bias that results in *overestimating* the nickel concentrations that are due to CIR residual oil use. Atmospheric temperatures are much lower during the heating season (winter), and therefore atmospheric mixing heights are lower than during the non-heating season.[40] A lower atmospheric mixing height means less space in which emissions can concentrate. As a result, the same level of emissions will result in higher ambient concentrations during cooler months as compared to warmer months. Since part of the elevated nickel concentrations observed in the winter could result from mixing height changes rather than from the seasonal use of residual oil, the methodology used here could overestimate the portion of ambient nickel due to CIR residual oil use.

Ultimately, these potential biases point in opposite directions, and so there is no reason to believe that their net effect is significant; as a result, no additional quantitative adjustment is necessary to provide reasonable estimates of the annual nickel concentrations due to CIR use of residual oil. If any cumulative bias does exist, the generally conservative assumptions and methodologies employed here will likely result in an overall underestimation of the actual impacts of CIR residual oil use.

C. Annual $PM_{2.5}$ from CIR Residual Oil Use

Annual ambient $PM_{2.5}$ concentrations from CIR residual oil sources are determined using the annual nickel concentrations from these sources (calculated above) in conjunction with the elemental source profile for nickel. Across the eleven monitoring locations, the range of annual $PM_{2.5}$ concentrations attributable to these residual oil sources is 0.00-0.62 μg/m³, with an average of 0.37 μg/m³—that means citywide, residual oil contributes on average about 3% of all measured fine particulate matter.[41] A list of the regressed values for the annual $PM_{2.5}$ concentrations attributable to CIR residual oil use at each of the eleven monitoring locations is found in Table 2.

Table 2. Regressed $PM_{2.5}$ Concentrations by County.

County	Site	Annual Ni (ng/m³)	Annual $PM_{2.5}$ (μg/m³)	County-Aggregated Annual $PM_{2.5}$ Concentration Averages (μg/m³)
Bronx	Bx1	3.9	0.60	0.56
	Bx2	4.0	0.62	
	Bx3	3.1	0.47	
New York	M1	2.7	0.42	0.36
	M2	1.4	0.21	
	M3	2.4	0.37	
Kings	Bk1	1.0	0.15	0.18
	Bk2	3.4	0.52	
	Bk3	0.4	0.06	
	Bk4	0.0	0.00	
Queens	Q1	4.0	0.61	0.39

Average $PM_{2.5}$ concentrations due to CIR residual oil combustion are calculated for each county in order to more readily use health statistics that are commonly aggregated at the county level. $PM_{2.5}$ values between monitor sites are determined by a standard statistical technique called Kriging interpolation using ArcView 9.3 and Spatial Analyst software.[42] County-average $PM_{2.5}$ levels are calculated, as weighted by neighborhood populations, by overlaying the interpolated values on population neighborhood maps.[43] The county-aggregated $PM_{2.5}$ values due to CIR residual oil combustion, presented in Table 2, are population-weighted in this manner in order to represent the average $PM_{2.5}$ concentration that each person in the county is likely exposed to due to these sources. These values are used in all health benefit calculations.

D. Emission Ratios for Conversion to #2 Distillate Oil and Natural Gas

As shown above in Table 2, average ambient $PM_{2.5}$ concentrations due to the CIR combustion of #6 residual oil—including the #6 residual oil component of blended #4 oil—ranges from a low of 0.18 μg/m³ in Kings County to a high of 0.56 μg/m³ in Bronx County. Restrictions on the use of residual oil will not completely eliminate those $PM_{2.5}$ concentrations, since the energy generated by residual oil combustion will need to be replaced by use of other fuel types, which also emit some quantity of particulate matter. The reduction of ambient $PM_{2.5}$ concentrations by conversion to other fuel types is calculated in Table 3 from emission factors and fuel efficiency values for #6 residual oil, #2 distillate oil, and natural gas.

Table 3. Primary $PM_{2.5}$ Emissions per Energy Unit by Fuel Type.

Fuel	BTUs	Emissions (lbs $PM_{2.5}$)	lbs $PM_{2.5}$/BTU	ratio to #6	1-ratio
#6	153600 (per gallon)	2.86 (per 1000 gal)	1.88E-08	1.00	0.00
#2	139400 (per gallon)	2.13 (per 1000 gal)	1.55E-08	0.82	0.18
NG	1020 (per cubic foot)	7.60 (per million cubic feet)	7.45E-09	0.40	0.60

Estimating $PM_{2.5}$ emissions and predicting ambient air quality impacts require the use of primary emission factors, which define a particular source's average emission rate for a pollutant relative to the intensity of a particular activity: for example, grams of pollution emitted per gallon of fuel burned. Primary $PM_{2.5}$ emission factors consist of both filterable and condensable fractions.[44] Filterable particulate matter can be either a solid or a liquid at stack temperature (i.e., the temperature at the emissions point, often a smokestack), while condensable particulate matter is a vapor or gas at stack temperature and condenses to a solid or a liquid after exiting the stack. Both fractions are stable in the atmosphere and are collected on ambient filters.[45] The inclusion of the condensable fraction in assessing the ambient impacts of heating oil conversion is especially important since a majority of emissions from #2 distillate oil and natural gas combustion are vapors that condense to form ambient $PM_{2.5}$.[46]

The U.S. EPA provides primary $PM_{2.5}$ emission factors for residual oil, distillate oil, and natural gas.[47] The emission factor for residual oil is defined by equation and is dependant on the sulfur content of the fuel.[48] The emission factor for residual oil used in this study is calculated assuming a sulfur content for #6 residual fuel of 0.3% (3000 parts per million), which is the maximum sulfur content allowed by current New York State Law.[49]

Fuel efficiency values and emission factors for #6 residual, #2 distillate, and natural gas are calculated from the U.S. EPA's *Compilation of Air Pollutant Emission Factors* (called the AP-42 document) and from efficiency statistics specific for New York State. Primary $PM_{2.5}$ emissions from #2 distillate oil are 82%, by energy unit, of #6 residual oil emissions. Natural gas emissions are 40% of #6 residual oil emissions.

Table 4. Decrease in Exposure upon Conversion.

County	County-Aggregated Average Annual Ambient $PM_{2.5}$ Concentrations ($\mu g/m^3$)		
	Current Concentrations Due To Residual Oil Use at CIR Buildings	Concentrations Due To Those Sources Assuming Full Conversion to #2 Distillate	Concentrations Due To Those Sources Assuming Full Conversion to Natural Gas
Bronx	0.56	0.46 (a decrease of 0.10)	0.22 (a decrease of 0.34)
New York	0.36	0.30 (a decrease of 0.06)	0.15 (a decrease of 0.21)
Kings	0.18	0.15 (a decrease of 0.03)	0.07 (a decrease of 0.11)
Queens	0.39	0.32 (a decrease of 0.07)	0.16 (a decrease of 0.23)

Converting from residual oil entirely to #2 distillate oil will result in a minimum 18% reduction in annual $PM_{2.5}$ ambient concentrations due to the burning of residual oil at CIR sites.[50] Full conversion to natural gas will result in a 60% reduction in annual $PM_{2.5}$ ambient concentrations from those same sources. Table 4 shows how such conversions would decrease the estimated average $PM_{2.5}$ concentration that each person in each county is likely exposed to due to use of heating fuels at CIR sources.

Chapter Two

Restricting Residual Oil's Use Will Save Lives

Ambient $PM_{2.5}$ pollution can travel deep into the lungs and even slip directly into the bloodstream. Consequently, $PM_{2.5}$ is at least partially responsible for many negative health outcomes, including mortality, cardiovascular and respiratory disease, and lost work days. Epidemiology studies have determined the relationship between $PM_{2.5}$ concentrations and such health results. Using these concentration-response functions, along with background health rates and population data for New York City, this Chapter estimates the annual reductions in mortality and morbidity due to restricting residual oil use. Full conversion at CIR sites from residual oil to natural gas, for example, could help New York City avoid about 73 to 188 mortalities each year, as well as prevent thousands of lost work days, significantly reduce the incidence of chronic bronchitis and non-fatal heart attacks, and lower the rate of childhood acute bronchitis by about 115 cases per year.

The magnitude of health benefits anticipated from restricting residual oil use depends on the rate of conversion to other fuel types; not all customers can or will convert to natural gas. Four conversion scenarios are used in this study to account for this variable. Over a 20-year period, if full conversion takes all twenty years, at least 597 mortalities will be avoided. For every five years earlier that full conversion is implemented, a minimum 54 additional mortalities will be avoided.

All the benefits calculated in this Chapter ignore the possible effect of particle composition on increased mortality, which could be significant and which is discussed further in Chapter Four.

A. Determining Improvements in Health Endpoints due to Pollution Reduction

A log-linear relationship describes how the relative risk for mortality and morbidity changes in response to ambient air pollution.[51] The general form for estimating reductions in health endpoints as a function of reduced ambient pollution concentrations is defined as:

$$Reduction\ in\ Health\ Endpoint = \left(1 - \frac{1}{\mathrm{EXP}(\beta \times \Delta \mathrm{Q})}\right) \times Incidence \times Population$$

Where, β is determined by specific epidemiological concentration-response functions;

ΔQ is the change in pollutant concentration;

Incidence is the age-adjusted incidence of the health endpoint; and,

Population is the number of people in the age groups defined by the epidemiological study that provided the beta value.

Table 5. Total Populations by County for the Age Ranges Used to Calculate Health Endpoints.

			2008 Population (millions)				
Health Endpoint	Start Age	End Age	Bronx	NY	Kings	Queens	Total
Hospital Admissions (HA), Asthma	0	64	1.25	1.39	2.21	1.98	6.82
Acute Myocardial Infarction (MI), Nonfatal	18	99	0.99	1.30	1.86	1.76	5.91
Mortality, All Cause; Mortality, Cardiovascular (Laden et al., 2006)	25	99	0.85	1.17	1.63	1.57	5.22
HA, All Cardiovascular (less MI); HA, Chronic Lung Disease (less Asthma); Work Loss Days	18	64	0.85	1.10	1.57	1.47	4.99
Chronic Bronchitis	27	99	0.81	1.13	1.55	1.51	4.99
Mortality, All Cause; Mortality, Cardiovascular (Pope et al., 2002)	30	99	0.74	1.07	1.44	1.41	4.66
HA, Pneumonia; HA, All Cardiovascular (less MI); HA, Congestive Heart Failure; HA, Dysrhythmia; HA, Ischemic Heart Disease (less MI)	65	99	0.14	0.20	0.29	0.29	0.92
Acute Bronchitis	8	12	0.11	0.07	0.18	0.14	0.50

The background incidences and populations used in these calculations are not inclusive of all age ranges. Instead, they include only the age ranges defined by the epidemiology studies that provide the concentration-response functions (note that two studies are used for all-cause and cardiovascular mortality calculations). In cases where the age-adjusted rate is not available for a given age range, it can be calculated if the overall age-adjusted rate, total population, and crude incidence by age group are known. This process was used in order to determine the age-adjusted rate for cardiovascular mortality for individuals 30-99 years old when only the overall (ages 0-99) adjusted rate was available by county from the New York State Department of Health.[52]

All health endpoints, except for cardiovascular mortalities, are calculated using EPA's BenMAP 3.0.14 software, which is available for download at the U.S. EPA website.[53] County-specific age-adjusted mortality rates, age-adjusted morbidity rates, and population data are all available in the BenMAP program.[54] Some of the morbidity incidence and prevalence data are grouped by region and therefore may slightly vary from New York City background rates.[55]

For this analysis, 2005 incidence rates are used for the all-cause mortality estimations, while all morbidity endpoints are calculated based upon 2000 incidence and prevalence data. Estimates of reductions in cardiovascular mortality are made using the 2004-2006 age-adjusted rates obtained from the New York State Department of Health.[56] All health endpoints are calculated using 2008 estimated populations. The exposed populations by county used for calculating each health endpoint are found in Table 5. A complete list of health endpoints used in this study along with the relevant epidemiology studies are listed in Appendix B.

B. Avoided Mortalities and Morbidities from Restricting Residual Oil

Central estimates by county of the avoided health endpoints as a result of converting CIR locations from residual oil to either #2 distillate oil or natural gas are found in Tables 6 and 7, respectively. The health endpoints listed in these tables are separated into two categories: chronic and acute exposure effects. Chronic, or long-term, exposure health effects include all-cause mortality, cardiovascular mortality, and chronic bronchitis. All other health effects are estimates based on acute pollution exposures.

Two estimates for all-cause mortality are calculated using concentration-response functions from two separate epidemiological studies: Pope and colleagues (2002), and Laden and colleagues (2006).[57] Both studies are extended analyses of long-term, prospective cohort studies whose initial publications have undergone extensive reanalysis by independent scientific experts.[58] A recent regulatory impact analysis performed by the U.S. EPA used these analyses to estimate reductions in premature, all-cause mortality caused by fine particulate matter; however, the estimates were not pooled due to differences in study design and study populations.[59] Similarly, the two estimates of avoided all-cause mortality calculated in this study are not pooled but presented as a range of central estimates.[60]

Assuming full conversion to #2 distillate oil, it is estimated that there will be 22 to 56 avoided all-cause mortalities annually, including 17 to 48 cardiovascular mortalities. Assuming full conversion to natural gas, it is estimated that there will be 73 to 188 avoided all-cause mortalities annually, including 58 to 127 cardiovascular mortalities.

The tables also detail a range of avoided morbidities, from avoiding thousands of lost work days to significant reductions in the incidence of chronic bronchitis, nonfatal myocardial infarction, and other heart and lung diseases. Of particular note are the total estimates for childhood acute bronchitis: just for ages 8 to 12, assuming full conversion to #2 distillate oil, it is estimated there will be about 34 avoided cases annually; assuming full conversion to natural gas, the central estimate rises to above 115 avoided cases annually.

Again, none of these estimates accounts for the potential effect of particle composition on mortality, which could be significant and which is discussed in Chapter Four.

Table 6. Central Estimates of Annual Health Endpoint Reductions Assuming Full Conversion to #2 Distillate Fuel.

Chronic Pollutant Exposure	Start Age	End Age	Annual Avoided Mortalities and Morbidities: Bronx	NY	Kings	Queens	Total
Mortality, All Cause (Laden et al., 2006)	25	99	16.3	11.5	10.0	18.1	55.9
Mortality, All Cause (Pope et al., 2002)	30	99	6.3	4.5	3.9	7.0	21.6
Mortality, Cardiovascular (Laden et al. 2006)	25	99	12.4	6.5	7.0	11.9	37.8
Mortality, Cardiovascular (Pope et al. 2006)	30	99	5.7	3.0	3.2	5.5	17.3
Chronic Bronchitis	27	99	3.8	3.4	2.4	5.0	14.6
Acute Pollutant Exposure							
Work Days Lost	18	64	840	700	505	1007	3052
Acute Myocardial Infarction (MI), Nonfatal	18	99	9.8	8.8	6.7	13.9	39.2
Acute Bronchitis	8	12	12.1	5.2	6.5	10.8	34.4
Hospital Admissions (HA), All Cardiovascular (less MI)	65	99	1.8	1.7	1.3	2.7	7.4
HA, Congestive Heart Failure	65	99	1.0	0.9	0.7	1.5	4.1
HA, Ischemic Heart Disease (less MI)	65	99	0.5	0.5	0.4	0.8	2.1
HA, Dysrhythmia	65	99	0.3	0.3	0.2	0.5	1.3
HA, All Cardiovascular (less MI)	18	64	1.1	1.0	0.7	1.5	4.4
HA, Pneumonia	65	99	1.2	1.1	0.9	1.9	5.1
HA, Asthma	0	64	1.1	0.7	0.6	1.1	3.4
HA, Chronic Lung Disease (less Asthma)	18	64	0.3	0.2	0.2	0.4	1.1

Table 7. Central Estimates of Annual Health Endpoint Reductions Assuming Full Conversion to Natural Gas.

			Annual Avoided Mortalities and Morbidities				
Chronic Pollutant Exposure	Start Age	End Age	Bronx	NY	Kings	Queens	Total
Mortality, All Cause (Laden et al., 2006)	25	99	54.6	38.7	33.6	60.8	187.8
Mortality, All Cause (Pope et al., 2002)	30	99	21.0	15.1	13.0	23.7	72.8
Mortality, Cardiovascular (Laden et al. 2006)	25	99	41.9	21.9	23.4	40.2	127.4
Mortality, Cardiovascular (Pope et al. 2006)	30	99	19.2	10.0	10.8	18.4	58.4
Chronic Bronchitis	27	99	12.8	11.5	8.1	16.7	49.0
Acute Pollutant Exposure							
Work Days Lost	18	64	2826	2354	1699	3388	10266
Acute Myocardial Infarction (MI), Nonfatal	18	99	33.0	29.6	22.4	46.7	131.7
Acute Bronchitis	8	12	40.4	17.4	21.7	36.1	115.7
Hospital Admissions (HA), All Cardiovascular (less MI)	65	99	6.1	5.6	4.3	9.0	24.9
HA, Congestive Heart Failure	65	99	3.3	3.1	2.3	4.9	13.6
HA, Ischemic Heart Disease (less MI)	65	99	1.7	1.6	1.2	2.5	7.0
HA, Dysrhythmia	65	99	1.0	0.9	0.7	1.5	4.2
HA, All Cardiovascular (less MI)	18	64	3.8	3.3	2.5	5.1	14.7
HA, Pneumonia	65	99	4.1	3.9	3.0	6.2	17.2
HA, Asthma	0	64	3.5	2.3	2.0	3.7	11.6
HA, Chronic Lung Disease (less Asthma)	18	64	0.9	0.8	0.6	1.2	3.6

C. Magnitude of Health Benefits Depends on Time and Rate of Fuel Conversion

The magnitude of the annual public health benefits that will result from restricting residual oil use depends on whether current residual oil users convert to natural gas or to #2 distillate oil, as well as how quickly they convert. Some residual oil users might convert voluntarily over time, for economic or other reasons; other users may only convert if required by regulation.

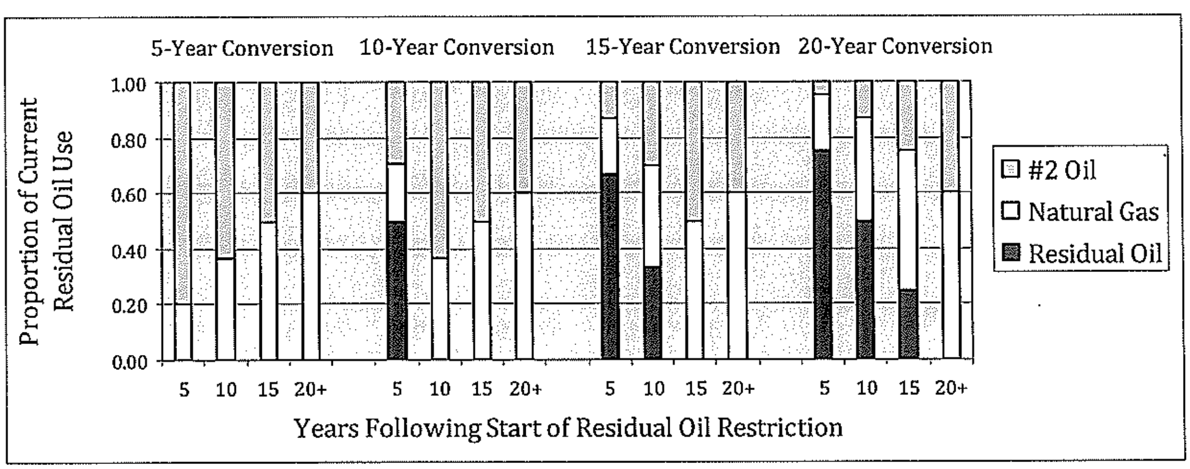
This analysis does not attempt to estimate a baseline rate of voluntary conversion or to predict precise conversion rates under any particular hypothetical regulation. Instead, this analysis explores four different time-conversion scenarios: 5, 10, 15, and 20-year time periods for full conversion from residual oil. Each scenario assumes that conversion from residual oil occurs regularly through time until full conversion. Each scenario also assumes that the conversion away from residual oil occurs at the same rate for both #6 and #4 residual oil.

Importantly, this analysis assumes a constant portion of conversion to natural gas versus #2 distillate oil, using Con Edison's expected conversion rates, during a 20-year phase out of residual oil.[61] Based on various factors, Con Edison—a natural gas provider for Manhattan, the Bronx, and parts of Queens—estimates that every year, four to five percent of residual oil heating customers will convert to natural gas, resulting in approximately 60% of the residual oil heating population converting to natural gas over 20 years.[62] If regulation requires full conversion by the end of 20 years, any remaining residual oil customers will have to switch to #2 distillate by that time.

However, that estimate of natural gas customers does not fully reflect how natural gas availability and use might change if a regulation were to mandate a full conversion timeline of less than 20 years. Such regulation could increase demand for natural gas and accelerate the expansion of natural gas infrastructure. Due to the difficulty of making such adjusted estimates, this analysis employs a conservative assumption and uses Con Edison's 20-year estimates for natural gas conversion in all four time-conversion scenarios explored. Nevertheless, actual conversion to natural gas could occur at a greater rate due to various regulatory or economic pressures, and a quicker, broader conversion to natural gas would increase the benefits of phasing out residual oil.

The estimated proportions of residual oil, #2 distillate oil, and natural gas used over time at sites that currently burn residual oil is shown in Figure 2 for each of the four conversion scenarios.

Figure 2. Fuel Proportions by Year for Four Time-Conversion Scenarios.



The cumulative avoided mortality estimates for each time-conversion scenario are found in Table 8. The range of estimates provided for each conversion scenario reflects the average calculations for avoided all-cause mortalities derived from the two different studies: Pope and colleagues (2002), and Laden and colleagues (2006). The central estimates of annual avoided mortalities due to lower ambient $PM_{2.5}$ concentrations are arithmetically averaged from the full conversion scenarios and therefore vary slightly from estimates independently calculated using log-linear estimates of the reductions in health risks. Given the level of pollution reduction calculated in this study, the central estimates used in Table 8 are within two percent of central estimates calculated using the log-linear reductions in relative risk.

Table 8. Cumulative Avoided Mortalities for Four Time-Conversion Scenarios.

	Years for Full Conversion			
Time after Start of Conversion Process	**5-Year Scenario**	**10-Year Scenario**	**15-Year Scenario**	**20-Year Scenario**
1st Year	7 – 17	4 – 12	4 – 10	3 – 9
2nd Year	20 – 51	13 – 34	11 – 29	10 – 26
3rd Year	39 – 102	26 – 68	22 – 57	20 – 51
4th Year	65 – 169	44 – 113	36 – 94	33 – 85
5th Year	97 – 252	65 – 168	54 – 140	49 – 126
6th Year	131 – 339	90 – 233	75 – 194	68 – 174
7th Year	167 – 432	120 – 309	99 – 256	89 – 230
8th Year	204 – 528	153 – 394	127 – 327	114 – 293
9th Year	243 – 629	189 – 489	157 – 405	141 – 363
10th Year	284 – 733	230 – 594	190 – 491	170 – 440
11th Year	326 – 842	272 – 702	226 – 584	203 – 523
12th Year	369 – 954	315 – 814	265 – 685	237 – 613
13th Year	414 – 1069	360 – 929	307 – 793	274 – 708
14th Year	460 – 1187	406 – 1048	352 – 908	314 – 810
15th Year	507 – 1309	453 – 1169	399 – 1030	356 – 918
16th Year	555 – 1434	501 – 1294	447 – 1154	400 – 1031
17th Year	605 – 1561	551 – 1421	495 – 1282	446 – 1150
18th Year	655 – 1691	601 – 1552	547 – 1412	494 – 1275
19th Year	706 – 1824	652 – 1685	598 – 1545	544 – 1405
20th Year	**759 – 1960**	**705 – 1820**	**651 – 1680**	**597 – 1540**

Over a twenty-year period, if full conversion takes all twenty years, a minimum of nearly 600 mortalities will be avoided. For every year quicker that full conversion is implemented, a minimum of 10 additional mortalities will be avoided over that same twenty-year period. However, it is equally as likely that the actual number of avoided mortalities will be 1,540 over twenty years with 28 additional avoided mortalities for every year quicker that full conversion is achieved.

After the twentieth year, under any of the four conversion scenarios, residual oil will be completely phased out of CIR boilers, and approximately 52 to 135 additional mortalities will be avoided every year. Since plans for natural gas infrastructure expansion are less certain after twenty years, these estimates assume a constant proportion of 60% CIR customers using natural gas and the rest burning #2 distillate oil. Therefore, these estimates likely represent minimum predictions for health benefits after twenty years, since natural gas use could increase beyond 60%.

Indeed, natural gas use could increase beyond 60%, either over time or as a result of regulatory and economic pressures. For example, if more stringent regulation increased demand for and availability of natural gas, all the estimated mortality statistics reported above would increase. Recall that 100% conversion to natural gas would result in 73 to 188 avoided mortalities per year.

Figures 3 and 4 show the average avoided mortalities per year and the cumulative avoided mortalities respectively for each of the four time-conversion scenarios as estimated using Pope and colleagues (2002) concentration-response functions. These numbers show the minimum number of avoided mortalities expected from the four different time-conversion scenarios.

Figure 3. Estimated Annual Avoided Mortalities by Time-Conversion Scenario.

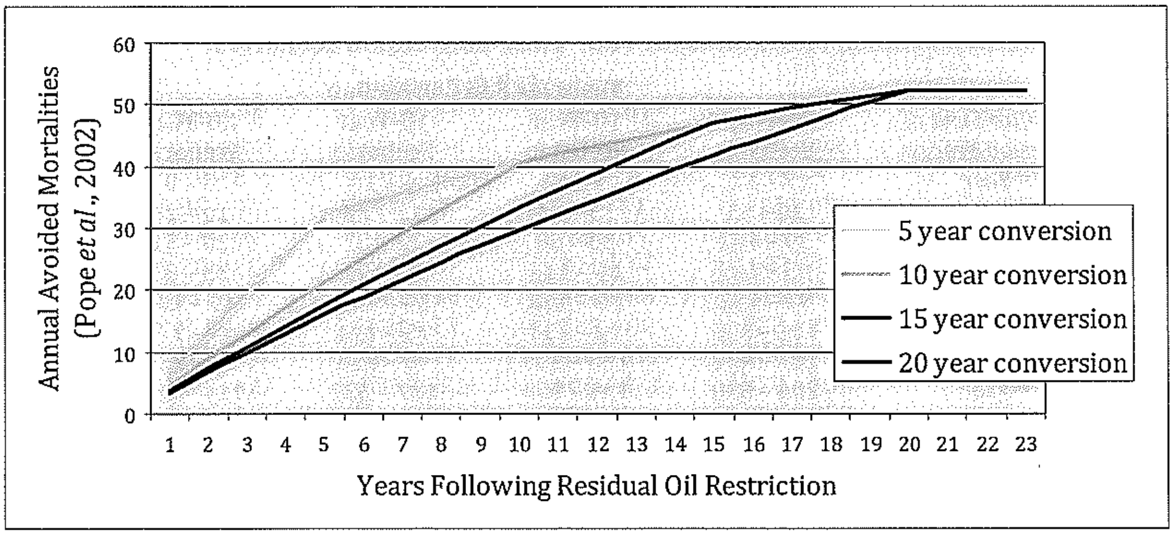
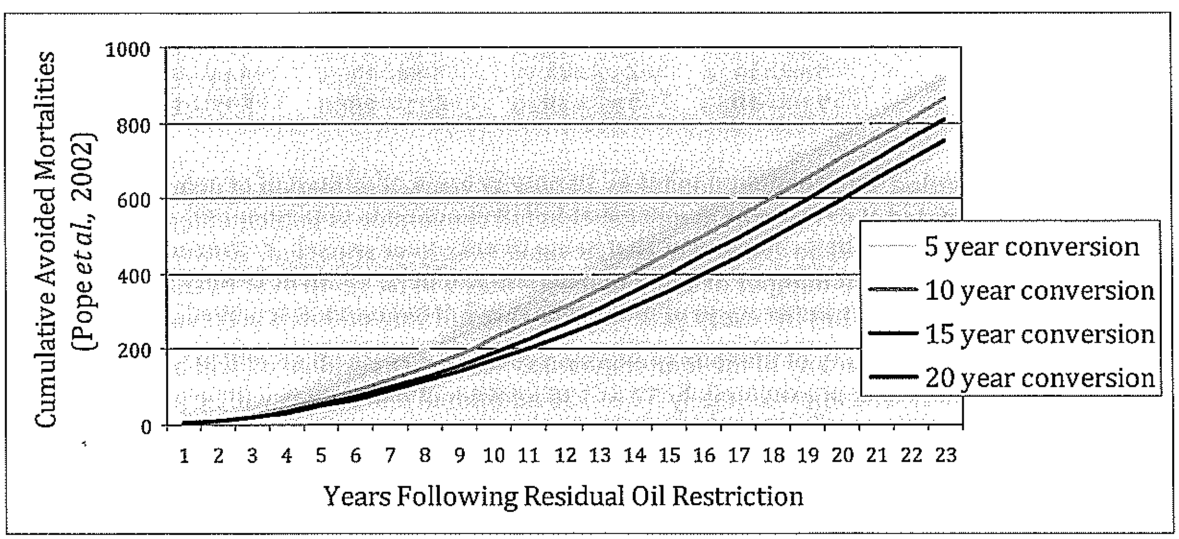


Figure 4. Estimated Cumulative Avoided Mortalities by Time-Conversion Scenario.



Chapter Three

Improving Community Health Delivers Significant Monetized Benefits

Saving lives, preventing illness, and generally improving public health delivers significant, quantifiable benefits that can be assigned a monetary value. Not only can the cost of illness be calculated—in terms of medical resources used, lost productivity (such as lost wages) during illness, and so forth—but individuals and society as a whole have a "willingness to pay" to avoid negative health outcomes. Government agencies routinely calculate and apply such monetary values when deciding whether to regulate a dangerous substance, to determine if the health benefits justify the economic costs of regulation.

Using conservative estimates for the monetized value of various health outcomes, phasing out use of residual oil at CIR sites over a twenty-year period will generate about $5.3 billion worth of health benefits. For every year earlier that full conversion occurs, an average of $111 million in additional cumulative health benefits can be expected. These estimates assume that no more than 60% of residual oil customers will convert to natural gas over a twenty-year period. However, if 100% converted to natural gas, monetized benefits could reach $558 million to $1.35 billion every year.

As with the previous section, all the benefits calculated in this Chapter ignore possible particle composition effects, which could be significant and which are discussed further in Chapter Four.

A. Monetizing the Value of Health Outcomes

Since the monetary value of avoiding mortalities typically constitutes the bulk of total monetized benefits for many environmental regulations, accurately determining the value of a statistical life is of great importance in generating health benefit estimations. The method for determining the value of a statistical life is complicated and not without dispute,[63] but the U.S. EPA has decades of experience with the practice of cost-benefit analysis.

Different values for a statistical life have been used by the EPA over the last several years in response to updated data, new economic theories, and changing economic conditions.[64] This analysis uses a recent and widely-accepted value calculated by the EPA, which is $6.9 million in 2008 dollars for each statistical life.[65]

The values of the avoided morbidities used in this study are based on the EPA's BenMAP 3.0.14 database.[66] The monetary values of avoided morbidities are calculated by concrete costs of the illness, individuals' willingness to pay to avoid the morbidity, or a combination of the two. The concrete costs of illness to society include the total value of the medical resources used as well as the value of lost productivity, such as wages lost.[67] The valuations have been inflation-adjusted and are presented in 2008 dollars.[68]

The annual monetized health benefits for full conversion of CIR sites to #2 distillate and natural gas are found in Tables 9 and 10, respectively. The ranges presented for total annual monetary benefits reflect the difference between using Pope and colleagues' figures for all-cause mortality and using those central estimates from Laden and colleagues instead.

Table 9. Annual Monetized Health Benefits Assuming Full Conversion to #2 Distillate Oil (Million 2008$).

Health Endpoint	Start Age	End Age	Annual Incidence Reduction	Monetized Benefits (Million 2008$)
Mortality, All Cause (Laden et al., 2006)	25	99	55.9	385.6
Mortality, All Cause (Pope et al. 2002)	30	99	21.6	149.4
Acute Myocardial Infarction (MI), Nonfatal	18	99	39.2	9.2
Chronic Bronchitis	27	99	14.6	6.2
Work Days Lost	18	64	3052	0.5
Hospital Admissions (HA), All Cardiovascular (less MI)	65	99	7.4	0.2
HA, All Cardiovascular (less MI)	18	64	4.4	0.1
HA, Pneumonia	65	99	5.1	0.1
HA, Asthma	0	64	3.4	0.03
HA, Chronic Lung Disease (less Asthma)	18	64	1.1	0.02
Acute Bronchitis	8	12	34.4	0.02
			Total	**165.8 – 402.0**

Table 10. Annual Monetized Health Benefits Assuming Full Conversion to Natural Gas Fuel (Million 2008$).

Health Endpoint	Start Age	End Age	Annual Incidence Reduction	Monetized Benefits (Million 2008$)
Mortality, All Cause (Laden et al., 2006)	25	99	187.8	1,295.8
Mortality, All Cause (Pope et al. 2002)	30	99	72.8	502.3
Acute Myocardial Infarction (MI), Nonfatal	18	99	131.7	31.1
Chronic Bronchitis	27	99	49.0	20.9
Work Days Lost	18	64	10266	1.8
Hospital Admissions (HA), All Cardiovascular (less MI)	65	99	24.9	0.7
HA, All Cardiovascular (less MI)	18	64	14.7	0.4
HA, Pneumonia	65	99	17.2	0.3
HA, Asthma	0	64	11.6	0.1
HA, Chronic Lung Disease (less Asthma)	18	64	3.6	0.06
Acute Bronchitis	8	12	115.7	0.05
			Total	**557.6 – 1,351.1**

B. Cumulative Monetary Benefits for Restricting Residual Oil

As demonstrated in Chapter Two, the magnitude of public health benefits will depend on whether current residual oil users convert to natural gas or to #2 distillate oil, as well as how quickly they convert. Using the same assumptions and the same four time-conversion scenarios employed above, the cumulative monetized benefits of restricting residual oil can be calculated. Recall that these assumptions are conservative. For example, the maximum proportion of natural gas consumers is estimated at 60%, a target only reached after twenty years time. If regulatory or economic pressures increase the demand for and availability of natural gas, the benefits of phasing out residual oil could be much greater than the conservative cumulative calculations made here.

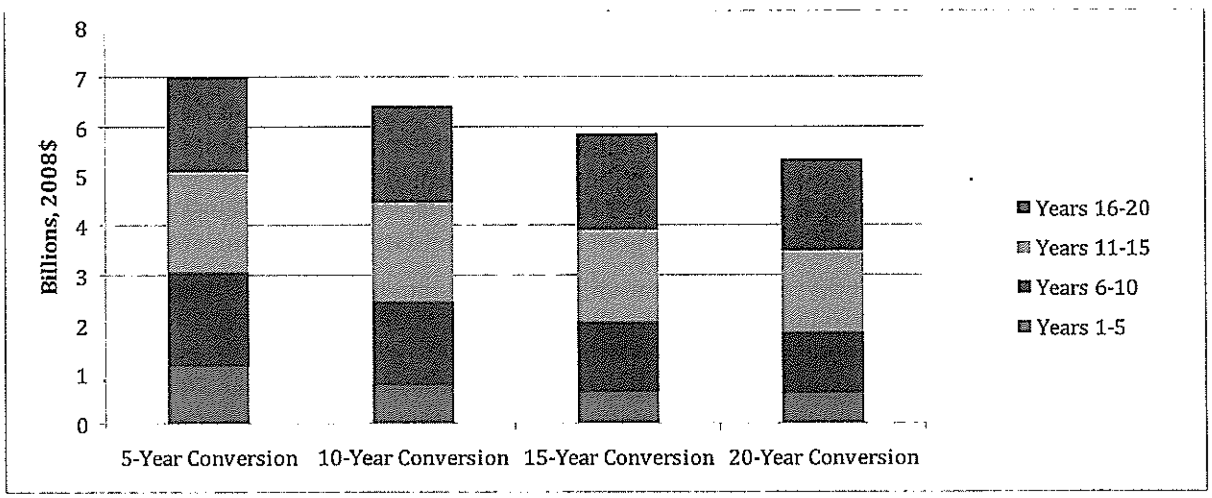
Table 11 and Figure 5 present these estimates, multiplying the monetary value of various health outcomes by the number of avoided mortalities and morbidities expected each year over a twenty-year period. The number of avoided mortalities anticipated in these calculations is based on an average of the Pope and colleagues (2002) estimates and the Laden and colleagues (2006) estimates, weighing each value equally. To be conservative, the monetary values of the various health outcomes have not been adjusted upward on an annual basis to keep pace with inflation or any other growth rate.

On the other hand, best economic practices require application of a discount rate to future streams of annual benefits, to determine the total net present value. Standard discount rates for this kind of context and timescale are 3% or 5%.[69] Table 11 and Figure 5 only present the values at the 3% discount rate, but calculations using the 5% rate are also given below.

Table 11. Cumulative Monetary Health Benefits (Million 2008$) for Four Time-Conversion Scenarios at a 3% Discount Rate.

Time after Start of Conversion Process	Years for Full Conversion **5-Year Scenario**	**10-Year Scenario**	**15-Year Scenario**	**20-Year Scenario**
1st Year	$84.42	$56.85	$47.67	$43.07
2nd Year	$247.06	$165.97	$138.94	$125.43
3rd Year	$482.10	$323.07	$270.06	$243.56
4th Year	$784.09	$524.17	$437.53	$394.21
5th Year	$1,147.92	$765.55	$638.10	$574.36
6th Year	$1,521.22	$1,043.74	$868.73	$781.23
7th Year	$1,902.25	$1,355.53	$1,126.65	$1,012.22
8th Year	$2,289.44	$1,697.90	$1,409.26	$1,264.94
9th Year	$2,681.36	$2,068.05	$1,714.14	$1,537.18
10th Year	$3,076.69	$2,463.38	$2,039.05	$1,826.89
11th Year	$3,474.26	$2,860.95	$2,381.93	$2,132.17
12th Year	$3,873.00	$3,259.69	$2,740.85	$2,451.26
13th Year	$4,271.95	$3,658.64	$3,114.02	$2,782.55
14th Year	$4,670.24	$4,056.94	$3,499.80	$3,124.53
15th Year	$5,067.10	$4,453.79	$3,896.66	$3,475.84
16th Year	$5,461.82	$4,848.51	$4,291.38	$3,835.17
17th Year	$5,853.78	$5,240.48	$4,683.35	$4,201.37
18th Year	$6,242.43	$5,629.13	$5,071.99	$4,573.34
19th Year	$6,627.27	$6,013.97	$5,456.83	$4,950.09
20th Year	**$7,007.87**	**$6,394.56**	**$5,837.43**	**$5,330.68**

Figure 5. Cumulative Monetary Health Benefits for Four Time-Conversion Scenarios at a 3% Discount Rate.



Over a twenty-year period, if full conversion takes all twenty years, quantifiable health benefits will be worth approximately $5.3 billion (at a 3% discount rate; the value is $4.2 billion at a 5% rate). For every year quicker that full conversion is implemented, an average of $111 million in additional cumulative benefits (at a 3% discount rate, or $98 million at a 5% rate) will be generated over that same twenty-year period.

After the twentieth year, under any of the four conversion scenarios, residual oil will be completely phased out of CIR boilers, and approximately $370 million (at a 3% discount rate, or $247 million at a 5% rate) in annual benefits will be generated starting the twenty-first year.[70]

As already mentioned, none of these calculations takes into account the potential effects of particle composition on increased mortality. Such potential effects could greatly increase the benefits of phasing out residual oil. The significance of those effects is discussed in the next Chapter.

Additionally, these calculations assume that the proportion of natural gas consumers never exceeds 60%. Switching from residual oil to natural gas generates much greater benefits than switching to #2 distillate oil. If regulatory or economic pressures increased the demand for and availability of natural gas, the cumulative, monetized benefits calculated here could be much higher. For example, recall from Table 10 that the monetized benefits of a 100% conversion to natural gas could total $558 million to $1.35 billion every year.

Chapter Four

Actual Health Benefits Could Greatly Exceed Quantitative Estimates

All the significant health benefits calculated in the previous chapters were based on well-reviewed concentration-response functions for particulate matter. However, those functions ignore the role of particle composition on increased mortality and morbidity. Compared to other sources of $PM_{2.5}$, residual oil emissions have high nickel and vanadium concentrations. If nickel and vanadium particles have a larger impact on health than other components of New York City's soot, the actual avoided mortalities and morbidities from restricting residual oil would be greater than predicted by the reduction in fine particle mass alone. And while more data is necessary, many recent studies support the theory that $PM_{2.5}$ from residual oil, with its high concentrations of nickel and vanadium, may strengthen the relationship between particulate air pollution and premature mortality.

Ambient concentrations of other pollutants, like sulfur dioxide and nitric oxides, will also be altered if residual oil is phased out. Reductions in these pollutants may lead to additional improvements in public health; but, these potential health improvements are not quantified in this study.

Given the potential significance of these additional un-quantified benefits, the monetized benefits presented above in Chapter Three likely underestimate the full value of phasing out residual oil.

A. Particle Composition Modifies Health Effects Due to Air Pollution

In addition to particle size and mass concentration, particle composition is an important characteristic of particulate matter pollution. Particulate matter is heterogeneous in nature, composed of metals, secondary particles from acidic gases such as sulfates and nitrates, organic compounds, elemental carbon, and water vapor.

The composition of $PM_{2.5}$ is determined by the sources that contribute to the ambient air emissions. Sources of fine particles in New York City include but are not limited to: transported secondary aerosols with high concentrations of sulfur as well as selenium, black carbon, and vanadium; motor vehicle emissions with high concentrations of organic compounds, elemental carbon, zinc, and barium; soil and road dust represented by aluminum, calcium, silica, magnesium, iron, and potassium; sea salt with high concentration of chlorine and sodium; and oil combustion with high concentrations of nickel and vanadium.[71]

These components of $PM_{2.5}$ vary in their strength of association with seasons as well as size fractions. For example, components related to soil, road dust, and sea salts (fine crustal components) are more generally associated with larger, coarse particles. In regards to seasonal variations, secondary particle concentrations are higher in the warm summer months due to the increased photochemical activity and lower in the cooler winter months.[72]

The health effects of particulate air pollution, including premature mortality, have a proven association with fine particle composition. A study of six U.S. cities showed that increases in daily mortality are associated with combustion sources of $PM_{2.5}$ but not associated with fine crustal components such as soil, road dust, and sea salts.[73]

Another study looking at associations between particle composition and daily mortality in 25 U.S. cities found larger increases in all-cause daily mortality when $PM_{2.5}$ mass contained a higher portion of aluminum, silicon, sulfate, and nickel.[74] A study of long-term mortality in a cohort of male U.S. military veterans with hypertension showed that different components of $PM_{2.5}$ vary substantially in their association with survival: nickel, vanadium, nitrates, and elemental carbon were significantly associated with increased mortality in single pollutant models.[75] Each of these studies lends supporting evidence that $PM_{2.5}$ from residual oil combustion, with its high concentrations of nickel and vanadium, may positively modify the relationship between particulate air pollution and all-cause mortality.

Several studies have been carried out that specifically examine the associations of nickel and vanadium on mortality risk estimates. A recent study compared fine particle composition with the National Mortality and Morbidity Study's estimates for coarse particulate matter (PM_{10}) mortality risk in 60 U.S. metropolitan areas. It showed that, out of the 16 key components most closely related to major source categories, nickel and vanadium were the strongest predictors of variation in PM_{10} risk estimates across the metropolitan areas.[76] That analysis also showed that only nickel and vanadium were significantly associated with the much higher daily mortality in New York City than other U.S. cities.[77]

Re-analysis of the National Mortality and Morbidity Study comparing long-term average county-level nickel and vanadium $PM_{2.5}$ concentrations also found that nickel and vanadium concentrations modified the relationship between PM_{10} mass and all-cause mortality; however, when New York City counties were excluded during sensitivity analysis, the evidence of the effect was weaker and no longer statistically significant.[78]

This finding does not mean that nickel and vanadium do not increase the risk of particulate matter on human health, but it does show the sensitivity of findings to influential observations from counties in New York City.[79] Additional studies may be necessary to distinguish the possible metal toxicity from spatial confounding by other characteristics of New York City where the highest ambient levels of nickel and vanadium are found.[80]

B. Intervention Studies Provide Insights into Health Impacts of Fuel Conversion

Intervention studies, as opposed to observational epidemiological studies, provide a natural experiment to assess the impacts of air pollution on human health. Planned and unplanned environmental changes have provided invaluable information regarding the health benefits of reducing air pollutants.

Several relevant intervention studies are available that involved fuel conversions in metropolitan areas. One intervention study comparing mortality statistics six years before and after a 1990 ban on bituminous coal in Dublin, showed that non-traumatic deaths decreased 5.7% and cardiovascular mortality decreased by 10.3%.[81]

The concentration-response relationship for all-cause mortality in the Dublin intervention study is comparable to what was reported in another intervention study during a 13-month strike at a steel mill in Utah Valley from 1986-1987.[82] Interestingly, the decrease in the mortality rate for the Dublin intervention study was more than twice than what was predicted by time-series analysis of daily mortality for the same level of pollution reduction.[83] This illustrates that the actual health benefits of reducing air pollutants can be greater than what is estimated using time-series studies.[84]

Perhaps more relevant than the Dublin intervention study in assessing the health effects of restricting residual oil use in New York City is an intervention study of the health effects of a mandated conversion to low-sulfur fuel in Hong Kong. In a single weekend in 1990, Hong Kong implemented a full and permanent restriction that required all power plants and on-road vehicles to use fuel with a sulfur content of less than 0.5% by weight.[85] In the five years following the low-sulfur mandate, there was a 2.1% decrease in all-cause mortality and a 2.0% decrease in cardiovascular mortality, even though annual ambient particulate matter concentrations remained unchanged.[86]

The immediate and sustained decrease in mortality observed in Hong Kong was associated with reductions in ambient nickel and vanadium concentrations.[87] The decrease in ambient nickel and vanadium occurred because any desulfurization process also removes nickel and vanadium from the fuel oil. Similarly, conversion from residual oil to distillate oil or natural gas in New York City would also result in a large decrease in ambient nickel and vanadium concentrations, which may also lead to significant and additional reductions in all-cause and cardiovascular mortality.

C. Reduced Ambient Nickel Concentrations May Result in Additional Health Benefits

Restricting CIR residual oil use in New York City will result in lower ambient nickel and vanadium concentrations in addition to reducing ambient $PM_{2.5}$ concentrations. Nickel and vanadium emissions are much lower for #2 distillate oil and natural gas than #6 residual oil.[88] For example, compared to #6 residual oil, #2 distillate oil and natural gas only emit 0.5% and 0.4% of nickel respectively on a per-energy basis, as shown in Table 12. Nickel emissions per million BTUs for #6 residual oil and natural gas are calculated assuming 152,048 BTUs per gallon for #6 residual oil and 1020 BTUs per cubic feet of natural gas.

Table 12. Nickel Emissions by Fuel Type

Fuel	Ni Emissions (lbs)	Ni (lbs) per Million BTUs	Portion of #6 emissions
Residual Oil (#6)	0.0845 (per 1000 gallons)	5.56E-04	100.0%
Distillate Oil (#2)	0.000003 (per million BTUs)	3.00E-06	0.5%
Natural Gas	0.0021 (per million cubic feet)	2.06E-06	0.4%

Full conversion from residual oil (including both #6 residual oil and #4 blended oil) to #2 distillate oil and natural gas at CIR sources will result in a roughly 27% reduction in annual ambient nickel concentrations across New York City. This is in sharp contrast to the approximately 1.5% reduction in annual ambient $PM_{2.5}$ concentrations and the 4.5% reduction in annual ambient $PM_{2.5}$ from local sources.[89] Estimated reductions in nickel by county are shown in Table 13. The annual nickel concentration averages for Bronx, New York, and Queens Counties were obtained from the Speciation Trends Network operated by the U.S. EPA for the years 2005-2008.[90] The nickel annual average for Kings County was calculated from interpolation methods previously described and from data found in Table 1.

Table 13. Reductions in Ambient Nickel Concentrations by County

	2005-08 Ambient Nickel (ng/m^3)		
	Annual Average	Aggregate Reduction	Percent Reduced
Bronx	11.5	3.6	31.7%
New York	8.9	2.3	26.0%
Kings	6.1	1.2	19.4%
Queens	8.2	2.5	31.0%
		Average Reduction:	27%

Nickel, and to a lesser extent vanadium, has been shown in epidemiological studies to positively modify the effect between particulate pollution and mortality. Additionally, the results of the Hong Kong fuel oil intervention study have shown that decreases in all-cause and cardiovascular mortality are associated with lower concentrations of ambient nickel and vanadium, even in the absence of decreases in overall annual particulate matter concentrations. Given this supporting evidence, and the expected 27% reduction in ambient nickel concentrations, it is anticipated that the actual health benefits of restricting the use of residual oil at CIR sites will greatly exceed the estimates based solely upon the roughly 1.5% reduction in annual ambient fine particle concentrations.

D. Reductions in Airborne Pollutants Other Than $PM_{2.5}$

Emissions of air pollutants other than fine particles will also be reduced as a result of conversion away from residual heating oil. These pollutants include coarse particles ($PM_{10-2.5}$), sulfur dioxide

(SO_2), nitric oxides (NO_x), and carbon dioxide (CO_2). Carbon monoxide (CO) emissions will increase because they are related directly to the amount of fuel burned, and greater volumes of cleaner, lighter fuels are needed to generate the same energy as the denser residual oil can produce per unit of volume. Table 14 shows the percent change in the emission of these pollutants as a result of switching from #6 residual oil to #2 distillate oil or natural gas, according to EPA emission factors.[91]

Of particular note are the 88% and 100% reductions in coarse particulate matter emissions (particles with diameters from 2.5 to 10 microns) in #2 distillate oil and natural gas, respectively, as compared to #6 residual oil. Such reductions in the emission of coarse particulate matter would likely result in additional health benefits. In particular, coarse particulate matter irritates the eyes, nose, and throat, and epidemiologic evidence suggests a causal relationship between short-term exposure to $PM_{10-2.5}$ and cardiovascular effects, respiratory effects, and mortality, especially for sensitive populations, like children, the elderly, and those with pre-existing conditions.[92]

Table 14. Reductions in Pollutants by Fuel Conversion

	Percent Emissions Reduction per Unit Energy					
Fuel Conversion	$PM_{2.5}$	$PM_{10-2.5}$	NOx	SO_2	CO	CO_2
#6 residual to #2 distillate	17.6	88.0	59.9	33.4	-10.4	7.2
#6 residual to natural gas	60.3	100.0	72.9	99.8	-150.4	32.7

Estimating health effects due to reductions in air pollution requires information on ambient air concentrations. Ambient $PM_{2.5}$ concentrations due to CIR residual oil use were determined by applying a New York City-specific source profile to ambient nickel concentrations. Since similar source apportionment data is not available for the other pollutants, the same technique can not be used to determine ambient concentrations and make quantitative health impact estimates.

In the absence of data regarding the portion of ambient levels of these other pollutants attributable to CIR residual oil use, quantitative estimates of the health impacts due to restricting residual oil is outside the scope of this analysis. Additionally, qualitative estimates of change in citywide emissions of these pollutants due to restricting residual oil are not made in this analysis using EPA's National Emissions Inventory (NEI), since area source emissions estimates for industrial, commercial, and institutional boilers are uncertain and may not accurately represent emissions from New York City boilers.[93] Chapter Five of this study does include some additional qualitative discussion of the environmental benefits from reducing carbon dioxide emissions.

The above discussion focused on reductions in other pollutants due to burning cleaner fuels, like natural gas, instead of residual oil. The distribution mechanism for natural gas versus residual oil may also affect the emission of harmful air pollutants. In particular, residual oil is typically delivered by truck to individual buildings; natural gas is usually delivered by pipeline.[94]

The U.S. Department of Energy's Argonne National Laboratory has developed a model to study Greenhouse Gases, Regulated Emissions, and Energy Use in Transportation (GREET). Since GREET focuses on transportation fuels and national averages, it does not perfectly model full lifecycle emissions from the delivery of residual oil and natural gas used for heating purposes in New York City. However, generally, GREET does suggest that the delivery of residual oil by ocean tanker, barge, and truck emits more sulfur dioxide and particulate matter than pipeline delivery of natural gas, though natural gas delivery does emit more methane.[95] Changing delivery patterns could also affect New York City traffic (including noise and congestion) and jobs.

E. Additional Un-Quantified Health Effects

$PM_{2.5}$ has proven cardiovascular and respiratory health effects beyond mortality or hospital admissions, but due to the predicted smaller magnitude of such effects and the lack of data, these additional health benefits are not quantified in this study. Similarly, though suggestive evidence links fine particulate matter to a range of other health endpoints, from low-birth weight to lung cancer, such effects are not analyzed here.[96] Also, this analysis also does not fully attempt to explore how all susceptible local subpopulations, such as those suffering from certain pre-existing diseases, might change the valuation of health impacts in New York City.[97]

Moreover, this study has only quantified health benefits for the four boroughs of New York City where sufficient air monitoring data exists. However, there is a chance that restricting residual oil use in New York City could also improve the air quality for Staten Island, Long Island, Connecticut, and other surrounding areas. More information about regional pollution patterns and better air monitoring data would be necessary to calculate these non-local health benefits.

Finally, this study assumes that, as it is phased out, residual oil will be replaced by the consumption of enough distillate oil or natural gas to generate an equivalent number of BTUs. Some CIR boilers may already be burning residual oil at near-optimal efficiency. However, other sites might upgrade to more efficient boilers or burners as they convert away from residual oil, meaning fewer BTUs will be necessary to meet the building's heating needs. Some boilers can burn either #6 residual oil or #2 distillate; but using #6 oil requires an extra energy input to keep the fuel sufficiently warm and viscous for use, and #6 residual oil tends to clog and foul the heating unit more quickly, which may reduce overall efficiency. If switching to cleaner fuels also increases efficiency, fewer BTUs of the cleaner fuels will be necessary compared to residual oil.[98] The result would be additional reductions across all pollutants, as less fuel is consumed. This study does not attempt to quantify such efficiency gains, but they could be significant.

Chapter Five

Restricting Residual Oil Also Benefits the Environment and Public Welfare

In addition to the significant health benefits discussed above, switching CIR boilers over to cleaner fuel types will also help mitigate the speed and severity of global warming, increase national energy security, protect the natural and built environments from particulate matter, and achieve cost-savings for energy consumers. For example, though no precise benefit can be quantified, citywide the total climate benefits of switching to cleaner fuels could easily total into the hundreds of millions of dollars annually.

A. Reductions in Greenhouse Gas Emissions

Relative to #6 residual oil, #2 distillate oil and natural gas both emit less carbon dioxide—the greenhouse gas pollutant most responsible for global climate change. The cleaner fuels also produce less elemental carbon (known as black carbon)—a major constituent of particulate matter that results from incomplete combustion; elemental carbon is now believed to be the most significant single agent of global warming after carbon dioxide. Natural gas's lifecycle emissions of nitrous oxide and methane—two other greenhouse gases—might exceed #6 residual oil's emissions of those two pollutants, but the total impact on the climate of such increases will be vastly outweighed by the carbon dioxide reductions achieved by the cleaner fuel.[99]

Cutting greenhouse gas emissions will mitigate the speed and severity of the myriad impacts of climate change on the environment, the economy, public health, and national security. Such benefits can be approximated by the "social cost of carbon" (SCC), which assigns a specific monetary value to the marginal impact over time of an additional ton of carbon dioxide-equivalent emissions. SCC estimates take into consideration such factors as net agricultural productivity loss, human health effects, property damage from sea level rise, and changes in ecosystem services.

While all current SCC estimates involve a great deal of uncertainty and incompleteness that likely results in significant underestimation, federal agencies have recently settled on relatively consistent range of SCC figures.[100] Despite the high potential for underestimation, these figures provide a good starting point for analyzing the benefits of reducing greenhouse gas emissions.

Table 15 shows the carbon dioxide reductions of switching from #6 residual oil to either #2 distillate oil or natural gas. These emission factors are calculated from the Energy Information Administration's database.[101] Due to data availability, for the purposes of this rough estimation, emissions of black carbon, methane, and nitrous oxide will not be analyzed. The carbon dioxide reductions achieved by switching to cleaner fuels can then be monetized by multiplying the number of tons cut by an SCC estimate. Table 15 shows estimations using SCC values at both the low and high end of the range developed by federal agencies (for year 2010 emissions).

Table 15. Primary CO_2 Emissions per Energy Unit by Fuel Type.

Fuel	CO_2 (lbs) Per Million BTUs	% Reduction from #6 Emissions	CO_2 (tons) Reduced from #6 Emissions, Per Million BTUs	Benefits Per Million BTUs (SCC of $5.46)	Benefits Per Million BTUs (SCC of $61.19)
#6	173.72	0%	0	0	0
#2	161.27	7.2%	0.0056	$0.03	$0.34
NG	116.98	32.7%	0.0257	$0.14	$1.57

Though the benefits of reducing greenhouse gas emissions may seem small per BTU, New York City likely burns millions of gallons of residual oil to generate trillions of BTUs each year. For example, a single large New York City apartment building might burn approximately 72,000 gallons of residual oil to generate 10.8 billion BTUs per year.[102] If that one building switched to natural gas, the climate benefits could total nearly $17,000 each year. Unfortunately, no comprehensive database exists of all the buildings using residual oil or of how much fuel they burn. Some reports suggest that as many as 9,000 large CIR buildings in New York City might use residual oil.[103] Though no precise benefit can be quantified, citywide the climate benefits of switching to cleaner fuels could easily total into the hundreds of millions of dollars annually.

Moreover, the relative impacts of the various heating fuels on greenhouse gas emissions should be remembered when comparing fuel prices and costs. As further discussed in Chapter 6, under any national cap on greenhouse gas emissions (or under an expansion of the regional cap already in place), some of the climate costs of these fuels would be internalized into their unit prices, erasing some of #6 residual oil's price advantages over #2 distillate and making natural gas seem even more cost-effective. While a policy phasing out the use of #6 residual oil would not change the overall greenhouse gas emissions under a national or regional cap (since polluters will always emit up to the level of the cap), switching to cleaner fuels for boilers would remain a highly cost-benefit justified method of complying with the cap.

B. Increased Energy Security

Federal agencies, such as the U.S. EPA and the Department of Transportation, calculate that reducing U.S. reliance on petroleum sources for fuel will generate benefits for "energy security."[104]

Global petroleum supply faces greater geopolitical instability compared to natural gas. A sudden, unanticipated disruption to oil supply could trigger effects that ripple through the U.S. economy. As a result, reducing domestic oil consumption decreases the risk of lost economic output during such a supply shock. EPA and the Department of Transportation value this benefit at around $6.70 per every barrel of petroleum not imported.[105] This study does not attempt to translate that figure into the quantified energy security benefits from curbing the use of residual oil, nor does it estimate the energy security impact of increasing demand for #2 distillate oil or natural gas. Nevertheless, there could be important energy security benefits to restricting use of residual oil (which the United States mostly imports) and relying more heavily on natural gas (for which the United States has expanding domestic production capacity).[106]

C. Environmental and Welfare Benefits of $PM_{2.5}$ Reductions

The U.S. EPA's 2009 draft Integrated Science Assessment for particulate matter lists a host of environmental and welfare effects caused by fine particulate matter, such as visibility impairment; chemical effects and physical deposition on vegetation, soil, and aquatic ecosystems; and physical deposition on buildings and culturally important items, like statutes and artwork.

The specific ecological effects of particulate matter depend in large part on chemical composition. Notably, nickel—a signature element of residual fuel's emissions profile—is one of the few heavy metals in particulate matter documented to frequently cause direct toxicity to plant life in field conditions.[107]

D. Cost-Savings for Energy Consumers

As discussed in Chapter Four, a switch to cleaner fuel types could be accompanied by some efficiency gains, in part because the particulate matter from #6 residual oil clogs and fouls the heating equipment more quickly. Using residual oil entails greater maintenance costs for the consumer to preserve a basic level of operation and efficiency. For example, switching a dual-fuel boiler from #6 residual oil to #2 distillate oil could reduce the rate of fouling and permit longer time intervals between vacuum cleanings. This study does not attempt to quantify any maintenance cost savings, though they could be significant.[108]

Chapter Six

Speculative, Limited Costs versus Real, Significant Benefits

Due to a lack of data, this study does not quantify the costs of phasing out the use of residual oil in CIR boilers. Instead, costs are discussed qualitatively. The two main categories of costs are conversion costs and operating costs. The likely capital conversion costs are one-time expenses that may at least partially overlap with inevitable replacement and maintenance costs; the annual operating costs are speculative, but most predictions suggest switching from residual oil to natural gas could be a cheaper option for consumers; and consumers may enjoy some additional efficiency gains and cost-savings. By contrast, the quantitative and qualitative benefits of phasing out residual oil are annual, real, and significant.

A. Conversion Costs and Operating Costs

To convert to cleaner fuel types, some CIR buildings will only require minor changes to their boiler equipment; others will need more substantial equipment replacement and new fuel delivery infrastructure. A few studies have attempted to estimate an average range of conversion costs: for example, one recent report gives an estimated range of $2,000 to $50,000 per building.[109] Though conversion cost estimates remain uncertain, it is important to remember that these are largely one-time capital costs. Moreover, heating equipment has a finite lifespan and must be replaced from time-to-time no matter what type of fuel a building uses.

Operating costs include the cost of purchasing enough fuel to generate the desired BTU output and the cost of maintaining the boiler equipment. The U.S. Department of Energy projects that, over the next decade, the average price of #2 distillate oil in the New York area will be a few dollars more per million BTUs than for #6 residual oil, and the average price of natural gas will be slightly over a dollar less per million BTUs than for #6 residual oil.[110] These estimates do not take into account how any additional restrictions in New York on the sulfur content of residual oil could increase the price of #6 fuel, nor do they consider how local utilities' contracts for "interruptible" natural gas service could decrease the price of natural gas.[111]

These estimates also do not take into account the effects of future regulations. For example, a national or regional cap on greenhouse gas emissions could very well cover the emissions from heating fuel. Such a cap would raise the price of fuel according to its greenhouse gas emissions, as the price internalizes some of the climate costs. Under the national cap-and-trade system proposed by the U.S. House of Representatives, fuel importers would have to hold emission allowances worth about $12 per ton of carbon dioxide-equivalent emissions (for year 2015). That would raise the price of #6 residual oil by about 7 cents per million BTUs relative to the price of #2 distillate oil; and it would raise the price of #6 residual oil by about 31 cents per million BTUs relative to the price of natural gas.[112]

Future regulations could also affect prices by changing demand for various fuel types. A New York City ban on #6 residual oil's use in CIR boilers would at most only marginally increase demand for #2 distillate oil and natural gas.[113] A perhaps more significant effect on demand might result from new national and international emissions standards for marine vessels, a prime consumer of #6 residual oil.[114] Such regulations could at first increase demand for low-sulfur residual oils, but eventually would slightly increase demand—and, therefore, price—for distillate fuels.[115] Similarly, worldwide demand for distillate continues to rise.[116] On the other hand, refiners have in the past responded to increased demand for distillate by increasing distillate yields.[117]

Some analysts have speculated that future costs of natural gas will not remain lower than residual oil per BTU, because natural gas is subject to potential supply interruptions and price spikes.[118] However, such analysis ignores the recent price volatility of petroleum, the recent expansion of domestic natural gas production, and the local plans to expand natural gas delivery infrastructure.[119]

Finally, all potential cost increases from converting to cleaner heating fuels must be weighed against the potential efficiency gains and cost savings that could accompany use of cleaner heating fuels.

B. Comparison of Costs and Benefits

This study does not include a sufficiently detailed or quantitative analysis of costs to draw a final conclusion about the magnitude of any potential net benefits from phasing out the use of residual oil in CIR boilers. That said, the likely capital conversion costs are one-time expenses that may at least partially overlap with inevitable replacement and maintenance costs; the annual operating costs are speculative, but most predictions suggest switching from residual oil to natural gas could be a cheaper option for consumers; and consumers may enjoy some additional efficiency gains and cost-savings. By contrast, the quantitative and qualitative benefits of phasing out residual oil are annual, real, and significant, including potentially hundreds of avoided mortalities and billions of dollars in better health outcomes for New Yorkers.

Costs and benefits should also be compared when considering the appropriate rate of conversion away from residual oil. For example, in designing a potential regulation to restrict residual oil use in CIR boilers, policymakers should take note that, for every year quicker full conversion is achieved, an additional 10 avoided mortalities and $111 million in quantifiable health benefits would result cumulatively over a twenty-year period. These significant, quantifiable public health benefits—in conjunction with the myriad qualitative health, environmental, and welfare benefits—may well justify the costs of faster mandatory conversion.

Conclusion

More Information Could Reveal Even Greater Benefits

The sources and impacts of pollution are not always obvious. Most New Yorkers probably spend little time thinking about how the buildings they live and work in are heated, or how those heating options might affect their health, their environment, and their welfare.

This Report has revealed one unseen source of a dangerous level of risk to New Yorkers: commercial, institutional, and residential boilers that burn residual oil. Citywide, these sources contribute as much as 29% of all locally-generated, wintertime particulate matter. Converting these sites to cleaner fuels, such as natural gas, could substantially decrease their contribution to soot concentrations—decreasing how much soot New Yorkers breathe in, and generating tremendous benefits.

For example, assuming that 60% of residual oil customers convert to natural gas over a twenty-year time period, with the rest converting to #2 distillate oil, phasing out residual oil will generate a minimum of 600 avoided mortalities and $5.3 billion worth of better health outcomes for New Yorkers. If the timeline for conversion is quicker, or if a larger proportion of customers switch to natural gas, those numbers greatly increase.

Yet not even those numbers capture all the hidden costs of burning residual oil. This analysis employs a series of conservative assumptions, meaning the results reported likely underestimate the benefits of phasing out residual oil. With more information, even greater benefits might be revealed.

Conservative Assumptions and Underestimation

This analysis employs a series of conservative assumptions. To start, by relying directly on monitoring data available for nickel, the methodology applied here entails much less uncertainty than a model-based approach. Furthermore, the methodology attributes only 27% of New York City's annual ambient nickel concentrations to the burning of residual oil at CIR sites. Because this approach fails to account for summer-time use of residual oil to heat water at CIR sites, as well as the summer-time use of residual oil at certain power plants, the annual nickel contribution from CIR sites is likely underestimated. As a result, all calculations for $PM_{2.5}$ concentrations and associated health impacts—which are all based on that initial nickel estimate—are conservative estimates.

Additionally, the emission factors for #2 distillate oil, compared to #6 residual oil, are very conservatively estimated. The estimates were drawn from documents provided by the U.S. EPA, which suggest that converting from residual oil to #2 oil would achieve an 18% reduction in $PM_{2.5}$ contributions. However, those same EPA documents also give alternative estimates, which would indicate that converting to #2 oil could achieve as much as a 32% reduction. Had the less conservative number been used, estimated mortality rates and other health effects would have changed significantly.[120]

Next, this analysis used expected conversion rates to natural gas provided by Con Edison. But that estimate does not fully reflect how natural gas availability and use might change if a regulation were to mandate a full conversion timeline of less than 20 years. Such regulation could increase demand for natural gas and accelerate the expansion of natural gas infrastructure. Due to the difficulty of making such adjusted estimates, this analysis employs a conservative assumption and consistently uses Con Edison's 20-year estimates for natural gas conversion. Nevertheless, actual conversion to natural gas could occur at a greater rate due to various regulatory or economic pressures, and a quicker, broader conversion to natural gas would significantly increase the benefits of phasing out residual oil.

Finally, when monetizing the health benefits, this analysis uses widely-accepted numbers for the value of a statistical life and for social willingness to pay to avoid various health endpoints. While economists continue to debate the appropriate monetized values for all those endpoints, some evidence suggests that the values used here fall on the conservative end of the scale.

Overall, the estimates provided by this study represent the minimum anticipated health benefits that will result from restricting the use of residual oil at CIR sites. The actual health impacts of restricting residual oil is likely much greater than these estimates.

Need for More Information

This analysis unfortunately had to leave several substantial benefits un-quantified, due to a lack of information. Most especially, phasing out residual oil could reduce New York City's toxic nickel concentrations by roughly 27%, but the precise health benefits cannot be calculated. Similarly, residual oil emits more greenhouse gases, more sulfur dioxide, and more nitric oxides than cleaner fuel alternatives, but the potentially large benefits to the climate, environment, and human health cannot be estimated with currently available data.

Developing emission factors specific to New York City and to the sulfur content of its heating fuels would be an important first step in estimating some of these hard-to-quantify benefits. Given the likely strong relationship between nickel concentrations and mortality rates, more scientific study of the health impacts of nickel is warranted.

Finally, the collection and application of new information should be an ongoing process. If New York City does develop a regulation to phase out residual oil, its scope, timeline, and stringency should be regularly reevaluated over time as new information on both costs and benefits is gathered. Indeed, this Report already suggests that while the speed of conversion might increase estimated costs, those costs might be well justified by the increased benefits of quicker conversion.

Hopefully, both New York's citizens and its politicians will keep these findings in mind when making decisions about phasing out residual oil, whether those decisions are voluntary or regulatory in nature.

Appendix A: Description of Positive Matrix Factorization

A brief description of the PMF-2 technique is provided here, with a more detailed description available in other documents.[121] PMF-2 assumes that measured trace element concentrations, x_{ij}, are from p independent pollution sources:

$$x_{ij} = \sum_{k=1}^{p} g_{ik} f_{kj} + e_{ij}$$

Where, x_{ij} is the j^{th} species concentration measured in the i^{th} sample;

g_{ik} is the mass contribution from the k^{th} source on the i^{th} sample (referred to as the G Matrix);

f_{kj} is the j^{th} species mass fraction from the k^{th} source (referred to as the F Matrix); and,

e_{ij} is the residual term or the unexplained part of x_{ij}.

The mass contributions for each source category can be estimated by a mass regression step once the G and F matrices are known. Daily $PM_{2.5}$ mass is regressed onto the PMF output G matrix, and the beta coefficients (β1...βp) are used to estimate daily mass contributions from p source categories:

Mass = β0 + β1*G1 + β2*G2 +... + βp*Gp

An intercept term (β0) is included in the model, given the possibility of certain sources not being fully represented by the model due to the set of elements chosen for the source apportionment model. The beta coefficients are then used to transform the F matrix to provide the fraction of mass associated with each element (i.e., source elemental "profiles").[122]

Appendix B. Epidemiological Studies Used in Calculating Health Benefits of Decreased Ambient PM2.5 Concentrations

Health Endpoint	Authors	Year	Location	Study title	Age Start	Age End	Function	Beta	Background
All-Cause Mortality	Laden et al.	2006	6 cities	Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-up of the Harvard Six Cities Study.	25	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.014842	Incidence*POP
All-Cause Mortality	Pope et al.	2002	51 cities	Lung cancer, cardiopulmonary mortality, and long-term exposure to fine particle air pollution	30	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0,00582689	Incidence*POP
Cardiovascular Mortality	Laden et al.	2006	6 cities	Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-up of the Harvard Six Cities Study.	25	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.024686	Incidence*POP
Cardiovascular Mortality	Pope et al.	2004	Nationwide	Cardiovascular mortality and long-term exposure to particulate air pollution: epidemiological evidence of general pathophysiological pathways of disease.	30	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.011333	Incidence*POP
Acute Myocardial Infarction	Peters et al.	2001	Boston, MA	Increased particulate air pollution and the triggering of myocardial infarction.	18	99	(1-(1/((1-Incidence*A) *EXP(Beta*DeltaQ)+Incidence*A))) *Incidence*0.93*POP	0.0092849	Incidence*POP*A
Chronic Bronchitis	Abbey et al.	1995	SF, SD, South Coast Air Basin	Chronis Respiratory Symptoms Associated with Estimated Long-Term Ambient Concentrations of PM2.5 and Other Pollutants.	27	99	(1-(1/((1-Incidence) *EXP(Beta*(MAX(Q1,C)-MAX(Q0,C))) +Incidence*POP* (1-Prevalence)	0.01318504	Incidence*POP* (1-Prevalence)
Work Loss Days	Ostro	1987	Nationwide	Air Pollution and Morbidity Revisited: A Specification Test.	18	64	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0046	Incidence*POP
HA, All Cardiovascular (less MI)	Moolgavkar	2003	Los Angeles, CA	Air Pollution and Daily Deaths and Hospital Admissions in Los Angeles and Cook Counties.	65	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0003442	Incidence*POP
HA, All Cardiovascular (less MI)	Moolgavkar	2000	Los Angeles, CA	Air Pollution and hospital admissions for diseases of the circulatory system in three U.S. metropolitan areas.	18	64	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0003415	Incidence*POP
HA, Pneumonia	Ito	2003	Detroit, MI	Associations of Particulate Matter Components with Daily Mortality and Morbidity in Detroit, Michigan.	65	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0016595	Incidence*POP
HA, Asthma	Sheppard	2003	Seattle, WA	Ambient Air Pollution and Nonelderly Asthma Hospital Admissions in Seattle, Washington, 1987-1994.	0	64	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0010446	Incidence*POP
Acute Bronchitis	Dockery et al	1996	24 communities	Health Effects of Acid Aerosols on North American Children - Respiratory Symptoms.	8	12	(1-(1/((1-Incidence) *EXP(Beta*DeltaQ)+Incidence))) *Incidence*POP	0.0170958	Incidence*POP
HA, Chronic Lung Disease (less asthma)	Moolgavkar	2000	Los Angeles, CA	Air Pollution and Hospital Admissions for Chronic Obstructive Pulmonary Disease in Three Metropolitan Areas in the United States.	18	64	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0007333	Incidence*POP
HA, Congestive Heart Failure	Ito	2003	Detroit, MI	Associations of Particulate Matter Components with Daily Mortality and Morbidity in Detroit, Michigan.	65	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.001292	Incidence*POP
HA, Dysrhythmia	Ito	2003	Detroit, MI	Associations of Particulate Matter Components with Daily Mortality and Morbidity in Detroit, Michigan.	65	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0020327	Incidence*POP
HA, Ischemic Heart Disease (less MI)	Ito	2003	Detroit, MI	Associations of Particulate Matter Components with Daily Mortality and Morbidity in Detroit, Michigan.	65	99	(1-(1/EXP(Beta*DeltaQ))) *Incidence*POP	0.0013001	Incidence*POP

Notes

[1] *The New York Times*, New York City Homicides, http://projects.nytimes.com/crime/homicides/map (last visited Jan. 19, 2010) (showing New York City homicide statistics for the years 2003-2009).

[2] BUREAU OF VITAL STATISTICS, NEW YORK CITY DEPT. OF HEALTH & MENTAL HYGIENE, SUMMARY OF VITAL STATISTICS 2007, 11 (2008), *available at* http://www.nyc.gov/html/doh/downloads/pdf/vs/2007sum.pdf (showing 300 total deaths for motor vehicle accidents).

[3] *See* U.S. Dept. of Defense, Casualty Report, http://www.defense.govnews/casualty.pdf (last visited Jan. 19, 2010); iCasualties.org, Operating Enduring Freedom, http://icasualties.org/OEF/ (last visited Jan. 19, 2010) (showing annual coalition mortalities from 2001-present).

[4] U.S. Envtl. Prot. Agency, Particulate Matter, http://www.epa.gov/oar/particlepollution/ (last visited Jan. 19, 2010).

[5] U.S. Envtl. Prot. Agency, Particulate Matter: Basic Information, http://www.epa.gov/air/particlepollution/basic.html (last visited Jan. 19, 2010).

[6] *Id.*

[7] WILLIAM C. HINDS, AEROSOL TECHNOLOGY: PROPERTIES, BEHAVIOR, AND MEASUREMENT OF AIRBORNE PARTICLES (2d ed. 1999).

[8] Jay R. Turner & David T. Allen, *Transport of Atmospheric Fine Particulate Matter: Part 1-Findings from Recent Field Programs on the Extent of Regional Transport within North America*, 58 J. AIR WASTE MGMT. ASS'N. 254 (2008).

[9] Y. Qin, E. Kim, & P. Hopke, *The Concentrations and Sources of PM2.5 in Metropolitan New York City*, 40 ATMOSPHERIC ENVIRONMENT S312-S332 (2006); *see also* CITY OF NEW YORK, PLANYC: A GREENER, GREATER NEW YORK, 120 (2007) ("Depending on the time of year, up to 70% of particulate matter measured in the city comes from somewhere else.").

[10] *See* C. Arden Pope III & Douglas W. Dockery, *Health Effects of Fine Particulate Air Pollution: Lines that Connect*, 56 J. AIR WASTE MGMT. ASS'N. 709 (2006).

[11] Sarah E. Hill et al., *Mortality among Lifelong Nonsmokers Exposed to Secondhand Smoke at Home: Cohort Data and Sensitivity Analyses*, 165 AM. J. EPIDEMIOLOGY 530 (2007). Exposure to an additional 10 $\mu g/m^3$ of fine particles causes a 16-17% increase in the total risk of mortality and a 12–28% increase in the risk of cardiovascular-related mortality. Francine Laden et al., *Reduction in Fine Particulate Air Pollution and Mortality: Extended Follow-Up of the Harvard Six Cities Study*, 173 AM. J. OF RESPIRATORY & CRITICAL CARE MED. 667 (2006); C. Arden Pope, III et al., *Cardiovascular Mortality and Year-Round Exposure to Particulate Air Pollution: Epidemiological Evidence of General Pathophysiological Pathways of Disease*, 109 CIRCULATION 71 (2004).

[12] *See* AM. LUNG ASS'N, STATE OF THE AIR: 2008 (2008), *available at* http://www.lungusa.org/sota08. The 60 million individuals who live in areas with unsafe annual $PM_{2.5}$ concentrations include around 50 million living in areas with annual concentrations above 15 $\mu g/m^3$ and over 11 million living in areas with annual concentrations above 14 $\mu g/m^3$. The U.S. EPA's Clean Air Scientific Advisory Committee recently recommended a maximum concentration standard of 13-

14 μg/m³. More than half of these individuals are especially susceptible to the health effects of long-term exposure to fine particles. *Id.* These include over 15 million children, almost 7 million elderly, 1.5 million children with asthma, 3.5 million adults with asthma, almost 2 million people with chronic bronchitis, less than 1 million people with emphysema, almost 15 million people with cardiovascular disease, and over 3 million diabetics. *Id.* at 7.

[13] The U.S. EPA sets National Ambient Air Quality Standards (NAAQS) in accordance with Section 109 of the Clean Air Act. 42 U.S.C. § 7409. The Act's stated objective is to protect the health of sensitive populations as well as general public welfare. The EPA first set the NAAQS for particulate matter in 1971 as one of six regulated pollutants under the Act. In 1997, the EPA revised its PM standards to include separate standards for fine particles that had been linked to serious health problems ($PM_{2.5}$). The EPA revised these standards once more in 2006, nearly halving the 24-hour $PM_{2.5}$ standard, and revoking a standard for coarser particulate matter (PM_{10}) due to a lack of evidence linking long-term PM_{10} exposure to health problems. *See* U.S. Envtl. Prot. Agency, Particulate Matter: PM Standards, http://www.epa.gov/air/particlepollution/standards.html (last visited Jan. 19, 2010). In February 2009, the D.C. Circuit Court of Appeals held that the EPA's 2006 $PM_{2.5}$ NAAQS were unsupported by "adequately reasoned decisionmaking" and were contrary to the Clean Air Act's mandate. The court remanded the standards back to the EPA for further proceedings. Am. Farm Bureau Fed'n v. EPA, 559 F.3d 512, 521 (D.C. Cir. 2009). The 2006 standards remain in effect, but EPA is in the process of reviewing them in light of the court's ruling.

[14] PLANYC, *supra* note 9, at 119.

[15] *See id* at 120 (noting, optimistically, that "[s]ome of these [out-of-state] polluters can be held accountable [in court]").

[16] *Id.*

[17] *Id.* at 121.

[18] *See* Michael M. Grynbaum, *Judge Blocks City's Penalty for Nonhybrid Cab Owners*, N.Y. TIMES, June 22, 2009 ("A federal judge dealt another setback on Monday to the Bloomberg administration's two-year effort to convert the city's yellow taxi fleet to gas-and-electric hybrids.").

[19] Press Release, New York City Mayor's Office, Statement by Mayor Michael R. Bloomberg on the Failure of the State Legislature to Vote Congestion Pricing (Apr. 7, 2008) (available through http://www.nyc.gov).

[20] They can also use bio-diesel and other fuels. For more background on how boilers work, see ENVIRONMENTAL DEFENSE FUND, THE BOTTOM OF THE BARREL: HOW THE DIRTIEST HEATING OIL POLLUTES OUR AIR AND HARMS OUR HEALTH (2009).

[21] *Id.*

[22] *See id* at 29.

[23] U.S. Energy Info. Admin., Petroleum Refining and Processing Definitions, Sources, and Explanatory Notes, http://tonto.eia.doe.gov/dnav/pet/TblDefs/pet_pnp_pct_tbldef2.asp (last visited Jan. 19, 2010) ("A general classification for the heavier oils, known as No. 5 and No. 6 fuel oils, that remain after the distillate fuel oils and lighter hydrocarbons are distilled away in refinery operations....No. 6 fuel oil includes Bunker C fuel oil and is used for the production of electric power, space heating, vessel bunkering, and various industrial purposes.").

[24] *See generally* BOTTOM OF THE BARREL, *supra* note 20.

[25] *See* N.Y. COMP. CODES R. & REGS. tit. 6 § 225-1.2 (d) (1985).

[26] *See* N.Y.C. ADMIN. CODE tit. 24 ch. 1.

[27] Using a wintertime average of 13 μg/m³ for $PM_{2.5}$ concentrations in New York City (a little higher than measured at the EPA sites but a little lower than the NYCCAS study, *compare* N.Y.C. DEPT. OF HEALTH & MENTAL HYGIENE ET AL., THE NEW YORK CITY COMMUNITY AIR SURVEY 21 (2009)), the 1.25 μg/m³ of wintertime $PM_{2.5}$ due to CIR residual oil use is 9.6% of wintertime concentrations. Using results from a source apportionment of fine particles in New York City, *see infra*, locally-generated $PM_{2.5}$ may only account for about one-third of the wintertime concentrations. Therefore, residual oil combustion from CIR sites may account for 29% of locally-generated $PM_{2.5}$ in the wintertime.

[28] Qin et al., *supra* note 9.

[29] R. Lall, A Source Apportionment and Time-Series Health Analysis of Fine Particle Air Pollution in New York City (2008) (Ph.D. thesis, N.Y.U. School of Medicine).

[30] *Id.* at tbl. 3.2.

[31] ICF CONSULTING & APPLIED STATISTICAL ASSOCIATES, PETROLEUM INFRASTRUCTURE STUDY: FINAL REPORT 107 (2006) (prepared for the New York State Energy and Research and Development Authority).

[32] R.E. Peltier et al., *Residual Oil Combustion: A Major Source of Airborne Nickel in New York City*, fig. 3, J EXPO. ANAL. ENVIRON. EPIDEMIOL. (2008).

[33] *Id.* at fig. 4.

[34] R.E. Peltier RE & M. Lippmann. *Residual Oil Combustion: Distributions of Airborne Nickel and Vanadium within New York City*, J. EXPO. SCI. ENVIRON. EPIDEMIOL. (2009).

[35] The site identifications on the map are different than what appear in Peltier and Lippmann, *id.* The three EPA STN sites have been relabeled as Bx1, M1, and Q1. Affects of the potential proximity of monitoring sites to specific residual oil burning devices are avoided by the methodology employed in this study (i.e., using seasonal differences and applying Kriging interpolation).

[36] *Id.*

[37] The time-weighted values are equal to the fraction of the year represented by the pilot study heating and non-heating seasons. Therefore, the time-weighted values equal 0.321 (3.85months / 12 months) and 0.679 (8.15 months / 12 months) for the heating and non-heating seasons, respectively. The use of these time-weighted values results in estimates of the annual mean with an error of approximately five percent.

[38] NORTHEAST STATES FOR COORDINATED AIR USE MANAGEMENT, HIGH ELECTRIC DEMAND DAY AND AIR QUALITY IN THE NORTHEAST (2006), *available at* http://www.ct.gov/dep/lib/dep/air/energy/final_white_paper_hi-electric_demand_day_06052006%5B1%5D.pdf.

[39] *See* New York Independent System Operators, Power Trends 2008, http://www.nyiso.com.

[40] R. BARRY & R. CHORLEY R, ATMOSPHERE, WEATHER, AND CLIMATE (8th ed., 2003).

[41] *See* NEW YORK CITY COMMUNITY AIR SURVEY, *supra* note 27, at 21 ("Across all NYCCAS sampling sites, after adjusting for temporal differences, wintertime PM2.5 averaged 14.1 µg/m3, compared with 12.4 µg/m3 at DEC regulatory monitoring sites.").

[42] ESRI Inc., ArcView 9.3.1 (2008), http://www.esri.com. Kriging interpolation is a geostatistical technique allowing estimation of values across the areas of New York where there is no monitoring data, based on the eleven observational points in geographic space where data does exist. Kriging interpolation provides confidence intervals around those points. The average variance around these Kriging interpolated values is 20 percent.

[43] Maps available from New York City Department of City Planning, http://www.nyc.gov/planning.

[44] MINNESOTA POLLUTION CONTROL AGENCY, ESTIMATING PM2.5 EMISSIONS FOR AERA'S (2006), http://www.pca.state.mn.us/publications/aq9-12.pdf.

[45] U.S. EPA Measurement Policy Group, $PM_{2.5}$ Emissions Data, Testing, and Monitoring Issues, http://www.epa.gov/ttnnaaqs/pm/presents/condensable_pm_issues-ron_myers.ppt (last visited Aug. 31, 2009).

[46] U.S. EPA, NO. AP-42-ED-5, COMPILATION OF AIR POLLUTANT EMISSION FACTORS: VOLUME 1, STATIONARY POINT AND AREA SOURCES (1995).

[47] U.S. EPA, Factor Information Retrieval (FIRE) Data System, http://www.epa.gov/ttn/chief/efpac/index.html (last visited Apr. 30, 2009).

[48] *Id.* The emission equation used for residual oil is: E = 1.92*A + 1.5; where, A = 1.12*S + 0.37; and, S = sulfur content by percent.

[49] N.Y. COMP. CODES R. & REGS. tit. 6 § 225-1.2 (d) (1985). However, according to anecdotal evidence and informal discussions with city and state officials, the law is loosely enforced, and sulfur content of #6 residual oil is likely often much higher than the values used in this analysis.

[50] This analysis uses a very conservative estimate of the reduction in $PM_{2.5}$ emissions expected from converting from #6 residual oil to #2 distillate heating oil. The 18% reduction utilized includes both the filterable and condensable portions of primary $PM_{2.5}$ emissions. The filterable $PM_{2.5}$ emission factor for #2 distillate oil used here is 0.83 lbs/1000 gallons, as listed in Table 1.3-7 of the EPA's AP-42 document, which coincides with what is listed in the EPA's WebFIRE document. However, it is unclear that this is the appropriate emission factor, as the calculation listed in footnote c of the same table indicates that the emission factor for filterable $PM_{2.5}$ for #2 distillate oil could be 0.46 lbs/1000 gallons (or 1.92*A, where A=0.24 for #2 distillate oil). Using this emission factor would have estimated a 32% reduction in $PM_{2.5}$ emissions when converting to #2 distillate oil from #6 residual oil (as opposed to the 18% reduction calculated in this analysis).

[51] L. CHESTNUT & B. OSTRO, EMPIRE STATE ELECTRIC ENERGY RESEARCH CORP., THE NEW YORK ELECTRICITY EXTERNALITY STUDY, VOLUME I: INTRODUCTION AND METHODS, ch. 5 (1995).

[52] The overall age-adjusted rate for cardiovascular mortalities in New York County is 253.8 per 100,000 individuals, with a total population of 1,634,795. Since 99.5% of the crude cardiovascular mortality rate occurs in individuals 30-99 years old, the age-adjusted rate for individuals ages 30-99 multiplied by the population aged 30-99 is simply 99.5% of the overall age-adjusted rate. This value can either be divided by the population aged 30-99 to find the age-adjusted rate for that age group, or it can be used directly in the health benefits calculation since the product of the population and age-adjusted rate is needed in the calculation.

[53] U.S. EPA, Environmental Benefits Mapping and Analysis Program (BenMAP), http://www.epa.gov/air/benmap.

[54] U.S. EPA, ENVIRONMENTAL BENEFITS MAPPING AND ANALYSIS PROGRAM (BENMAP) USER'S MANUAL (2008).

[55] U.S. EPA, ENVIRONMENTAL BENEFITS MAPPING AND ANALYSIS PROGRAM (BENMAP) USER'S MANUAL APPENDICES (2008).

[56] N.Y.S. Dept. of Health, Statistics, http://www.health.state.ny.us/statistics (last visited May 30, 2009).

[57] *Compare* F. Laden et al., *Reduction in Fine Particulate Air Pollution and Mortality*, 173 AM. J. OF RESPIRATORY & CRITICAL CARE MEDICINE 667-672 (2006), *with* C. Pope et al., *Cardiopulmonary Mortality, and Long-term Exposure to Fine Particulate Air Pollution*, 287 J. OF THE AMA, 1132-1141 (2002).

[58] D. Krewski et al., *Reanalysis of the Harvard Six Cities Study and the American Cancer Society Study of Particulate Air Pollution and Mortality* (Special Report to the Health Effects Institute, Cambridge MA) (2000).

[59] U.S. EPA, 2006 NATIONAL AMBIENT AIR QUALITY STANDARDS FOR PARTICLE POLLUTION: REGULATORY IMPACT ANALYSIS (2006).

[60] The concentration-response functions provided by the two aforementioned epidemiology studies are assigned in this analysis an equal likelihood of representing the true relative risk of $PM_{2.5}$ concentrations in New York City. The true health benefits that will occur are expected to be between the two central estimates provided by these two studies. The 95% confidence intervals around the central estimates have not been reported since they are much smaller than the margin between the central estimates themselves and do not significantly alter the estimated health benefits of restricting residual oil.

[61] This analysis does not assume any significant growth in the use of biodiesel or other alternative options for heating.

[62] E-mail Correspondence with Christine Cummings, Con Edison Public Relations–NYC Government Relations (August 28, 2009). This estimate is based upon the following assumptions: there will be no significant changes in fuel costs; there will be no significant changes in the costs to the customer to convert their equipment; there will be no significant changes in the incentives customers may receive from Con Edison or NYSSERDA; oil heating customers have remained such due to positive economic benefits; and, no significant improvements made to #2 oil to reduce emissions will affect the number of conversions.

[63] *See* C. DOCKINS ET AL., U.S. EPA NAT'L CTR FOR ENVTL. ECON., VALUE OF STATISTICAL LIFE ANALYSIS AND ENVIRONMENTAL POLICY (2004). The general approach taken by the EPA is to perform meta-analyses of willingness-to-pay studies involving workers wages and survey responses from sampled populations. These analyses provide mean predicted values and confidence intervals. These confidence intervals can be very large. For example, for several years the EPA calculated that the mean value of one statistical life as $5.5 million (1999$) with a lower and upper confidence limit of $1 million (1999$) and $10 million (1999$) respectively.

[64] *Id.*

[65] *Id.* However, a recent draft of EPA's economic analysis guidelines suggests that, in the future, EPA will recommend a central VSL of $7.0 million (2006$). Nat'l Ctr. for Evntl. Econ., U.S. Envtl. Prot. Agency, Guidelines for Preparing Economic Analysis 7-6 (Sept. 12, 2008) (unpublished external review draft). Using that slightly higher value would result in slightly higher benefits estimates throughout this Report. Also, several biases and potentials for underestimation are built in to the EPA's methodology for calculating the VSL. For an example of such criticism, see RICHARD L. REVESZ & MICHAEL A. LIVERMORE, RETAKING RATIONALITY: HOW COST-BENEFIT ANALYSIS CAN BETTTER PROTECT THE ENVIRONMENT AND OUR HEALTH (2008).

[66] BenMAP User's Manual Appendices, *supra* note 55.

[67] BenMAP User's Manual, *supra* note 54.

[68] *See* Bureau of Labor Statistics, U.S. Dept. of Labor, Consumer Price Index, http://www.bls.gov/cpi (last visited June 30, 2009).

[69] Though the White House Office of Management and Budget recommends using discount rates of 3% and 7%, in recent reviews of the costs and benefits of emissions controls under the Clean Air Act, the EPA's Scientific Advisory Board has recommended using an intermediate 5% rate instead. Because there are reasons to be skeptical about an estimated 7% real, pre-tax opportunity cost of capital, this Report has focused on 3% and 5% rates. *See* Guidelines for Preparing Economic Analysis, *supra* note 65, at 6-13 n.92 & generally ch.6.

[70] At the 3% discount rate depicted in Figure 5, the cumulative monetary health benefits after 20 years are $7 billion, $6.4 billion, $5.8 billion, and $5.3 billion (2008$), for 5-year conversion, 10-year conversion, 15-year conversion, and 20-year conversion, respectively. At 5% discount rate, $5.6 billion, $5.1 billion, $4.6 billion, and $4.2 billion.

[71] L. Zheng et al., *Sources of Fine Particle Composition in New York City*, 38 ATMOSPHERIC ENVIRONMENT 221 (2004).

[72] Lall, *supra* note 29.

[73] F. Laden et al., *Association of Fine Particulate Matter from Different Sources with Daily Mortality in Six U.S. Cities*, 108 ENVTL. HEALTH PERSPECTIVES 10 (2000).

[74] M. Franklin, P. Koutrakis, & J. Schwartz, *The Role of Particle Composition on the Association Between $PM_{2.5}$ and Mortality*, 19 *Epidemiology* 5 (2008).

[75] F. Lipfert et al., *$PM_{2.5}$ Constituents and Related Air Quality Variables as Predictors of Survival in a Cohort of U.S. Military Veterans*, 18 INHALATION TOXICOLOGY 645-657 (2006).

[76] M. Lippmann M et al. *Cardiovascular Effects of Nickel in Ambient Air*, 114 ENVTL. HEALTH PERSPECTIVES 1662–1669 (2006).

[77] R.E. Peltier & M. Lippmann, *supra* note 34.

[78] F. Dominici et al., *Does the Effect of PM_{10} on Mortality Depend on PM Nickel and Vanadium Content? A Reanalysis of the Nmmaps Data*, 115 ENVTL. HEALTH PERSPECTIVES 1701–1703 (2007).

[79] *Id.*

[80] F. Lipfert et al., *supra* note 75.

[81] L. Clancy et al., *Effects of Air-Pollution Control on Death Rates in Dublin, Ireland: an Intervention Study*, 360 LANCET 1210-1214 (2002).

[82] C. Pope et al., *Daily Mortality and PM_{10} Pollution in Utah Valley*, 47 ARCH. ENVTL. HEALTH 211–17 (1992).

[83] R. Brook et al., *Air Pollution and Cardiovascular Disease: A Statement for Healthcare Professionals from the Expert Panel on Population and Prevention Science of the American Heart Association*, 109 *Circulation* 2655-2671 (2004).

[84] It is important to note that concentration functions using long-term or chronic pollution exposures results in higher estimates of health endpoints than the cumulative short-term or daily pollution time-series concentration response estimates. It is possible that the use of concentration-response functions from long-term pollution studies may have provided a better estimate of the reduced mortality in Dublin than the short-term time-series concentration functions.

[85] A. Hedley et al., *Cardiorespiratory and All-Cause Mortality after Restrictions on Sulfur Content of Fuel in Hong Kong: an Intervention Study*, 360 *Lancet* 1646-52 (2002).

[86] *Id.*

[87] R.E. Peltier & M. Lippmann, *supra* note 34.

[88] U.S. EPA, Factor Information Retrieval (FIRE) Data System, *supra* note 47. Unfortunately, there is a lack of adequate emission factors for #4 blended oil, which complicates calculations of nickel reductions by switching from #4 oil to an alternative heating fuel..

[89] Y. Qin et al., *supra* note 9. Qin et al. estimates that 69% to 82% of $PM_{2.5}$ mass in New York City is from non-local sources. This estimate is similar to the Lall and Thurston estimate that 90% of sulfate mass was identified as being transported into New York City. *See* R. Lall & G. Thurston, *Identifying and Quantifying Transported vs. Local Sources of New York City $PM_{2.5}$ Fine Particulate Matter Air Pollution*, 40 ATMOSPHERIC ENVRT. 336-346 (2005).

[90] U.S. EPA, Air Quality System (AQS) Annual Summary Monitor Data Queries, http://www.epa.gov/aqspubl1/annual_summary.html (last visited June 30, 2009).

[91] Data for carbon dioxide emission factors comes from Energy Info. Admin., U.S. Dept. of Energy, Fuel Emission Factors, http://www.eia.doe.gov/oiaf/1605/excel/Fuel%20Emission%20Factors.xls (last visited Jan. 19, 2010).

[92] Nat'l Ctr. for Envtl. Assessment, U.S. EPA, EPA/600/R-08/139F, INTEGRATED SCIENCE ASSESSMENT FOR PARTICULATE MATTER at 2-28 (2009); U.S. EPA, PM_{10} Fact Sheet, http://www.epa.gov/wtc/pm10/pm_fact_sheet.html (last visited Jan. 19, 2010).

[93] *Compare* Ozone Transport Commission, ICI Boilers: OTC SAS Committee Meeting (2009).

[94] *See generally* BOTTOM OF THE BARREL, *supra* note 20.

[95] For more information on the emissions of volatile organic compounds, carbon monoxide, nitrogen oxides, sulfur oxides, particulate matter, methane, nitrous oxide, and carbon dioxide, see ARGONNE NAT'L LAB., GREET MODEL 1.8 (2008), *available for download at* http://www.transportation.anl.gov/modeling_simulation/GREET/index.html.

[96] *See* INTEGRATED SCIENCE ASSESSMENT FOR PARTICULATE MATTER, *supra* note 92.

[97] *See id.* for more details on various susceptible populations. This analysis does look at a few age-specific populations, in particular the effects of soot on childhood bronchitis. Long-term studies carried out in California demonstrate that children living in areas with higher annual concentrations of $PM_{2.5}$ experience less growth in lung function as compared to children in areas with cleaner air. W. James Gauderman et al., *The Effect of Air Pollution on Lung Development from 10 to 18 Years of Age*, 351 NEW ENG. J. MED. 1057 (2004). Research studies have also shown that the incidence and severity of lung disease in children is also increased as a result of chronic exposure to elevated concentrations of $PM_{2.5}$. Rob McConnell et al., *Prospective Study of Air Pollution and Bronchitic Symptoms in Children with Asthma*, 168 AM. J. OF RESPIRATORY & CRITICAL CARE MED. 790 (2003).

[98] *See generally* BOTTOM OF THE BARREL, *supra* note 20.

[99] *See* GREET Model, *supra* note 95. Though nitrous oxide and methane are more potent greenhouse gases than carbon dioxide per ton emitted, so many more tons of carbon dioxide are emitted that its effects often dominate a fuel's lifecycle emissions. Some elements of particulate matter are theorized to have a possible cooling effect on the climate, but that

cooling potential might be outweighed by opposing warming potentials of other elements, and are certainly outweighed by the overall warming effects of carbon dioxide emissions and black carbon emissions. *See* INTEGRATED SCIENCE ASSESSMENT FOR PARTICULATE MATTER, *supra* note 92.

100 Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, 74 Fed. Reg. 49,454, 49,612 (proposed Sept. 28, 2009).

101 EIA, Fuel Emission Factors, *supra* note 91 (factors given for "Heavy Fuel Oil (No. 5, 6 fuel oil), bunker fuel"; "Middle Distillate Fuels (No. 1, No. 2, No. 4 fuel oil, diesel, home heating oil)" and "Weighted National Average Pipeline Natural Gas"). It is unclear how the sulfur-content of New York City specific oils might affect these emission factors.

102 BOTTOM OF THE BARREL, *supra* note 20, at 68.

103 *Id.* at 3.

104 The two other possible energy security benefits ("monospony benefits" and military cost reductions) are not discussed because (a) the quantities of fuel implicated by this rule are unlikely to produce significant benefits; and (b) "monspony benefits" are not actually efficiency gains and should be treated as distributional impacts. *See* Proposed Rulemaking to Establish Light-Duty Vehicle Greenhouse Gas Emission Standards and Corporate Average Fuel Economy Standards, *supra* note 100.

105 *Id.* at 49,622 (for year 2015, midpoint estimate).

106 *See* Clifford Krauss, *Shale Fracturing Could Lead to Boom in World Supplies*, N.Y. TIMES, Oct. 10, 2009 ("The fracturing technique has led to an increase in U.S. gas supplies of 40 percent.").

107 *See* INTEGRATED SCIENCE ASSESSMENT FOR PARTICULATE MATTER, *supra* note 92.

108 For example, a 2005 study by NESCAUM found that switching to lower-sulfur fuel, by virtue of reducing particulate matter emissions, could achieve maintenance cost savings of $29,000 a year per 1000 houses on a national basis. NESCAUM, LOW SULFUR HEATING OIL IN THE NORTHEAST STATES: AN OVERVIEW OF BENEFITS, COSTS, AND IMPLEMENTATION ISSUES (2005). To some extent such a figure would not represent a standard benefit, but rather would constitute a wealth transfer from maintenance companies to fuel consumers. Nonetheless, such efficiency or distributional effects could be significant.

109 BOTTOM OF THE BARREL, *supra* note 20.

110 U.S. Energy Info. Admin., Supplemental Tables, Updated Annual Energy Outlook 2009 Reference Case with ARRA, http://eia.doe.gov/oiaf/aeo/supplement/stimulus/suparra.htm (last visited Jan. 19, 2010) (giving 2010-2020 averages for the Middle Atlantic region, in 2007$). The estimates for distillate, residual, and natural gas are only given for commercial/institutional customers, not for residential customers. It is unclear whether the price of residual oil fully accounts for New York's sulfur requirements, which could raise the price above this average estimate.

111 *See* BOTTOM OF THE BARREL, *supra* note 20 (discussing how New York utilities give price breaks to buildings that accept contracts for "interruptible" gas supply).

112 See analysis from Chapter 5, *supra*, on the relative climate impacts of various heating fuels.

113 *See* U.S. EPA, EPA-420-R-09-019, Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines at 7-10 (2009) (noting that switching all marine vessels in U.S. waters from standard #6 residual to lower sulfur fuels will only result in a "small increase in the price of marine distillate fuels"); *cf.* Energy Policy Research Foundation, *Costs and Supply Risks to Prohibitions on the Use of No. 4 and No. 6 Oil in New York City* (preliminary report) (Feb. 12, 2009).

114 On December 12, 2009, the EPA finalized emission standards under the Clean Air Act for Category 3 marine diesel engines (marine engines with per-cylinder displacement at or above 30 liters). 40 C.F.R. § 94 (2009). In this new regulation, the EPA forbids the production and sale of marine fuel oil above 1,000 ppm sulfur in U.S. waters unless the vessel achieves equivalent emission reductions through alternative measures. Only a select number of ships on the Great Lakes are allowed to buy residual fuel that does not meet the 1,000 ppm sulfur standard. These standards will go into effect January 2015. *See* U.S. Envtl. Prot. Agency, Ocean-going Vessels: EPA Regulations, http://www.epa.gov/otaq/oceanvessels.htm#regs (last visited January 19, 2010). The new regulation applies to U.S.-flagged vessels and is equivalent to the standards in the MARPOL treaty, which contains marine pollution standards set forth by the International Maritime Organization (IMO). The standards in Annex VI of MARPOL, representing marine air pollution, came into force in May 2005. U.S. Envtl. Prot. Agency, New Law Bolsters U.S. Efforts to Make Ocean-Going Ships Cleaner, http://yosemite.epa.gov/opa/admpress.nsf/6424ac1caa800aab85257359003f5337/f1e6594e8e04fdd88525748e0069fb1f!OpenDocument (last visited January 19, 2010). Annex VI also applies to the United States after President Bush signed the Act to Prevent Pollution from Ships (33 U.S.C. 1901, et. seq.).

115 *See* U.S. EPA, EPA-420-R-09-019, Regulatory Impact Analysis: Control of Emissions of Air Pollution from Category 3 Marine Diesel Engines 7-10 (2009); PETROLEUM INFRASTRUCTURE STUDY: FINAL REPORT, *supra* note 31, at ES-12 ("Likely

changes will require the use of low sulfur bunkers and marine diesels by vessels along the East Coast, and in turn, may drive up the price of residual fuel shifting the relationship between fuels.").

[116] *See* PETROLEUM INFRASTRUCTURE STUDY: FINAL REPORT, *supra* note 31.

[117] *See* Energy Policy Research Foundation, *supra* note 113, at 8.

[118] *See id.*

[119] *See* Letter from Michael Livermore, Exec. Dir. of IPI, to Minerals Management Service, U.S. Dep't of Interior (Apr. 6, 2009) (discussing price volatility of petroleum); Krauss, *supra* note 106; E-mail Correspondence with Christine Cummings, Con Edison Public Relations–NYC Government Relations (August 28, 2009) (discussing plans for increased availability of natural gas in New York City).

[120] If the emissions from #2 distillate oil are actually 68% that of #6 residual oil in New York City (as opposed to the 82% figure used in this study), then there would be an additional 55-143 avoided mortalities expected over twenty years. Also, the emission factors used in this analysis assume the sulfur content of residual oil to be .3% (3000 ppm). However, the law that mandates sulfur content in heating oil is loosely enforced, and sulfur content of #6 residual oil is likely often much higher than the values used in this analysis.

[121] P. HOPKE, A GUIDE TO POSITIVE MATRIX FACTORIZATION, *available at* http://www.epa.gov/ttnamti1/files/ambient/pm25/workshop/laymen.pdf; *see also*, U.S. EPA, EPA/600/R-08/108, PMF 3.0 Fundamentals and User Guide.

[122] Lall, *supra* note 29.

Institute for Policy Integrity
New York University School of Law
245 Sullivan Street, Suite 472
New York, New York 10012
www.policyintegrity.org

Testimony of Marcia Bystryn
President
New York League of Conservation Voters

Committee on Environmental Protection
New York City Council
May 28, 2010

Good morning Chairman Gennaro and members of the Committee on Environmental Protection. Thank you for providing me this opportunity to present our position on this important piece of legislation.

I am Marcia Bystryn, President of the New York League of Conservation Voters (NYLCV), an environmental advocacy and education organization. I am here today to express our support for Intro. 194, which will create a bioheating fuel standard and reduce the permissible sulfur content of all No. 4 heating oil burned in New York City. In addition, I will take this opportunity to offer recommendations that will improve the sustainability and public health goals of this legislation.

Despite laudable improvements from past decades to New York City air quality, the city struggles to comply with Federal clean air standards for fine particle pollution (PM2.5) and ozone. Linked to aggravated asthma, cancer, lung and heart disease, high levels of PM2.5 emissions have devastating impacts on public health.

In fact, New York City has twice the national asthma hospitalization rate among children age 0 to 14 years. The highest asthma rates are in the city's lowest-income and minority neighborhoods, indicating an environmental justice imperative to improve New York City's air quality.

In addition to public health implications, costs to the city linked to high PM2.5 levels cannot be overlooked. According to Environmental Defense Fund's recent report, "The Bottom of the Barrel", in the year 2000, asthma hospitalizations alone cost the government and individuals more than $240 million. Improving the city's air quality makes public health as well as economic sense.

The necessity to mitigate climate change is an additional rationale for supporting Intro. 194. Scientific researchers have provided robust evidence that the Earth's climate is warming due to increasing levels of greenhouse gases (GHS) – carbon dioxide, methane and nitrous oxide – in the atmosphere. The improved combustion of biodiesel reduces emissions of GHGs, particularly carbon dioxide.

By requiring low-sulfur No. 4 heating oil and mandating a 2 percent biodiesel blend for all New York City heating oil, passage of Intro. 194 is a significant step in the right direction to address the environmental, economic and sustainability concerns mentioned above.

However, while NYLCV supports this legislation, we believe that the following recommendations will dramatically improve the sustainability and public health goals set forth in Intro. 194.

Regarding the use of biodiesel fuels, we believe it critical to include a sustainability provision that requires the biodiesel product used in heating New York City buildings have a lower aggregate GHG lifecycle than the Nos. 2, 4, or 6 heating oil it would replace. Perhaps the easiest way to ensure this is to require that 50 to 60 percent of biodiesel come from New York City waste vegetable oil. Using local waste vegetable oil will divert this product from the waste stream, create a local market and ensure a reduced aggregate GHG lifecycle.

We recommend using the Environmental Protection Agency's National Renewable Fuel Standard Program as a model for analyzing the aggregate GHG lifecycle of biodiesel fuel.

Further, Intro. 194 mandates a 1,000 to 2,000 parts per million (ppm) range for low-sulfur No. 4 heating oil. We believe that the legislation should be simplified by requiring that all No. 4 heating oil used in New York City buildings have a maximum 1,500 ppm sulfur content, thereby guaranteeing greater public health benefits.

These two achievable recommendations will go a long way in ensuring this already laudable legislation achieves its intention of creating a more sustainable and healthier New York City.

City residents deserve to live in healthy communities and this legislation is an important step toward that aim. I thank you Chairman Gennaro and members of this committee for taking the lead on this legislation and offer NYLCV's support in any way possible to help the goals set forth in this legislation become a reality.

Thank you.

CNYC

Council of New York Cooperatives & Condominiums
INFORMATION, EDUCATION AND ADVOCACY

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TESTIMONY COMMENTING ON INTRO 194
WHICH REQUIRES THE USE OF BIODIESEL HEATING OIL

Presented by Mary Ann Rothman
Friday, May 28, 2010

Good morning Chairman Gennaro and members of the Committee. My name is Mary Ann Rothman, and I am the Executive Director of the Council of New York Cooperatives & Condominiums, a membership organization comprised of housing cooperatives and condominiums located throughout the five boroughs of New York City. More than 170,000 New York families make their homes in our member buildings. Like all New Yorkers, we want clean air to breathe and a clean city in which to live. But we are also mindful of the cost of mandates that impose new responsibilities and new investments on our members. And we are aware of instances when well-intentioned legislation has set standards that are so high that they cannot be achieved in the marketplace.

We acknowledge the care and concern that have gone into crafting Intro. 194, but, we respectfully request that sulphur standards be reviewed and that time frames for compliance be extended to ensure that there will be sufficient supply of quality fuel without steep price increases.

In the past, some of our member cooperatives and condominiums have taken part in programs where they received incentives for using #2 oil mixed with biodiesel. They found no difference in the quality of the heat produced, but, absent the incentive programs, the cost of the new product would have exceeded the market price of #2 oil by a considerable margin.

As fuel companies modify their equipment to try to produce the mixture required by Intro 194 in sufficient quantities to meet the needs of all their clients by October of 2011, it is our belief that steep increases in the cost of this fuel will be inevitable. And this will be a harsh blow for all building owners in our city as they struggle to meet a myriad of increased costs (property tax increases, double digit water rate increases, additional cost for elevator inspections and for meeting benchmarking requirements, etc.). A more gradual deadline should produce a smoother transition to biodiesel, and should help ensure sufficient supply for all customers. CNYC joins industry experts in suggesting 2015 as the target date for complete transition to biodiesel and would suggest incentives to encourage earlier compliance wherever possible. We would also encourage further research to determine with certainty what particulate levels are achievable within reasonable time, quality and cost constraints.

Thank you.

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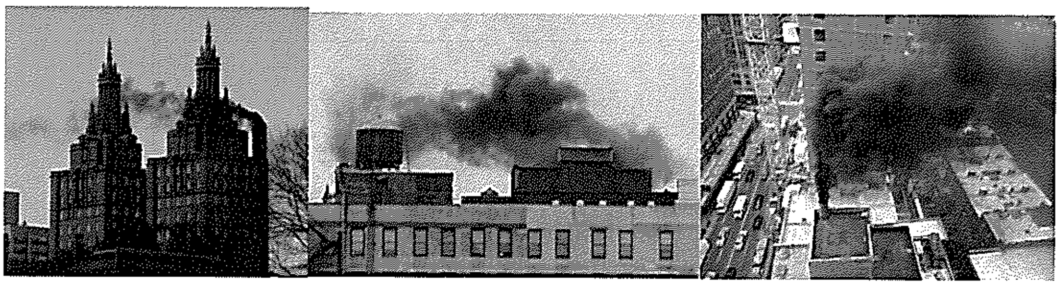
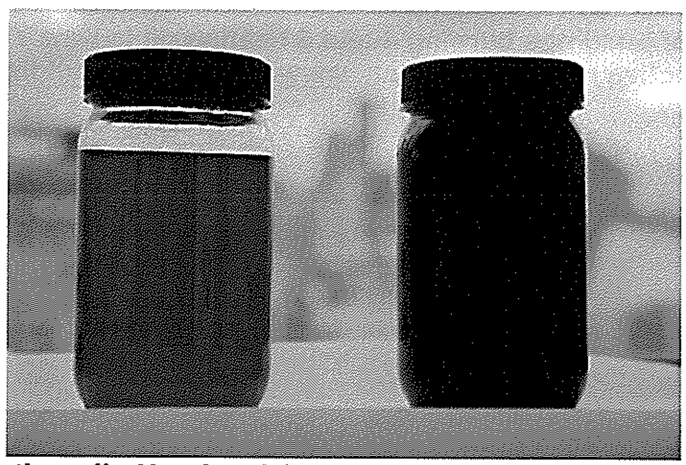
www.edf.org/dirtybuildings

Heating oil generates more particulate matter pollution in NYC than cars and trucks *combined*. See: "*The Bottom of the Barrel*" at www.edf.org/dirtybuildings





Heating oil: Number 2 (on left) and Number 6 (on right)
Photo credit: Yuki Kokubo, EDF

"All New York Yorkers, and especially those with heart and lung disease, have a stake in improving the City's air quality. New Yorkers banned coal furnaces decades ago, as the health impact became clear. The time has come to phase out residual oil for the same reason."

Dr. Thomas Farley, New York City Health Commissioner

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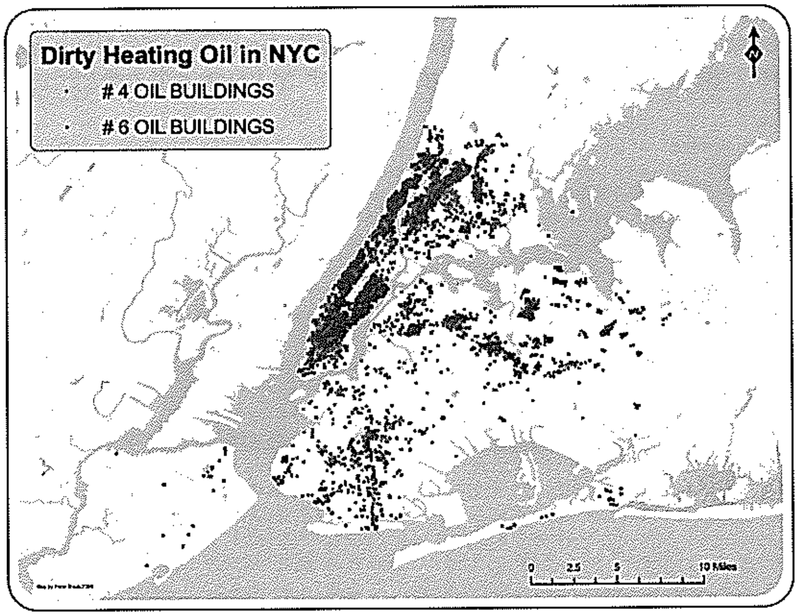
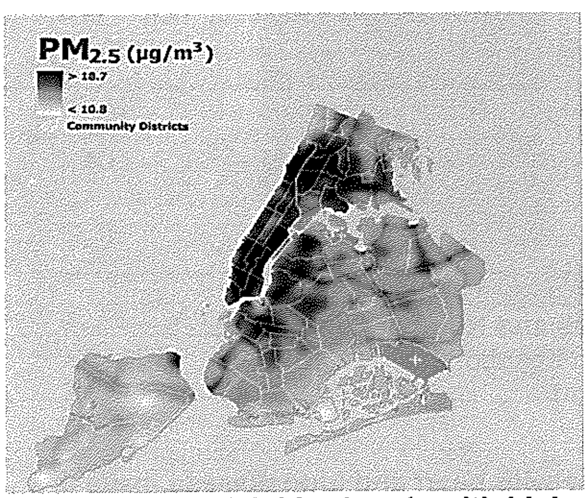
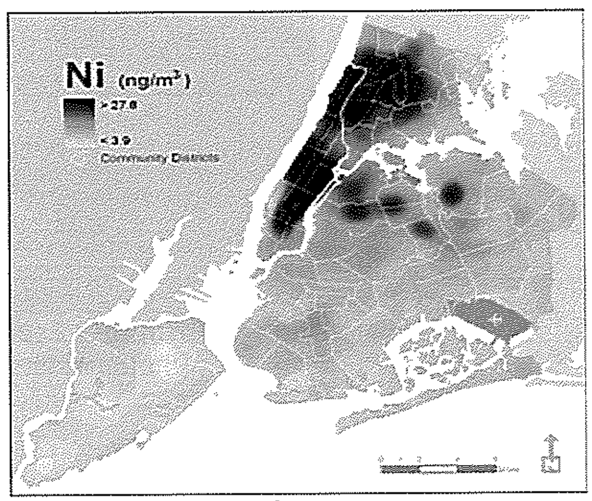


Location of buildings burning 4 and 6 heating oil in New York City
Interactive map available at: www.edf.org/dirtybuildings





Neighborhoods with highest airborne concentrations of particulate matter (left) and airborne nickel (right)
Source: NYC Department of Health
http://www.nyc.gov/html/doh/downloads/pdf/eode/nyccas_master_report_12_15_09.pdf
http://www.nyc.gov/html/doh/downloads/pdf/eode/nyccas-ni-report0510.pdf

For more information, contact EDF: www.edf/org/dirtybuildings
Isabelle Silverman: isilverman@edf.org (212) 616-1337
Mary Barber: mbarber@edf.org (212) 616-1351

NRDC

THE EARTH'S BEST DEFENSE

NATURAL RESOURCES DEFENSE COUNCIL

Statement of the Natural Resources Defense Council
By
Richard Kassel
On
Int. 194
May 28, 2010

My name is Richard Kassel,[1] and I am a Senior Attorney at the Natural Resources Defense Council. NRDC is a national, non-profit environmental organization, based here in New York City. For almost two decades, I have directed NRDC's work on diesel and other fuels issues.

Thank you for the opportunity to testify on Int. 194 today. Int. 194 is a critically important step towards solving the city's longstanding heating oil pollution problem.

As we all know, heating oil is a critical component of our city's multi-fuel strategy for ensuring the New Yorkers have reliable, affordable heat and hot water in the winter. Unfortunately, heating oil is also a significant contributor to our local, chronic particulate air pollution problems.

Particulate pollution is a one-stop shop for many health impacts. Studies show that it is linked with increased asthma emergencies, bronchitis, lower birth weights, heart disease and tens of thousands of premature deaths every year across the nation. And, it poses a particular threat to children, the elderly and anybody with heart or lung ailments. Millions of New Yorkers live in communities with some of the highest asthma levels in the nation.

Heating oil[2] from the city's roughly 800,000 buildings contribute 14 percent of the city's local soot pollution. 86 percent of this heating-related soot pollution comes from the roughly 1 percent of the buildings that still use residual fuel oil, alternatively known as No. 4 or No. 6 oil. These grades of heating oil typically contain about 175 times as much sulfur as the diesel fuel used in the city's trucks and buses, along with metals like nickel that worsen heart disease and other ailments. Just yesterday, the city's Community Air Survey showed that nickel levels are highest during heating season. The survey found that airborne nickel levels were nearly four times as high in neighborhoods with large numbers of buildings that burn residual fuel oil than in neighborhoods with fewer such buildings.

As Dr. Thomas Farley, the city's health commissioner said, "The time has come to phase out residual oil."

---

[1] Mr. Kassel can be reached at (212) 727-4454 or at rkassel@nrdc.org.

[2] Citywide, roughly 5,500 large boilers burn approximately 227 million gallons of No. 6 oil annually. An additional 3,500 large boilers burn about 84 million gallons of cleaner No. 4 oil, which is typically a 50/50 mix of No. 2 and No. 6 oils. In contrast, city buildings burn about 700 million gallon of the cleanest No. 2 oil each year.

Passing Int. 194 would be an important step towards reducing the impacts of this oil while it is still used. By requiring all heating oil to include 2% biodiesel, it would reduce our dependence on oil, help support a growing local biodiesel industry, and reduce greenhouse and health-related emissions. By lowering sulfur levels in all No. 4 heating oil, it would reduce the particulate matter emissions that are at the core of our concerns about the heating oil status quo.

As you move towards adopting Int. 194, NRDC strongly urges you to incorporate the following three proposed modifications:

First, we believe that the city must include a strong commitment to ensuring that only advanced, sustainable biodiesel is used to heat the city's buildings. We firmly believe that EPA has set a good standard for the city to adopt. In its March 26, 2010 Renewable Fuel Standard rule (the "RFS-2" rule), EPA created a voluntary "biomass-based diesel" certification that ensures that biodiesel certified to this designation would reduce greenhouse gas emissions by at least 50 percent, compared to conventional diesel. By including direct and indirect impacts of biodiesel production in its analysis, this certification addresses sustainability concerns that we raised with the Council several years ago.

We strongly urge the Council to amend the current draft of Int. 194 to require that all biodiesel used in the city's heating oil must meet this RFS-2 definition as a base line performance standard. It is worth reiterating that the EPA RFS-2 program is not a mandatory certification program - it's entirely voluntary. So, by requiring this certification as a baseline, the city would be helping steer the market towards this fuel, rather than a sub-RFS-2 version of biodiesel.

Second, we strongly urge the Council to add a requirement that at least 75 percent of the biodiesel used to meet the requirements of Int. 194 be derived from Waste Vegetable Oil (WVO). It has been widely reported that the local biodiesel industry and NYSERDA believe that local WVO could provide 50-75% of a B2 mandate. At this time, we are not urging the Council to adopt a requirement that buildings use locally-sourced WVO in their heating oil. Such a requirement would be extremely difficult to enforce, could distort the market in ways that could increase heating oil prices, and might be unconstitutional. But this assessment of the local market for WVO should be compelling as the Council considers what level of WVO is appropriate for Int. 194. We urge you to adopt a WVO content requirement at the high end of the projected WVO availability. Given that such a requirement would not be limited to locally-sourced WVO, we believe that a 75% minimum WVO content is both feasible and appropriate.

Last, NRDC strongly urges the Council to tighten its sulfur provisions in Int. 194. Lowering sulfur levels reduces particulate pollution, plain and simple. Rather than a range of sulfur levels, NRDC strongly urges the Council to cap sulfur in the city's No. 4 residual fuel oil at 1500 parts-per-million. Further, we ask you to implement this provision at the same time as you would implement the 2% biodiesel provision, i.e., in October 2011.

No. 4 residual fuel oil is generally made by combining equal parts of No. 2 oil and No. 6 oil. Thus, the recipe for this fuel will be equal parts today's No. 6 oil (capped at 3000 ppm) and an ultra-low sulfur diesel or comparable fuel. By 2011, all highway and nonroad diesel fuel in the nation will be capped at 15 ppm. Thus, supplies of this fuel will be plentiful. If anything, very high sulfur fuels like No. 6 oil will be supply-constrained because refineries are switching to ultra-low sulfur fuels to meet the EPA sulfur requirements limits for highway and nonroad fuels.

In sum, NRDC urges you to adopt Int. 194 to help reduce greenhouse and particulate emissions from heating oil, to reduce our dependence on oil, and to help spur the market for advanced biodiesel fuels. To do so, we strongly urge you to consider our three modifications, as summarized above.

Thank you for the opportunity to testify today.

EDF
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Statement of Environmental Defense Fund
Regarding Int. 194
Before New York City Council
Environmental Protection Committee
May 28, 2010

Good morning Chairman Gennaro and members of the Environmental Protection Committee. My name is Isabelle Silverman and I am an attorney with Environmental Defense Fund (EDF), a national non-profit organization based in New York and representing over 500,000 members. I am here to express EDF's support for the goals of Int. 194 and to recommend specific changes that we believe will strengthen the law's ability to meet those goals. Cleaning up heating oil is one of the most cost-effective and immediate steps that can be taken to deliver cleaner air to New York City's neighborhoods.

EDF urgently proposes two main changes to Int. 194, as currently introduced.

1) First, EDF strongly urges a firm limit of 1,500ppm on the sulfur content of No. 4 heating oil. In addition, there should be no discretionary powers by the Commissioner to increase that sulfur limit. Such a firm sulfur limit should be set like the City Council has already acted to set firm sulfur limits for No. 6 and No. 2 heating oil sold in New York City.

2) Second, EDF strongly urges sustainability standards for any biodiesel used in New York. These should be designed to help grow the market for biodiesel from local sources, like restaurant grease, and avoid the negative environmental consequences that can arise from transporting biodiesel from far away (including, for example, Latin America or the Midwest) or using feedstocks that threaten valuable rain forest or other lands.

I. Heating Oil: More Fine Particulate than Cars and Trucks *Combined*

In December 2009, EDF published a first-of-its-kind report[1] showing that buildings burning No. 6 or No. 4 oil emit more soot pollution than all cars and trucks *combined* in New York City. We identified the buildings that burn the dirty heating oil and mapped them on an interactive web site: www.edf.org/dirtybuildings. Over 9,000 buildings, mostly large commercial and residential buildings, burn the dirtiest grades of heating oil – No. 6 and No. 4 oil.

Overall, residential, commercial and institutional heating systems release 50% more soot

257 Park Avenue South
New York, NY 10010
T 212 505 2100
F 212 505 2375
www.edf.org
New York, NY / Austin, TX / Bentonville, AR / Boston, MA / Boulder, CO / Raleigh, NC
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(PM)[2] and 17 times more sulfur dioxides (SO_2) than cars and trucks on New York City's roads.[3,4] Nos. 6 and 4 are responsible for over 90% more sooty particulate matter (PM) emissions than either No. 2 heating oil or natural gas. Due to the disproportionate amount of soot pollution coming from the over 9,000 buildings burning No. 4 or No. 6 oil, these buildings are responsible for over 86% of the heating oil soot pollution in the city. Heating oil is also a big source of nickel pollution, a heavy metal linked to heart and other disease. Winter nickel levels are nine times higher in New York City than in the average American city.

High Health Costs, Especially for Children.

New York City's air fails to meet health-based National Ambient Air Quality Standards (NAAQS) for soot and ozone.[5] Not surprisingly, the American Lung Association's (ALA) 2010 State of the Air report gives New York City a failing grade in terms of air quality.[6] The ALA report cites new research that continues to strengthen the stark health case against ozone and fine particle pollution ($PM_{2.5}$).

Heating oil pollution is linked to asthma attacks, heart disease, children's lung development, hardened arteries, and even brain development. It also causes premature death.[7] New York City has twice the national asthma hospitalization rate among children 0–14 years. In 2000, New York City asthma hospitalizations alone cost government and individuals more than $240 million a year.[8] Medicaid and Medicare paid about 72% of these costs.

Heating Oil: Primary Driver of Variations in Air Quality across NYC Neighborhoods

Last December, the New York City Department of Health released its first community air survey, based on 150 local air quality monitors set up in every borough of the city. The findings are stark: air quality is worst in neighborhoods like the Bronx, midtown and downtown Manhattan, the Upper West Side and the Upper East Side – in short, wherever there is a combination of large buildings burning dirty heating oil and heavy traffic.[9]

The conclusion is inescapable: cleaning up heating oil is essential to improving poor air quality in New York City's most crowded neighborhoods – where millions of us live and work.

II. The Solution: Transition Quickly to Cleaner Fuels

The solution is to phase out the dirtiest grades of heating oil (No. 6 and No. 4 oil) and transition to both cleaner heating oil and natural gas. EDF is urging a full transition, over time, to either ultra-low sulfur No. 2 heating oil or natural gas, with buildings taking steps to improve significantly maintenance and operations to increase efficiency.

By switching to cleaner heating fuel, the particulate (soot) pollution from heating oil can be reduced by 65%. The changes proposed in Int. 194 are critically important steps to that goal, as they will reduce emissions from burning No. 4 oil. They will make it possible for buildings to shift from No. 6 to No. 4 oil quickly at a modest cost, even before buildings are required to transition to No. 2 heating oil or natural gas.[10]

III. Recommendations to Improve Int. 194

EDF supports the goals of Int. 194 because reducing the pollution content of No. 4 oil is a critically important step toward cutting pollution from heating oil citywide. In order to better achieve the bill's goals, EDF strongly urges the following changes.

Set Sulfur Cap at 1,500ppm for No. 4 Heating Oil for 2012

EDF urges the City Council to cap sulfur limits of No. 4 oil at 1,500ppm (or 0.15 percent) instead of allowing a range for the sulfur content of 0.1 percent to 0.2 percent (see § 10. Subdivisions b and d of section 24-169). The law should be clear on what the maximum allowable sulfur limit is which would be consistent with how the Administrative Code has set sulfur limits for No. 4 and No. 6 oil in the past (with a cap at 0.3 percent). There is no reason to give such a big range between 1,000ppm to 2,000ppm which is basically only a cap at 2,000ppm (0.2 percent).[11,12]

EDF is further urging City Council to remove "as determined by the Commissioner to be commercially available and necessary to reduce air pollution" in § 10. Subdivisions b (3) because our research shows there will be enough ultra low sulfur diesel oil to make enough No. 4 oil at 1,500ppm by October 1, 2012.[13]

Ensure Sustainable Biodiesel Is Used For B2 Requirement

It appears that the B2 mandate in this bill would reduce soot (PM) emissions from heating oil by about 1%. Furthermore, nitrogen oxides and sulfur dioxides emissions are also reduced with biodiesel. However, not all biodiesel is created equal, and there is extensive scientific literature to show that, in many cases, biofuels can have unanticipated adverse environmental impacts, some of which could – if the policy is not designed carefully -- overwhelm the scale of the benefits to be achieved from the B2 mandate's local emissions reductions.

EDF therefore strongly urges that the biodiesel definition of Int. 194 be modified to ensure that transport, agricultural and land use impacts of using biodiesel do not cancel out the air pollution benefits of using biodiesel. We recommend that the biodiesel definition include the following:

1) 75% of the feedstock should be from waste vegetable oil (WVO), and to the extent possible, local policies should be created to maximize opportunities for local collection.
2) All biodiesel required under Int. 194 must be certified to meet EPA RFS-2 standards.[14]
3) Mandatory public reporting requirements must disclose feedstock, origin of biodiesel and means of transportation.

EDF recognizes that there can be important economic and environmental benefits to building a local WVO market. For example, creating a demand for restaurant grease has the potential to create an incentive to have waste vegetable oil collected throughout New York City and the Tri-State area, but only if it is clear that these sources can compete effectively against biodiesel imported from foreign countries or using feedstocks that threaten rain forests, food prices and other ecologically valuable lands.

Creating an incentive to collect waste vegetable oil can also help reduce pollution of city waterways, because restaurants today often dispose of WVO by pouring it down the drain or freezing it and dumping it in the garbage. Given that about 1 billion gallons of heating oil are burned annually in New York City, about 20 million gallons of biodiesel will be needed to satisfy a B2 mandate. Policy should do all it can to ensure that that biodiesel diverts pollution from local sources.

The U.S. EPA has promulgated sustainability standards – known as RFS-2 – for the use of biodiesel in transportation fuels. RFS-2 lays the foundation for achieving significant reductions of greenhouse gas emissions from the use of renewable fuels, for reducing imported petroleum, and encouraging the development and expansion of our nation's renewable fuels sector.[15] Even though RFS-2 standards apply to the transportation sector, Int. 194 should require that any biodiesel used in heating oil be certified to meet those standards.

It is in effect the same biodiesel and there is no significant practical reason why the certification should not apply for bioheat. In addition, industry has already started using these standards to certify biodiesel. RFS-2 certification will help ensure actual greenhouse gas emission reductions and avoid damage to the environment in other ways (e.g. by creating an incentive to damage the rainforest, or increase emissions from transporting fuel, etc).

Reporting and transparency are essential components of any biodiesel program, to ensure that these goals are met in practice. We recommend that the law require the DEP Commissioner to provide the City Council with bi-annual reports documenting the feedstock of the biodiesel used, the place of origin and the means of transportation. This information will help City Council determine whether or not this bill has the intended effects of stimulating the local biodiesel market.

Conclusion

EDF commends the City Council for acting to reduce heating oil pollution. We believe that capping the sulfur content of No. 4 oil at 1,500ppm is an essential and needed step toward reducing the significant particulate and heavy metal pollution from heating oil used in New York City today. New York City is not meeting federal health-based standards for $PM_{2.5}$[16], and heating oil is one of the largest local sources of that pollution. Finally, EDF can support the biodiesel mandate only if the bill is modified to protect against inadvertent environmental damage, as described above.

---

[1] *The bottom of the barrel: how the dirtiest heating oils pollute our air and harm our health* (see www.edf.org/dirtybuildings).
[2] This report will refer to total PM which includes PM_{10}, $PM_{2.5}$, ultrafine PM, and nano-sized PM.

[3] According to EPA's emission model MOBILE6.2, there are 1.13 million gasoline-powered vehicles in New York City and more than 108,000 diesel-powered vehicles.

[4] In New York City, residential, commercial and institutional heating systems release more than 30,000 tons of nitrogen oxides (NO_x), more than 17,000 tons of sulfur dioxide (SO_2) and more than 1,100 tons of soot or particulate matter every year. Over 750 tons/year of particulate matter come from buildings burning No. 4 or 6 oil. Data are from the EPA 2005 National Emissions Inventory. (NOx is a precursor to ozone.)

[5] See EPA web site for detailed information. Online resource is available at: http://www.epa.gov/oar/oaqps/greenbk/

[6] See http://www:stateoftheair.org/ .

[7] See http://www.stateoftheair.org/2009/health-risks/overview.html and also see *Residual Risks, The Unseen Costs of Using Dirty Oil in New York City Boilers*, a 2010 report by the New York Law School Institute for Policy Integrity, online resource at: http://www.policyintegrity.org/documents/ResidualRisks.pdf

[8] The $242 million in asthma hospitalization costs in New York City are split up among the following payers: 49% by Medicaid, 23% by Medicare, 9% self-pay and 19% by others. See Asthma Facts, 2nd Ed. NYC Dept. of Health, 2003, p. 13. Online resource is available at http://www.nyc.gov/html/doh/downloads/pdf/asthma/facts.pdf .

[9] See http://www.nyc.gov/html/om/pdf/2009/pr_538_nyccas_report.pdf.

[10] Along with a modified version of Int. 194, EDF is calling for changes in city and state law and regulation that would phase out the use of No. 6 heating oil and a state-wide transition to a cleaned-up version of No. 2 heating oil, to bring it to the same pollution content as the ultra-low sulfur diesel fuel currently used in the transportation sector.

[11] In 2008, about 220 million gallons of No. 6 oil, 80 million gallons of No. 4 oil and about 700 million gallons of No. 2 heating oil were burned in New York City.

[12] By reducing allowable sulfur levels from 3,000ppm for No. 4 oil down to 1,500ppm, City Council would reduce PM emissions by over 130 tons annually.

[13] If No. 4 oil burning buildings will need to switch to low sulfur No. 4 oil, by about 2012, that would mean oil companies would need to refine 42 million gallons of ultra low sulfur No. 2 heating oil or ULSD to make enough low sulfur No. 4 oil for the No. 4 oil burning buildings by 2012. To satisfy the demand of No. 6 oil burning buildings that would need to switch to low sulfur No. 4 oil between 2012 and 2015, oil companies would need to refine about an additional 35 million gallons of ultra low sulfur No. 2 heating oil or ULSD to satisfy the demand for low sulfur No. 4 oil. However, as more buildings convert to No. 2 heating oil or natural gas, fewer gallons of low sulfur No. 4 oil will be needed over time.

[14] The RFS program was created under the Energy Policy Act (EPAct) of 2005, and established the first renewable fuel volume mandate in the United States. EPA is responsible for developing and implementing regulations to ensure that transportation fuel sold in the United States contains a minimum volume of renewable fuel. Under the Energy Independence and Security Act (EISA) of 2007, the RFS program was expanded in several key ways:

- EISA expanded the RFS program to include diesel, in addition to gasoline;
- EISA increased the volume of renewable fuel required to be blended into transportation fuel from 9 billion gallons in 2008 to 36 billion gallons by 2022;
- EISA established new categories of renewable fuel, and set separate volume requirements for each one.
- EISA required EPA to apply lifecycle greenhouse gas performance threshold standards to ensure that each category of renewable fuel emits fewer greenhouse gases than the petroleum fuel it replaces.

See http://www.epa.gov/otaq/fuels/renewablefuels/index.htm.

[15] See http://www.epa.gov/otaq/fuels/renewablefuels/index.htm.

[16] EPA has announced that it will further tighten PM2.5 standards, which will make it even harder for the city to meet them and achieve "the cleanest air of any big city in America" as stated in PlaNYC.

Potential Impacts of Proposed Amendments to Title 15, Chapter 2, Rules of the City of New York Pertaining to the Prohibition of the Use of No. 4 and No. 6 Fuel Oil

Prepared by:
ENVIRON International Corporation
Newark, New Jersey
Groton, Massachusetts

Date:
December 2009

Project Number:
02-22920A

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1 The Potential Phase-Out of No. 4 and No. 6 Fuel Oil in New York City

The New York City Department of Environmental Protection is contemplating the phase-out of the use of No. 4 and No. 6 fuel oil within the City's five Boroughs (Bronx, Brooklyn, Manhattan, Queens, Staten Island) based on the presumed environmental benefits of using alternative lighter fuels (e.g., natural gas and No. 2 fuel oil). Based on a pre-draft of the proposed amendments to Chapter 2 of Title 15 of the Rules of the City of New York pertaining to the prohibition of the use of No. 4 and No. 6 fuel oil, the City states that "Section 24-102 of the Administrative Code of the City of New York declares that ... the emission into the open air of harmful or objectionable substances, including substances resulting from the use of fuel burning equipment, is a menace to the health, welfare, and comfort of the people of the City and a cause of extensive damage to property and that it is the public policy to actively regulate and reduce such emissions." The proposed amendment would prohibit the use of No. 4 and No. 6 oil in newly installed boilers, and phase out the use of No. 4 and No. 6 oil in existing boilers through 2027.

While the proposed amendment contemplates that natural gas may not be "readily available" for use at certain premises, and that significant costs may be incurred for supplying utility gas to the property line, the proposed amendment only contemplates a variance for up to six years for converting existing boilers to natural gas or No. 2 fuel oil. Further, the proposed amendment does not consider the costs to retrofit existing boilers from No. 4 or No. 6 fuel oil to natural gas or No. 2 fuel oil, which can be considerable; nor does the proposed amendment consider potential natural gas infrastructure capacity issues and fuel price impacts. In addition, the proposed amendment is silent on other potential environmental impacts (e.g., spill containment, remediation implications) from switching from No. 4 and No. 6 fuel oil to less dense No. 2 fuel oil. This paper explores these issues in more depth.

Based on understanding the characteristics of the different fuels and how they might be used in New York City, this analysis revolves around four primary areas: 1) the differences in physical properties of the fuels that would have environmental or cost implications; 2) the air quality implications of fuel switching; 3) the potential cost/economic implications of physically switching to lighter fuels; and 4) the infrastructure and price considerations of eliminating No. 4 and No. 6 fuel oil.

1.1 Executive Summary

- Capital costs for switching boilers from No. 6 fuel oil to natural gas are potentially significant, with potential burner replacement costs alone ranging from $10,000 to $20,000 for relatively small, single-burner boilers to about $1 million for the larger, multi-burner boilers operating within the City. Capital costs for switching boilers from No. 6 fuel oil to No. 2 fuel oil are typically lower than a conversion to natural gas. However, total capital costs will vary significantly from location to location depending on the extent of modifications and retrofits needed, the upgrades to chimneys and stacks required to meet code, and the need to install additional natural gas compression and piping to buildings in certain cases. These costs are typically borne by building owners, which would have an adverse impact upon the economics of building ownership and increase tenant rents.

- The lower cost fuel conversion of No. 6 fuel oil to No. 2 fuel oil would result in a dramatic increase in operating costs. Whether converting from No. 6 oil to No. 2 oil, or from No. 6 oil to natural gas, these increases in fuel costs can be passed onto tenants and, for the No. 6 to No. 2 conversion, could increase average citywide rent from about $75 to $90 per month per unit, with a range from about $70 to over $100 per month over the phase-in period of the proposed rule. The increased rent would increase the rent burden on tenants up to 35% or 36% of net income in certain boroughs. Pass-through of equipment conversion costs (noted above) would result in even greater rent increases.

- Residual fuel oil makes up approximately 45% to 50% of the total liquid fuel consumed in City buildings. Therefore, residual fuel oil serves an important "peak shaving" role for natural gas supplies during the critical winter months. A phase out of the residual fuel oils would increase the demand for distillate fuel oils and natural gas. Without the availability of residual oil, natural gas flow into the City would have to increase by about 20% to 27% during the months of December through February, raising the frequency of gas curtailments during peak consumption days and creating potential price volatility.

- By 2030, annual heating fuel consumption in the City is expected to increase by 14% from 2005 levels (from 422,000,000 million Btu/year (MMBtu/yr) in 2005 to 480,000,000 MMBtu/yr in 2030) and electricity consumption is expected to increase by 44% from 2005 levels (from 50,000,000 megawatt-hours/year (MWh/yr) in 2005 to 72,000,000 MWh/yr in 2030). Natural gas infrastructure limitations already hinder the ability for natural gas to meet this increased demand for heat and electricity, without oil backup, even without taking further conversions into account.

- Natural gas demand in the City currently exceeds the natural gas pipeline capacity into the City by up to 1.2 billion cubic feet on the hottest and coldest days of the year. Modeling by the New York State Energy Planning Board, in its 2009 DRAFT Energy Plan, shows that the growth in natural gas demand over the planning period is already projected to be capacity constrained.

- The gap in natural gas pipeline capacity on peak demand days could be lessened with stored natural gas supplies within and near the City. However, the three storage facilities located in or near the City are limited by the inability to rapidly refill the tanks (because of normal natural gas demands on an ongoing basis), the limitations of trucking liquefied natural gas (LNG) within the City, and the ban on construction, reconstruction, or expansion of LNG terminals within the City.

- The permitting, siting, and approval process for building new natural gas pipeline capacity and/or establishing LNG terminals and regasification facilities within the City will require a long lead time, with additional time needed to overcome environmental group and citizen concerns with these facilities. For example, the Millennium Pipeline Project required eleven years from initial FERC filing to being placed into service. Expansion of natural gas capacity within New York City also raises important issues concerning community disruption due to the noise, dust, and traffic and pedestrian disruption caused by construction; the acquisition of property by eminent domain; disruption of other subsurface utilities; and worries by neighbors about natural gas pipeline safety.

- We have been advised that the City's proposal is targeted exclusively at the commercial sector. However, that sector accounts for only 35% of residual fuel use in New York City. The electrical generating sector consumes 40% of the residual fuel, the transportation sector (principally ships) uses 22%, and the industrial sector is 3%. These would be unaffected by the proposal.

- There were approximately 571 reported spills of No. 2 fuel oil in the five boroughs in 2008 and approximately 301 in 2009 to date (until September 3, 2009). Phase out of the use of No. 6 and No. 4 fuel oils would increase the use of No. 2 fuel oil and consequently, the number of spills of No. 2 fuel oil. The number of spills of residual fuel oils (No. 4, No. 5, and No. 6 fuel oils) in the five boroughs over this same time period is significantly less, with approximately 219 and 121, respectively.

- The physical differences between No. 2 and No. 6 fuel oil can have environmental implications when these fuels are released to the soil and/or groundwater, with the more adverse impacts from No. 2 fuel oil exacerbated with the increase in the number of spills anticipated by the phase out of the residual fuel oils. Compared to No. 6 oil, No. 2 oil has higher mobility in surface water and ground water, and volatilizes into the air more readily.

- Many of the air quality impacts associated with residual oil combustion can be reduced through improved equipment tuning and maintenance practices, as well as the development and deployment of new oil burner technologies. For example, staged air combustion can be effective in controlling fuel NO_x, and is an approach that has been demonstrated for combustion of heavy oils. Tuning and maintenance can reduce emissions of carbonaceous particulate matter and carbon monoxide, and improved atomization can also significantly reduce particulate emissions.

2 Setting and End Uses for No. 6 and No. 4 Fuel Oil in New York City

Fuel oil plays a vital role in New York City's energy infrastructure. Both residual and distillate fuels[1] are used for heating, powering industrial processes, generating electricity, and transportation. Table 1 shows a breakdown of the fuel usage by sector in the New York City and Northern Suburbs, as reported in the 2006 Petroleum Infrastructure Report prepared for the New York State Energy and Research Development Authority (NYSERDA) by ICF Consulting LLC[2]. The statistics shown in Table 1 include areas outside of New York City (specifically, Rockland and Westchester counties); it is expected that fuel oil usage statistics for New York City alone could differ[3].

The predominant use for residual fuel oil is by the electrical (i.e. electricity generation) sector, followed closely by the commercial and transportation sectors. Residual fuel oil accounts for over 96% of all fuel oil use by the electrical sector, reflecting an overwhelming reliance on this fuel. The relatively large consumption of residual oil by the transportation sector is largely driven by the use for marine transportation in ports. The negligible residual fuel oil consumption attributed to the residential sector is affected by the exclusion of multi-dwelling apartment buildings from the residential sector statistics, and its inclusion in the commercial sector statistics.

Table 1: Average Daily Consumption of Fuel Oil in New York City Metropolitan Area[1,2]

Sector	Sales in 2004 (1000 bbl/day)			
	Distillate	Kerosene	Residual	Total
Commercial[3]	24.2	1.0	15.8	41.0
Electrical[4]	0.6	-	18.1	18.7
Industrial[5]	1.1	0.3	1.3	2.7
Residential[6]	15.6	1.1	-	16.7
Transportation[7]	22.8	-	9.8	32.6
Total	64.3	2.4	45.0	111.7

[1] Data taken from the 2006 Petroleum Infrastructure Report, prepared for NYSERDA by ICF Consulting LLC. The primary source of the data used by ICF to prepare the values shown in this table was the publicly available Energy Information Administration (EIA) reports, and specifically EIA's report: *U.S. Fuel Oil and Kerosene Sales (2004).* It should be noted that the smallest geographic location for which this EIA data is available is the state level. As

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[1] According to AP-42 Chapter 1.3 (United States Environmental Protection Agency), distillate oil includes No. 1 and No. 2 fuel oil, and residual oil includes No. 5 and No. 6 fuel oil. No. 4 fuel oil is typically a blend of No. 2 and No. 6 fuel oils. According to the U.S. Department of Energy No. 4 fuel oil can be classified as diesel, distillate or residual fuel oil.. In Table 1 and Figure 1, No. 4 fuel oil is included in the distillate oil category.

[2] The stated goal of the study by ICF was to provide an assessment of the petroleum storage and delivery infrastructure to the New York City, Long Island, and Hudson River regions of New York State.

[3] Based on 2008 census data, New York City represents about 87% of the population of New York City, Rockland and Westchester Counties.

Table 1: Average Daily Consumption of Fuel Oil in New York City Metropolitan Area[1,2]				
Sector	Sales in 2004 (1000 bbl/day)			
	Distillate	Kerosene	Residual	Total

such, ICF derived county-level estimates from the EIA data using U.S. census statistics to estimate the distribution of fuel demand at the county level.

2 New York City Metropolitan Area as defined by the 2006 Petroleum Infrastructure Report includes the following counties: Bronx, Kings, New York, Queens, Richmond, Rockland and Westchester.

3 The commercial sector is comprised of office buildings, businesses, and multi-dwelling apartment buildings and is generally characterized by the use of single- or dual-fired boilers that can operate on either natural gas or oil.

4 It is not clear whether the electrical sector includes smaller power generation sources such as emergency generators.

5 Industrial customers in the New York City area consist of a few large plants, but mostly many small machine shops.

6 The residential sector does not include multi-dwelling apartment buildings.

7 The transportation sector includes consumption associated with ground, marine, and air transportation.

Table 2 shows the breakdown of fuel oil use by building type for commercial and multi-unit tenant residential buildings burning fuel oil in New York City. The buildings shown in this table represent a subset of the approximately 900,000 total buildings in New York City, and do not include one- and two-family homes, or buildings with boilers less than 350,000 Btu/hr), which are not regulated by the New York City Department of Environmental Protection (NYCDEP). It should be noted that one- or two-family homes, and buildings heated with boilers less than 350,000 Btu/hr would typically be heated with natural gas or No. 2 fuel oil.

The majority of buildings in the table use No. 2 fuel oil. Of the approximately 8,800 buildings burning residual fuel oil; the vast majority (85%) are multi-unit residential properties (i.e. large apartment buildings). The potential for adverse impacts on apartment building economics due to the proposed phase out of residual fuel oils is discussed in Section 4.3.2.1.

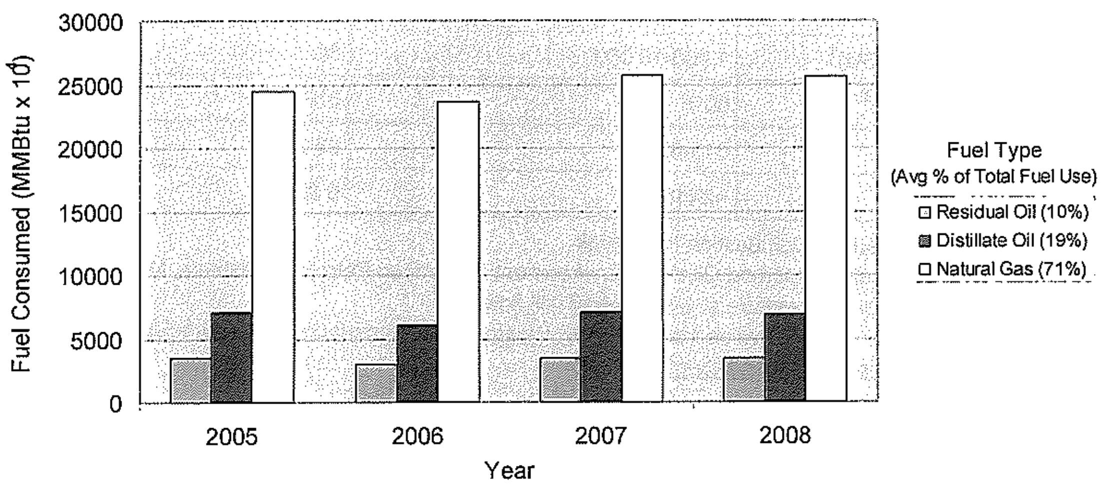
Table 2: Commercial and Multi-Unit New York City Buildings with Fuel-Oil Boilers Greater than 350,000 Btu/hr[1]

City Borough	No. 6 Fuel Oil		No. 4 Fuel Oil		No. 2 Fuel Oil		Total
	Non-Residential	Residential	Non-Residential	Residential	Non-Residential	Residential	
Bronx	63	1,148	51	1,227	815	2,645	12,160
Manhattan	382	1,240	505	2,044	1,665	6,822	17,247
Brooklyn	105	302	48	425	1,265	7,427	13,754
Queens	104	352	49	714	1,385	3,302	9,632
Staten Island	7	8	5	16	147	100	3,994
Total	**661**	**3,050**	**658**	**4,426**	**5,277**	**20,130**	**56,787**

1 Data taken from a 2009 report prepared by the Environmental Defense Fund (EDF) and the U.S. Green Buildings Council (EDF, 2009) based on data from the NYCDEP. This table only includes buildings regulated by NYCDEP, and thus does not include one- or two-family homes or boilers less than 350,000 Btu/hr. The EDF report notes that the majority of one- or two-family homes typically burn No. 2 fuel oil or natural gas.

As shown in Figure 1, an inventory conducted by the Mayor's Office of Long-Term Planning and Sustainability shows that although distillate fuel oil is the more common fuel oil type used for New York City buildings, residual fuel oil consumption comprises a significant fraction of overall fuel oil consumption in City Buildings, equivalent to 45 to 50% of distillate consumption[4].

Figure 1. Fuel Consumption in New York City Buildings. Data provided by New York City Mayor's Office of Long-Term Planning and Sustainability.



According to the 2007 PlaNYC report prepared by the New York City Mayor's Office, by 2030, the City's annual heating fuel consumption is expected to increase by 14% from 2005 levels (up from 422,000,000 MMBtu/yr in 2005 to 480,000,000 MMBtu/yr in 2030), and electricity consumption is expected to increase by 44% in the same time period (from 50,000,000 megawatt hours per year (MWh/yr) in 2005 to 72,000,000 MWh/yr in 2030); although initiatives are being undertaken by the city to curb this rising demand. Consumption predictions for specific fuel types are not readily available; however, natural gas supply limitations may hinder the ability for natural gas to meet this increased demand for heat and electricity. See additional discussion about the fuel infrastructure issues in Section 5.

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4 "PlaNYC: Inventory of Greenhouse Gas Emissions," New York City Mayor's Office of Long-Term Planning and Sustainability, September 2009.

3 Physical Property Differences and Environmental Implications

Common physical properties of No. 2 and No. 6 fuel oil are summarized in Table 3.

Table 3: Common Physical Properties of No. 6 and No. 2 Fuel Oil

Property	No. 6 Fuel Oil	No. 2 Fuel Oil
Density (lbs/gallon)[1]	7.9-8.2	7.0-7.3
Gross Heating Value (Btu/gallon)[1]	153,000-149,000	141,000 -143,000
Typical Viscosity @ 70°F (SSU)[1]	1,000-10,000	36
Typical Pour Point (average)[2,3]	60°F	0°F
Boiling Point Range[2]	615-826°F	93-365°F
Vapor Pressure (psia)[4]	~$2X10^{-6}$	0.009

[1] Values from the North American Combustion Handbook.
[2] "Effects of Oil and Chemically Dispersed Oil in the Environment," American Petroleum Institute, May 2001.
[3] The pour point is the lowest temperature at which the oil will flow.
[4] No. 2 oil value from MSDS. No. 6 oil value from http://www.warren-group.com/publications/articles/characteristics-of-no-6-fuel-oil-and-the-related-fire-hazards-of-welding/index.cfm;jsessionid=f030859fcd2723dfbef1173d2345523f7a4b?bhcp=1

The physical differences between No. 2 and No. 6 fuel oil can have environmental implications when these fuels are released to the soil and/or groundwater. Specifically, because No. 6 fuel oil is more viscous than No. 2 fuel oil and requires application of heat to allow No. 6 fuel oil to flow, releases of No. 6 oil are generally easier to contain. In addition, because No. 2 fuel oil will spread more readily and is more volatile, releases of No. 2 oil may be more likely to cause vapor intrusion issues in buildings located near releases. It should be noted that because No. 6 fuel oil is less volatile than No. 2 fuel oil, the use of certain remediation techniques may be less effective when employed on a release of No. 6 fuel oil. Specifically, when No. 6 fuel oil is released to the environment, a higher concentration of the oil will be left behind in the affected environmental media (e.g., soil, groundwater) when compared to a release of the same amount of No. 2 fuel oil. The higher residual concentration associated with the No. 6 fuel oil release will typically degrade more slowly using natural attenuation (e.g., allowing the residual material to degrade naturally) and bioremediation methods.

3.1 Important Factors in Evaluating Environmental Impacts of Fuel Oil Spills

3.1.1 Composition of Fuel Oils

Fuel oils are a complex mixture of hydrocarbons and other constituents whose composition can vary considerably depending on the crude oil source, the refining processes used to generate the various petroleum fractions and end products, and product additives used to achieve certain product specifications. In general, oils consist of light-weight components, medium-weight components, and heavy-weight components. The environmental behaviors of the different fuel oils depend on the relative quantities of each component. The composition of oils may also have implications should a release occur which requires remediation, as contact with oil components during remedial activities could pose health risks (in particular, acute risks) to remedial workers.

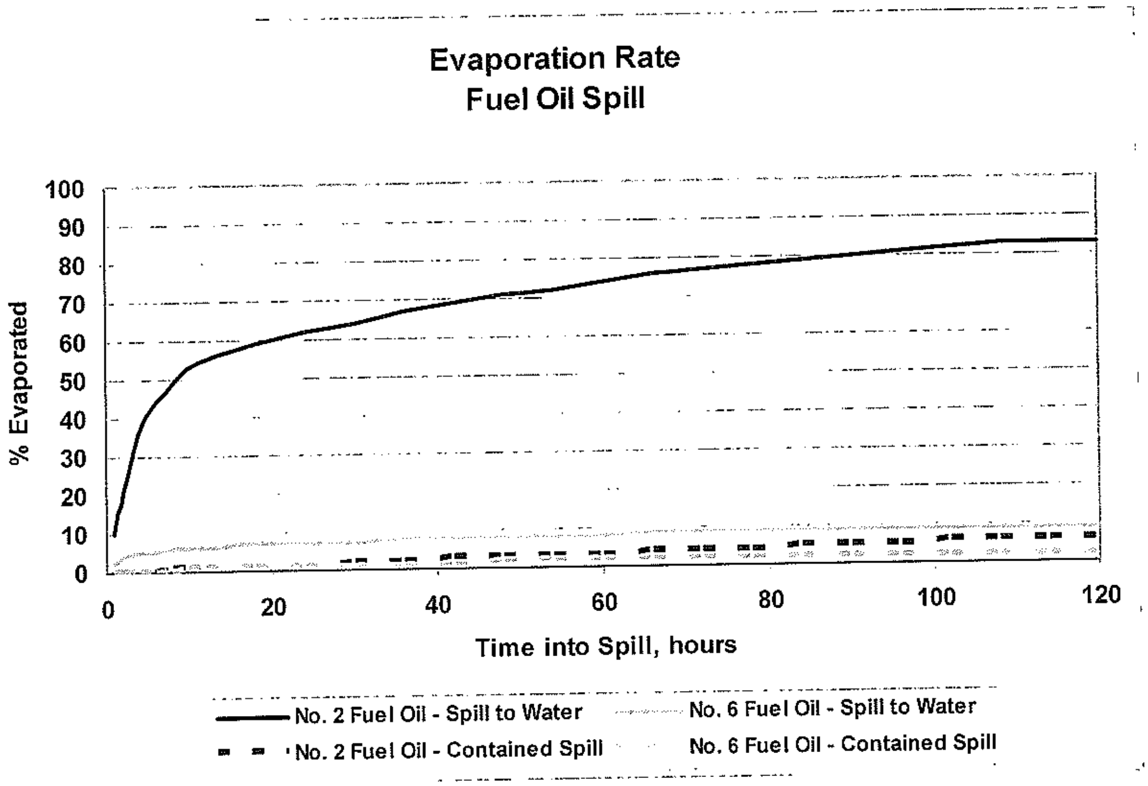
3.1.2 Weathering of Fuel Oils

Petroleum products that are released into the environment undergo volatilization, transport, and degradation at rates dependent on a variety of different parameters. These parameters include the specific composition of the fuel oil that is released, the environmental conditions, and the media to which the product is released.

Evaporation is the most important weathering process occurring in the first few days following an oil spill. In the evaporation process, the lighter constituents of the petroleum fraction evaporate and leave the heavier constituents behind, increasing the density and viscosity of the residual material. The evaporation rate of No. 2 fuel oil will be significantly greater than No. 6 fuel oil with greater quantity of lighter constituents, as shown by the following graph[5]. Volatilization of the lighter constituents could pose an inhalation exposure risk to residents. The volatilization process from a pool of fuel oil that might result from a spill generally occurs on a shorter timeframe than biodegradation.

5 Estimates based on simulations using the National Oceanic and Atmospheric Administration's (NOAA's) ADIOS2 model (Office of Response and Restoration). The scenarios represent 5 barrel (210 gallon) spills of No. 2 and No. 6 fuel oils to fresh water body and onto land (simulated as a spill onto an area of about 168 square feet resulting in an oil thickness of about 2 inches).

Figure 2. Relative Fuel Oil Evaporation Rates. Simulated data from ADIOS2 (NOAA Office of Response and Restoration)



Transport involves the movement of the released petroleum products in the environment, for instance, via soils into groundwater. Transport through the different media depends on the physical and chemical properties of the petroleum products themselves and of the media they come into contact with. Lighter hydrocarbons are relatively mobile and can be transported away from a spill site by groundwater and air. The heavier, branched compounds (e.g., PAHs, asphaltenes, and tars) are more stable and tend to persist in the environment. These heavier compounds are generally less mobile. Very heavy hydrocarbon compounds, such as PAHs, do not readily volatilize because of their very low vapor pressures, may be solids at ambient temperatures, and do not readily solubilize in water because of their low oil/water partitioning coefficient.

The lighter aromatics, and especially BTEX, tend to be the most water-soluble fraction of petroleum[6]. Part of the aromatic fraction of an oil spill on soil may partition into groundwater that has been in contact with the contaminated soil, resulting in a plume of water soluble aromatics radiating out from the location of the spill[7]. In addition, storm drains, pipes, and utility lines can provide conduits for mobile oil, water and water-soluble hydrocarbons to spread. The dissolved

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[6] AEHS, Appendix II-B, 1998.

[7] A competing process is the volatilization of these volatile aromatic compounds from the soil particles.

concentration of petroleum hydrocarbons in groundwater or surface water is controlled by the concentration of the specific constituents in the oil[8]. Therefore, because the concentration of the lighter aromatics (e.g., BTEX) is greater in No. 2 fuel oil than No. 6 fuel oil, the potential impacts on groundwater and surface water will be greater, causing the potential mobility of these constituents to increase.

3.1.3 Implications for Environmental Impacts of Fuel Oil Spills

The phase out of No. 6 and No. 4 fuel oil in New York City would increase the use of No. 2 fuel oil and consequently the likelihood for a proportionately higher number of spills of No. 2 fuel oil within the City. NYSDEC's Spill Incidents Database (http://www.dec.ny.gov/chemical/8437.html) indicated that there was a significant number of No. 2 fuel oil spills in New York City over the past year[9]. These data indicated that there were approximately 571 reported spills of No. 2 fuel oil in the five boroughs in 2008, and approximately 301 in 2009 to date (until September 3, 2009). The phase out of No. 4 and No. 6 fuel oils would likely increase the spills of No. 2 fuel oil. The properties of the fuel oils (described above) and the increased number of spills have potential environmental implications:

- The increased volatility of No. 2 fuel oil means that exposure to volatile petroleum hydrocarbon constituents will increase;
- The increased mobility of No. 2 fuel oil (particularly the lighter constituents of No. 2 fuel oil) will increase the possibility of surface water and ground water contamination from hydrocarbon constituents; and
- The increased mobility of No. 2 fuel oil increases the potential for spreading of the contamination via storm drains, pipes, and utility lines.

3.2 Air Quality Implications

The primary basis for the proposed phase out use of No. 6 and No. 4 fuel oil in New York City is the environmental benefits of using lighter fuels. This improvement in air quality needs to be evaluated against the associated costs for converting combustion units from residual fuel oils to distillate oils and natural gas, and in comparison to other mechanisms for achieving emission reductions and air quality improvements (e.g. efficiency improvements, restrictions on sulfur content in fuel oil, etc.), which may not entail the large capital expenditures associated with boiler conversion costs. As discussed in detail in Section 4, the conversion costs per boiler could range from several thousand dollars for a residual fuel oil to distillate fuel oil conversion and up to several hundred thousand dollars per boiler for a residual fuel oil to natural gas conversion.

[8] "Predicting the Effect of Hydrocarbon and Hydrocarbon-Impacted Soil on Groundwater," API, September 2001.

[9] A search of the database was conducted for the time period from January 1, 2008 to September 3, 2009.

Based on the pattern of fuel consumption for buildings in New York City (Figure 1 above) and published emission factors for fuel combustion[10], residual fuel oil combustion in City buildings accounts for between 18% to 33% of total criteria pollutant[11] emissions from combined residual oil, distillate oil, and natural gas combustion in City buildings. Because combustion of distillate fuels also contributes to criteria pollutant emissions, the replacement of all residual oil fuel use with distillate fuel oil use (on a BTU basis) would only be expected to reduce overall criteria pollutant emissions from fuel combustion in City Buildings by an estimated 8% to 14% (based on fuel consumption data for 2005-2008)[12]. Because combustion of natural gas also contributes to criteria pollutant emissions, a city-wide conversion from residual fuel oil to natural gas combustion would only reduce overall criteria pollutant emissions from City Building fuel combustion by as little as 10%. In addition, while the reduction in pollutant emissions may be greater for a switch from residual fuel oil to natural gas, the potential conversion costs could be significantly higher.

As discussed elsewhere in this report, there are other opportunities for reducing air emissions and improving air quality, while still allowing for continued the use of No. 6 oil (e.g. the utilization of more modern and efficient fuel oil burning equipment). The City's proposals do not fully consider most of these opportunities.

[10] ENVIRON calculated emissions for residual fuel, distillate fuel, and natural gas based on emission factors derived from U.S. EPA AP-42 Chapters 1.3 (Fuel Oil Combustion) and 1.4 (Natural Gas Combustion). For certain pollutants a range of emission factors are available. For example, AP-42 Chapter 1.4 includes ten unique NOx emission factors for natural gas combustion in boilers of various sizes, firing type (e.g. tangential vs. normal), and emission controls (e.g. low NOx burner, flue gas recirculation, or no control). For purposes of this analysis, ENVIRON conservatively used the "worst-case" emission factors (e.g., those representing the highest emissions). For estimates of SO_2 emissions, ENVIRON assumed 0.3% and 0.2% sulfur by weight for residual and distillate fuels, respectively [the sulfur limits codified in the New York Codes Rules and Regulations (NYCRR) Chapter III Subpart 225-1 Table 1].

[11] Criteria pollutants include carbon monoxide (CO), nitrogen oxides (NO_x), particulate matter less than 10 microns (PM_{10}), particulate matter less than 2.5 microns ($PM_{2.5}$), sulfur dioxide (SO_2), and volatile organic compounds (VOCs).

[12] Irrespective of the proposed phase-out of residual oils, reductions in criteria pollutant emissions from City Buildings would occur if seasonal limitations targeting the sulfur content of heating fuels are imposed (such restrictions have been under consideration). Proposed limitations have included a 0.0015 percent sulfur by weight limit for No. 2 heating oil use. A restriction of this type could reduce total criteria pollutant emissions from fuel combustion in City Buildings as much as 9% - 23% (based on 2005-2008 distillate fuel oil consumption data for City buildings).

4 Costs for Physically Converting Combustion Units

Should residual oil use in New York City be phased out, owners of affected combustion equipment would face the choice of conversion to either natural gas or No. 2 oil. Through discussions with equipment manufacturers and field service staff, typical conversion requirements and approximate capital costs were identified. In addition, regional fuel pricing data and near-term forecasts were assessed to define the potential impact of fuel switching on operating costs. Conversion costs can be substantial, up to several hundred thousand dollars per boiler depending on the specific installation, whether conversion is from residual fuel oil to distillate fuel oil or natural gas, and the availability of natural gas service (quantity and gas pressure) at a particular location. In addition, operating costs can be substantially higher for distillate fuel oil or natural gas. For example for rent stabilized housing, rents could increase on average from $70 to $85 per month on a citywide basis over the phase-in period of the proposed rule and each year thereafter.

4.1 Capital Cost Associated with Switching to Natural Gas

The capital costs involved with switching boilers from No. 6 fuel oil to natural gas are potentially significant. Equipment changes that may be required are as follows:

Installing or upgrading the natural gas service: The cost of upgrading the natural gas service may include the installation of new or larger supply lines from the nearest main as well as larger meters, valves and pressure regulators. Should the gas supply pressure be inadequate, additional on-site gas compression equipment would be required. These costs are highly variable and are specific to each installation. As an example, for conversion of 200 and 250 hp boilers, the gas train upgrade costs alone were approximately $80,000. If the gas line needed to be extended a greater distance and/or required more volume, the upgrade costs could be significantly more. The responsibility for and allocation of these costs are likely site-specific and dependent on negotiations between the customers and the local gas supply company.

Upgrading the exhaust stack or chimney: The conversion from oil to natural gas will trigger a requirement to bring the exhaust stack or chimney system up to current building code standards. Lining of the chimney with a gas-tight, metal sleeve to achieve compliance will likely cost between $5,000 and $10,000 per story.

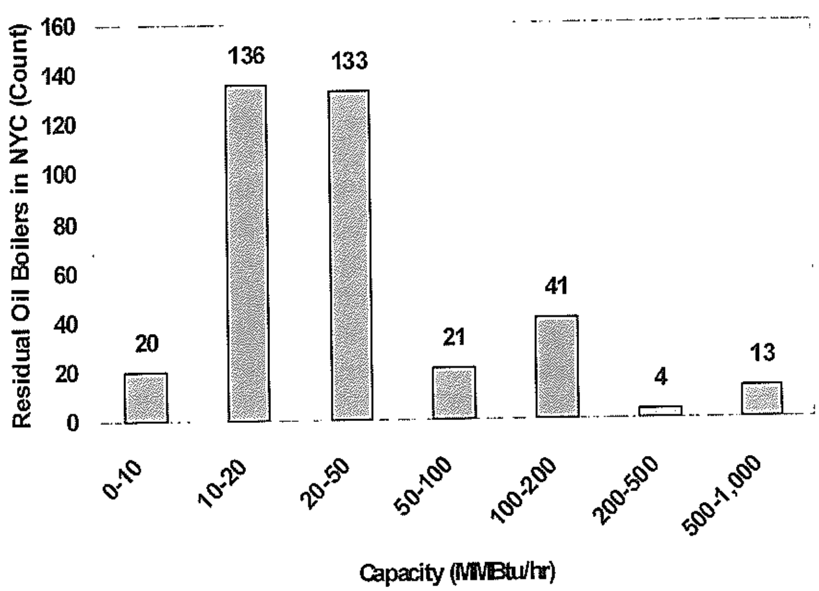
Removal of the oil storage tank: The oil storage tank must be emptied, cleaned and disposed of. The cost for removing a 5,000 gallon tank is about $12,000.

Removal of the oil heater: No. 6 oil must be heated to about 200°F in order to reduce its viscosity for pumping and good atomization. The oil heat exchanger and associated plumbing must be removed and disposed of.

Replacement of the Burner: If the existing No. 6 fuel oil burner (or multiple burners for larger units) is not capable of firing gas, it must be removed and replaced with a new natural gas burner. Also, the oil fuel train would be removed. The cost for burner replacement varies significantly, depending primarily on the size of the boiler, the number of burners, and the NO_x emissions requirements.

Figure 3 shows the distribution of NYSDEC-permitted, residual-fuel-oil-fired boilers in New York City with a firing rate below 1,000 MMBtu/hr. The figure depicts only a subset of total boilers in the City[13], as boilers less than 10 MMBtu/hr are exempt from NYSDEC permitting. For these units, the burner replacement costs range from about $10,000 to $20,000 for the relatively small, single-burner, fire-tube boilers on the left side of this histogram to about $1,000,000 for the large, multi-burner, water-tube units on the right. These costs include the new burners, a gas fuel train, and a new combustion control system. The total capital cost required to convert a boiler from No. 6 fuel oil to natural gas will depend primarily upon the size of the unit, the local gas service, the condition of the flue gas exhaust system, and the configuration of the existing burner.

Figure 3. Distribution of Permitted Boilers. Data provided by the New York State Department of Environmental Conservation (NYSDEC).



Fuel conversion example: A recent conversion of a 200 hp (approximately 8 MMBtu/hr firing rate) boiler from No. 6 oil to natural gas cost the owner about $280,000. Since the existing burner was already capable of firing natural gas, a new burner was not required. However, the local natural gas service pressure was insufficient. Consequently, a gas compressor was installed. The cost associated with upgrading the gas service and routing the gas fuel train to the burner was $80,000. The additional costs were primarily associated with lining of the chimney with a metal sleeve to achieve compliance with the current building code.

4.2 Capital Costs Associated with Switching to No. 2 Oil

The capital costs involved with switching boilers from No. 6 fuel oil to No. 2 fuel oil are typically lower than a conversion to natural gas. In this situation, the oil heat exchanger and associated plumbing must be removed and disposed of. The No. 6 oil storage tank can likely be used for storage of No. 2 oil. However, the tank should be inspected and cleaned prior to introducing

[13] Refer to Table 2.

No. 2 oil. For typical smaller-sized facilities, total costs for conversion to No. 2 oil are within the range of $5,000 - $30,000.

Conversions of larger boilers from No. 6 fuel oil to No. 2 fuel oil are not typically done because of the high cost of No. 2 fuel oil relative to No. 6 fuel oil. With the larger boilers, it may not be required to remove the heat exchanger and associated plumbing. Therefore, the costs for converting larger boilers may be higher or lower than the conversion of typical smaller-sized facilities.

4.3 Operating Costs Associated with Switching to No. 2 Oil or Natural Gas

Changes in boiler operating costs are dependent primarily on the boiler's efficiency level and the cost per unit of energy (e.g., $/MMBtu) of the fuel supply. The impact of fuel type on each factor is discussed below.

4.3.1 Boiler Efficiency

Several fuel-related parameters that affect overall boiler efficiency are provided below:

- The fuel composition;
- The level of excess air supplied to the burner;
- The temperature of the flue gas exiting the boiler; and
- Auxiliary heat, steam, and electrical power usage.

Thermal efficiencies, when calculated on a Higher Heating Value (HHV) basis, can vary moderately based on fuel composition. For example, Table 4 provides thermal efficiencies for each of the three fuel types, given similar boiler operating conditions (20% excess air and 400 °F stack temperature):

Table 4: Boiler Efficiency Changes[1]

Fuel	Thermal Efficiency (HHV basis)	Efficiency Change
No. 6	86.9%	Baseline
No. 2	85.6%	-1.3 points
Natural Gas	82.6%	-4.3 points

[1] Data obtained from Hays Charts of stack losses for various fuels reproduced in the Cleaver Brooks Publication "Boiler Efficiency: Facts you should know about fire tube boilers and boiler efficiency"

The relatively high efficiency associated with No. 6 fuel oil results from its relatively low hydrogen concentration. Through the combustion process, hydrogen in the fuel is oxidized to water vapor. The energy associated with vaporizing water is lost when water vapor is discharged through the stack. Consequently, lower hydrogen content yields higher efficiency when performance is analyzed on an HHV basis. In practice, however, there are additional impacts on efficiency:

- For No. 6 oil, parasitic losses may be associated with the use of air or steam for oil atomization, thermal losses from heating of the oil, electrical power for pumping oil, and the use of steam for soot blowing of boiler tubes;
- For No. 2 oil, parasitic losses may be associated with the use of air or steam for oil atomization and electrical power for pumping oil; and
- For natural gas, should the delivered gas pressure be too low, there will be parasitic losses associated with on-site gas compression.

In addition, soot and ash generated from oil combustion can deposit on boiler tubes, thereby reducing heat transfer rates and lowering efficiency. Periodic soot blowing or cleaning can reduce this impact. The impact of these additional losses on efficiency can be determined through an assessment of specific facilities. However, it is likely that the second factor, cost per unit energy of fuel, will dominate any operating cost analysis.

4.3.2 Fuel Cost

Historical data for retail fuel prices for New York State are prepared by the US Department of Energy (DOE), and are provided in Figure 4a for the period between 2000 and 2009. To enable direct comparisons, the prices are expressed in dollars per million Btu (HHV basis) of fuel energy. Historical data *and* near-term forecasts for commercial sector fuel prices are provided in Figure 4b. This information was prepared by the US Department of Energy (DOE) specifically for the Mid-Atlantic States[14].

[14] Note, historical prices for longer periods for the Mid-Atlantic Region are not available from the DOE on a comparable basis. All prices in Table 4a and Table 4b are nominal prices.

Figure 4a: Retail Fuel Prices in New York State (All Sectors)

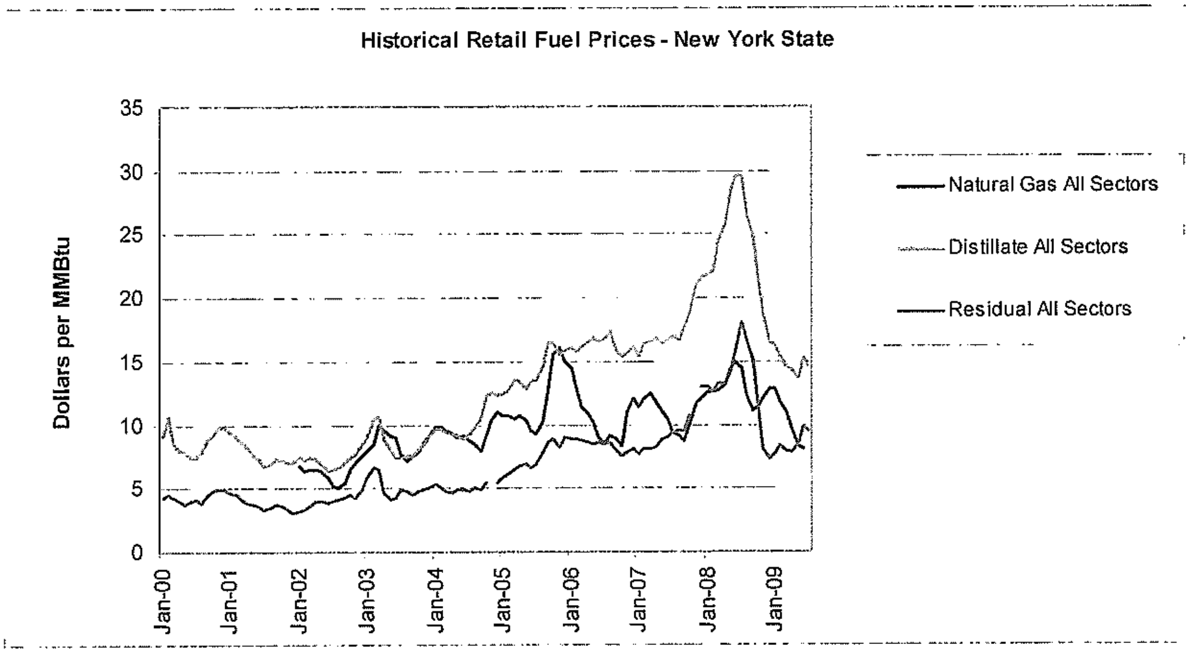
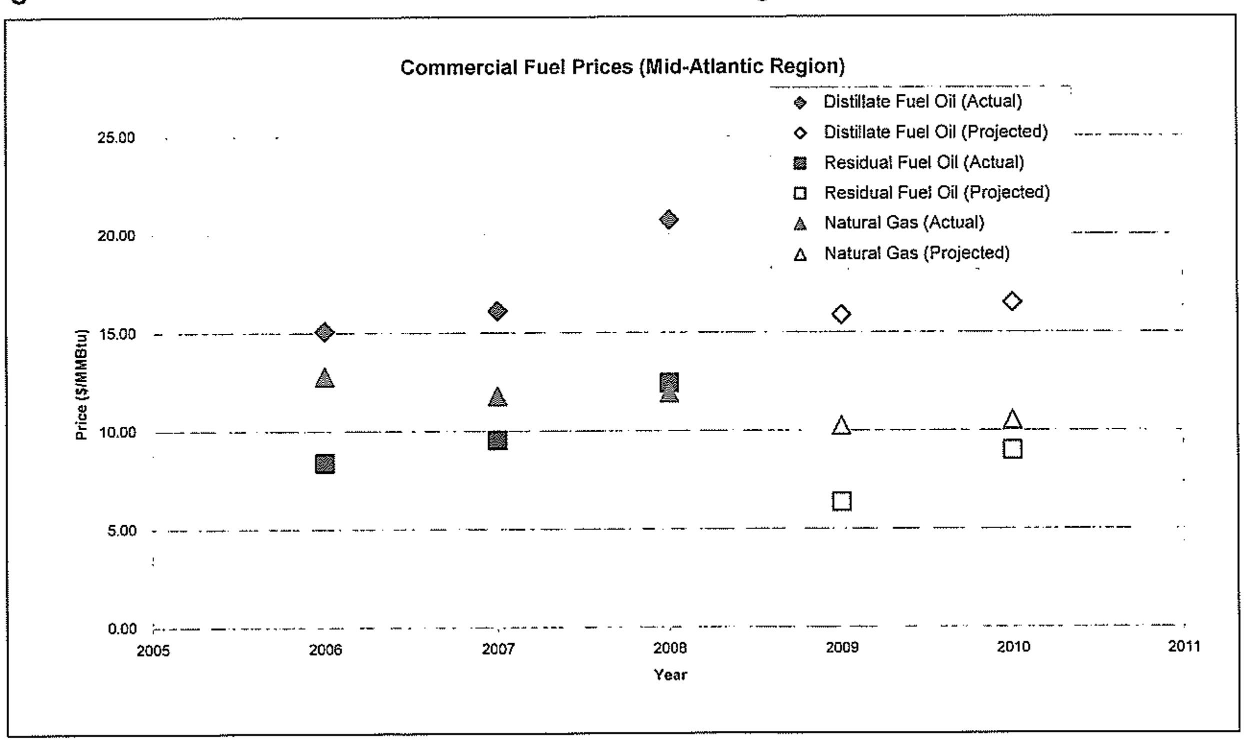
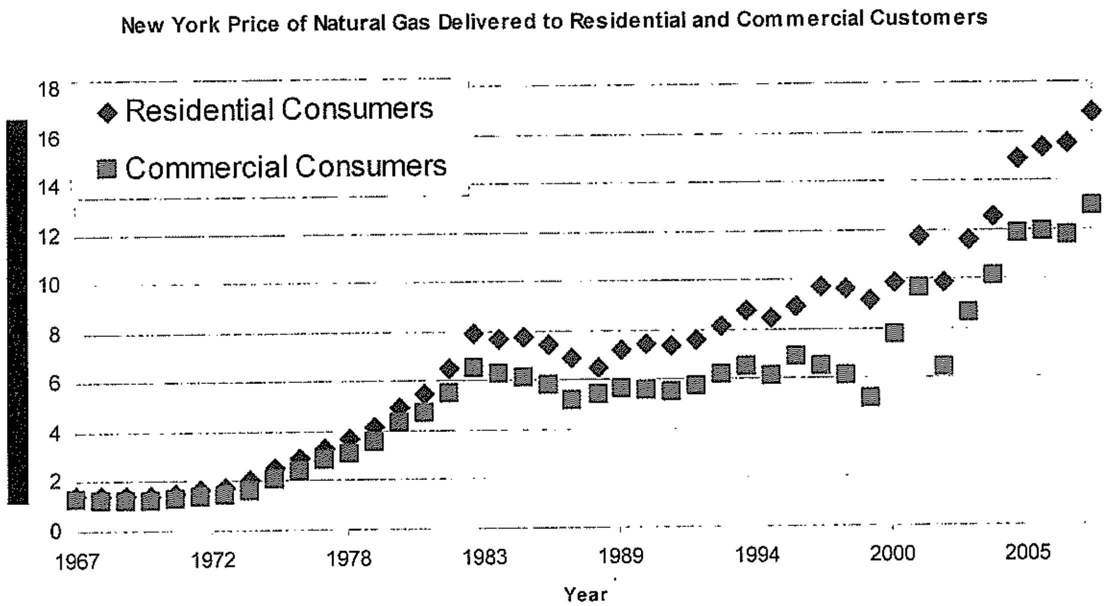


Figure 4b: Commercial Fuel Prices in the Mid-Atlantic Region



Historical natural gas prices in New York State for domestic and commercial customers are shown in Figure 5, below. This information was prepared by DOE. The chart shows a significant increase in the natural gas prices in the past two decades.

Figure 5: New York State Natural Gas Prices



To evaluate potential operating cost impacts, the average fuel prices since 2000 shown in Figure 4a were utilized. These prices are provided in Table 5 below.

Table 5: Historical Average Fuel Prices for New York State (All Sectors)

Fuel	Average Price, \$/MMBtu[1,2]	Price Differential, %
No. 6	6.82	Baseline
No. 2	12.87	+89
Natural Gas	10.05	+47

[1] Average price excludes those periods for which data were not available.
[2] Prices represent nominal prices.

On an energy equivalent basis, over this period the price of No. 2 fuel oil is about 89% higher than that for No. 6 fuel oil, while the price of natural gas is about 47% higher. For a 30 MMBtu/hr boiler operating at an annual load factor of 25% and with similar boiler efficiencies for each fuel, the annual fuel costs would be about $448,000 for No. 6 oil, $846,000 for No. 2 oil, and $660,000 for natural gas. Additional examples are provided in Appendix A for typical public housing apartments in New York City. The following two examples provide an estimate of the potential impacts of increased fuel costs that might result from the required switch from No. 6 and No. 4 fuel oils.

4.3.2.1 Example of Fuel Price and Pass-Through Boiler Conversion Cost Impacts on Apartment Building Economics – New York City Rent-Stabilized Housing

This example applies to rent-stabilized rental housing in New York City. As required by the Rent Stabilization Law, the Rent Guidelines Board (RGB) analyzes the costs of operating and maintaining rent-stabilized housing in New York City. The most recent report completed in 2009 providing 2007 income and operating expense statistics is available on the RGB's website (http://www.housingnyc.com/html/research/cresearch.html). This study provides a summary of the income and expenses of over 13,200 rent-stabilized buildings containing more than 620,700 units throughout the five boroughs. A summary of the study is provided in Table 5 below[15]. Of note in Table 5, the expenses do not include expenditures for capital improvements or debt service (e.g., mortgages or other financing mechanisms). Therefore, the net income for these apartment buildings may be substantially less.

The data in Table 6 shows that fuel costs are a significant portion of the total expenses, comprising up to 20% of these expenses. If we assume a fuel price increase of 89% for a switch from No. 6 to No. 2 fuel oil, fuel costs would be a significantly higher percentage of the total expenses, increasing to up to over 30% in some instances. As an example, on a citywide-average basis for a post-46 100-unit apartment building, if fuel costs increase by 89%, average expenses could increase by nearly $90,000 per year (an average increase of about $73.87 per month per unit x 100 units x 12 months = $88,600 per year). The increase in fuel costs for natural gas would be lower (an average increase of about $39.01 per month per unit x 100 units x 12 months = $46,800). Annual fuel cost increases for larger apartment buildings with a larger number of units will be proportionately larger (e.g., for a post-46 400-unit apartment building, fuel costs could increase by over $350,000 per year. These increases in fuel costs can be passed onto tenants, which could result in an average citywide rent increase from about $75 to $90 per month, with a range from $70 to over $100 per month over the phase-in period of the proposed rule. Pass-through of equipment conversion costs would result in greater rent increases. However, if some or all of these increased costs are absorbed in an apartment building's operating margins, net operating income (to cover capital improvements, taxes, and debt service) will be significantly less, and even negative in some instances.

It should be noted that the median rent burden[16] in New York City is approximately 29.9% in 2007[17], ranging as high as 32% in the Bronx, Brooklyn, and Staten Island. An increase in fuel

[15] "2009 Income and Expense Study," New York City Rent Guidelines Board, April 21, 2009

[16] The percentage of a renter's income that goes towards paying rent on a rental property.

[17] "State of the City's Housing and Neighborhoods, 2008," The Furman Center, New York University.

costs which would be passed onto tenants would increase the rent burden significantly, up to 35% or 36% in these same boroughs. See Table 7 below.

Table 6. Fuel Price Impacts on Apartment Building Economics – New York City Rent-Stabilized Housing (Costs Per Apartment Per Month)

Income and Expense

	Post-46 Buildings									Pre-47 Buildings								
Location	Rent	Income[1]	Expenses[2]	Net Operating Income	Fuel Costs	Fuel Costs % of Costs	Fuel Costs with Higher Fuel Prices[3]	Fuel Costs with Higher Fuel Prices[3] % of Costs	Potential Rent Increase	Rent	Income[1]	Expenses[2]	Net Operating Income	Fuel Costs	Fuel Costs % of Costs	Fuel Costs with Higher Fuel Prices[3]	Fuel Costs with Higher Fuel Prices[3] % of Costs	Potential Rent Increase
Citywide	$1,088	$1,200	$803	$397	$85	11%	$161	18%	$76	$924	$1,039	$710	$329	$102	14%	$193	24%	$91
11-19 Units	$923	$1,041	$709	$332	$93	13%	$176	22%	$83	$944	$1,127	$766	$361	$111	14%	$210	24%	$99
20-99 Units	$894	$952	$652	$300	$86	13%	$163	22%	$77	$868	$957	$666	$291	$103	15%	$195	26%	$92
100+ Units	$1,312	$1,482	$974	$508	$83	9%	$157	15%	$74	$1,343	$1,542	$971	$571	$75	8%	$142	14%	$67
Bronx	$811	$850	$618	$232	$91	15%	$172	25%	$81	$690	$751	$585	$166	$109	19%	$206	30%	$97
11-19 Units	--	--	--	--	--	--	--	--	--	$653	$740	$642	$98	$127	20%	$240	32%	$113
20-99 Units	$793	$825	$596	$229	$91	15%	$172	25%	$81	$690	$750	$580	$170	$109	19%	$206	30%	$97
100+ Units	$857	$908	$659	$249	$90	14%	$170	23%	$80	$748	$800	$588	$212	$89	15%	$168	25%	$79
Brooklyn	$841	$896	$641	$255	$87	14%	$164	23%	$77	$776	$816	$588	$228	$104	18%	$197	29%	$93
11-19 Units	--	--	--	--	--	--	--	--	--	$788	$838	$614	$224	$107	17%	$202	29%	$95
20-99 Units	$830	$875	$632	$243	$90	14%	$170	24%	$80	$764	$799	$576	$223	$104	18%	$197	29%	$93
100+ Units	$870	$944	$666	$278	$81	12%	$153	21%	$72	$860	$915	$620	$295	$95	15%	$180	25%	$85
Manhattan	$1,726	$2,003	$1,244	$759	$86	7%	$163	12%	$77	$1,200	$1,420	$901	$519	$99	11%	$187	19%	$88
11-19 Units	$1,416	$1,890	$1,072	$818	$106	10%	$200	17%	$94	$1,162	$1,498	$944	$554	$112	12%	$212	20%	$100
20-99 Units	$1,219	$1,365	$844	$521	$84	10%	$159	17%	$75	$1,106	$1,276	$822	$454	$101	12%	$191	21%	$90
100+ Units	$1,923	$2,244	$1,397	$847	$85	6%	$161	11%	$76	$1,674	$1,969	$1,201	$768	$64	5%	$121	10%	$57
Queens	$909	$967	$668	$299	$80	12%	$151	20%	$71	$856	$895	$620	$275	$94	15%	$178	25%	$84
11-19 Units	$930	$1,005	$706	$299	$92	13%	$174	22%	$82	$797	$841	$600	$241	$102	17%	$193	28%	$91
20-99 Units	$890	$940	$631	$309	$79	13%	$149	21%	$70	$860	$896	$618	$278	$93	15%	$176	25%	$83
100+ Units	$930	$996	$711	$285	$79	11%	$149	19%	$70	$943	$1,001	$681	$320	$90	13%	$170	22%	$80
Staten Island	$797	$866	$610	$256	$79	13%	$149	22%	$70	--	--	--	--	--	--	--	--	--

[1] The difference between income and rent reflect revenues from commercial space, which is often part of apartment complexes.
[2] Expenses include operating expenses, including fuel costs, but do not include any expenditures for capital improvements, taxes, or debt service (e.g., mortgages or other financing mechanisms).
[3] Higher fuel prices reflect switch from No. 6 to No. 2 fuel oil.

Table 7. Rent Burden as a Percentage of Income by Borough – Data from the Furman Center (NYU)

Income and Expense

	Post-46 Buildings										Pre-47 Buildings									
Location	Rent	Average % of Income	Fuel Costs		Fuel Costs with Higher Fuel Prices[1]		Rent with Higher Fuel Prices	Average % of Income	Potential Rent Increase		Rent	Average % of Income	Fuel Costs		Fuel Costs with Higher Fuel Prices[1]		Rent with Higher Fuel Prices	Average % of Income	Potential Rent Increase	
				% of Costs		% of Costs								% of Costs		% of Costs				
Citywide	$1,088	29.9%	$85	11%	$161	18%	$1,164	32.0%	$76		$924	29.9%	$102	14%	$193	24%	$1,015	32.8%	$91	
Bronx	$811	31.9%	$91	15%	$172	25%	$892	35.1%	$81		$690	31.9%	$109	19%	$206	30%	$787	36.4%	$97	
Brooklyn	$841	31.6%	$87	14%	$164	23%	$918	34.5%	$77		$776	31.6%	$104	18%	$197	29%	$869	35.4%	$93	
Manhattan	$1,726	26.4%	$86	7%	$163	12%	$1,803	27.6%	$77		$1,200	26.4%	$99	11%	$187	19%	$1,288	28.3%	$88	
Queens	$909	31.1%	$80	12%	$151	20%	$980	33.5%	$71		$856	31.1%	$94	15%	$178	25%	$940	34.1%	$84	
Staten Island	$797	32.1%	$79	13%	$149	22%	$867	34.9%	$70		–	–	–	–	–	–	–		–	

[1] Higher fuel prices reflect switch from No. 6 to No. 2 fuel oil.

4.4 Fuel Switching Cost Implications

Thus, the relatively easy and lower cost fuel conversion (No. 6 oil to No. 2 oil) results in a dramatic increase in operating costs. The more expensive fuel conversion (No. 6 to natural gas) yields a moderate increase in operating costs.

A relatively modest conversion cost from switching from No. 6 fuel oil to No. 2 fuel oil could result in an average of nearly $90,000 per year in additional expenses for a 100-unit apartment building (over $350,000 per year for a 400-unit apartment building), equivalent to an increase of about $74 per month per unit. The more capital intensive conversion from No. 6 fuel oil to natural gas will result in a smaller increase in costs of about $47,000 per year for a 100-unit apartment building (about $187,000 per year for a 400-unit apartment building), equivalent to an increase of about $39 per month per unit. If these costs are passed on to tenants, the rent burden for the tenants could increase significantly, over the phase-in period of the proposed rule. This impact can be reduced for certain facilities if oil-firing capability is maintained as a backup fuel and interruptible natural gas pricing is obtained.

4.5 Timing of Conversions/Age of Equipment

The rule will prohibit the use of No. 4 and No. 6 fuel oil in newly installed boilers and phase out the use of No. 4 and No. 6 fuel in existing boilers. The dates for the phase out range from 2012 and 2027, and are based on the expiration date of a boiler's current Certificate of Operation. Typically a Certificate of Operation would simply be renewed, without a requirement for an equipment change. While these phase out dates may be a convenient time to convert boilers from burning No. 4 and No. 6 fuel oils, the costs for conversion are not mitigated.

When a residual oil burner reaches the end of its useful life and requires replacement, the capital costs incurred are associated with installation of a new residual oil burner only. Similarly, if an existing residual fuel-fired boiler requires replacement, baseline costs would be for the installation of a new boiler firing residual oil, which would not necessarily require replacement of ancillary oil-burning and related equipment.

However, under the proposed phase out of residual fuel oil, additional capital costs will be incurred that do not reflect the end of useful life of the equipment. In the case of residual fuel oil conversion to natural gas, additional incurred costs could include: chimney refurbishment; removal of the oil tank(s); oil plumbing; oil heating equipment; new natural gas plumbing; and if required, natural gas infrastructure improvements (new or bigger supply line, additional pressure boosting). For conversion to No. 2 oil, additional costs could include the removal of the oil heating equipment, cleaning of the oil tank, and removal of the other ancillary equipment. All of these costs have been covered elsewhere in this report.

The assumption that newer burners (e.g., less than 20 years old) can be adjusted to burn all fuels may not be accurate. While dual-fuel burners may have been in existence for 20 years, not all burners installed in boilers may be dual-fuel burners. Therefore, even conversion of some of the newer boilers could incur conversion costs.

In its draft presentation, the City implies that certain combustion efficiency and emission control measures (for increased boiler efficiency and reduced emissions) are difficult to install and operate on residual fuel oil-fired boilers. However, these measures are not restricted to natural gas and No. 2 fuel oil-fired boilers. For instance, low NO_x burners, closed loop controls and economizers are not technologies exclusive to natural gas or distillate fuel fired boilers. For example, low NO_x burners can be purchased from Todd/Coen for use on heavier fuels. Also, economizers with residual oil fired boilers need to be operated at higher exhaust gas temperatures[18], but can still be employed.

[18] Temperatures should be operated to avoid condensation of water, to reduce the potential for corrosion.

5 Fuel Infrastructure Issues

Conversion of combustion equipment in New York City from residual oil to natural gas or No. 2 oil will strain local area supplies and prices at times when gas is actually used to replace residual fuel oil. Current natural gas demand in the City exceeds the natural gas pipeline capacity into the City by up to 1.2 billion cubic feet during the hottest and coldest days of the year. Natural gas providers use interruptible gas-service contracts with customers to manage the shortfall on these peak days. The over 5,000 "temperature controlled" gas-service customers in the New York City metropolitan are automatically disconnected from gas service and required to switch to their alternate fuel, if the temperature drops below 15°F on any given day[19].

The gas load in the New York City metropolitan area is growing at a rate of about 1% per year, which means that utilities serving New York City will need to secure additional capacity to meet firm customer load. The phase-out of residual fuel oil in the City would place a greater strain on the existing natural gas infrastructure. The City's ban on the construction, reconstruction, or enlargement of LNG facilities within the City, limitations imposed on trucking LNG within the City, and local opposition to construction of LNG storage and terminals hamper utilities' efforts to secure additional capacity to meet this growing customer load.

Given the current inability of the natural gas infrastructure to meet the City's peak demand levels, it is important that a functioning fuel oil infrastructure be in place to provide fuel to interruptible natural gas customers on restriction days. This requires a financially viable fuel oil industry. If a company is required to maintain bulk storage facilities, a fleet of trucks, and employees solely for delivering fuel oil ten or twenty days during the winter, a significant financial burden would be imposed. Adoption of the proposed rule could expose energy consumers to more severe price spikes, and could weaken the fuel oil "safety net."

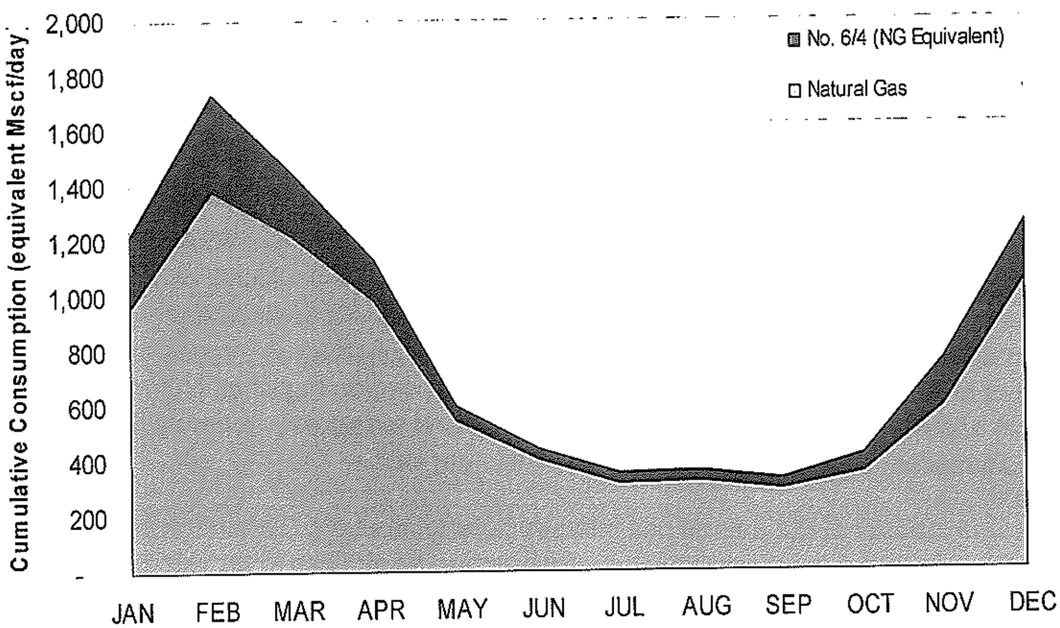
5.1 Fuel Oil as "Peak Shaving" for Natural Gas Supplies

Typical monthly consumption data for natural gas and residual oil, provided in Figure 6, illustrate this challenge. Both natural gas and residual fuels experience significant consumption peaks in the winter months due to increased heating demand. Consequently, residual oil currently serves an important "peak shaving" role[20] for natural gas supplies during the critical winter months. In February, for example, the typical daily consumption of natural gas and residual oil is 1,380 Mscf and 350 Mscf (equivalent), respectively. Without the availability of residual oil, natural gas flow into the City would have to increase by about 20-27% during the months of December through February. This increased demand would raise the frequency of gas curtailments during peak consumption days due to limitations on current gas supply infrastructure, and would risk supply disruptions during these periods of high demand, unless local gas distributors and pipelines expand to meet the added demand.

[19] New York State, Gas Policy Section, Office of Electric, Gas & Water, personal correspondence on October 7, 2009.

[20] In this context, "peak shaving" refers to the use of No. 6/4 fuel oils as a supplement to natural gas use during periods of peak demand in the commercial/residential sectors.

Figure 6. Monthly Consumption of Residual Fuel and Natural Gas in New York City. Data from the Mayor's Office of Long-Term Planning and Sustainability.



In certain industrial and electrical generation facilities, No. 6 fuel oil can be used as back-up for interruptible fuel supplies[21]. With No. 6 oil unavailable, the only available back-up fuel for interruptible facilities, such as industrial and electric generation facilities, would be No. 2 oil. However, this is not an attractive alternative due to the comparatively high price of No. 2 oil, as illustrated in Table 5. Also, consumption of No. 2 oil peaks in the winter due to residential heating demand. Increased use of this fuel in the commercial sector and apartment buildings would likely lead to higher costs for all customers.

5.2 Natural Gas Infrastructure Capacity Limitations

As reported in the 2007 PlaNYC report, natural gas demand in the City exceeds the natural gas pipeline capacity into the City by up to 1.2 billion cubic feet during the hottest and coldest days of the year. Although the City has adopted an initiative to expand the natural gas infrastructure in the City, it is unclear how quickly these projects can be completed, and whether these efforts will thus adequately meet future demands.

[21] No. 6 fuel is not used as a back-up for boilers below a certain firing rate, such as boilers typically used in single family homes.

The New York State Energy Planning Board, in its 2009 DRAFT Energy Plan[22] also provides projections of New York State demand and supply for natural gas. In its recent draft report, the Board reports that "[m]ost of the growth in natural gas demand over the planning period is projected to be in the capacity constrained downstate region. Some additional pipeline capacity would be needed to transport incremental gas supplies to meet this projected demand." The modeling results show that most of the interstate pipelines serving New York are now operating at or near full capacity on a peak day[23].

Table 8. Peak Day Pipeline Utilization. Information from the New York 2009 DRAFT State Energy Plan

	Reference Case	
	2009 Peak Day	2018 Peak Day
Millennium	90%	98%
Algonquin	100%	100%
Tennessee to Downstate	86%	100%
Iroquois to Downstate	99%	56%[24]
Texas Eastern	100%	100%
Transcontinental to Downstate	100%	100%

According to DOE, New York receives more than 85% of its natural gas requirements from interstate pipelines that extend from the Gulf of Mexico to Canada, some of which operate on an average load factor of more than 90%[25]. This is consistent with the estimate of the City that on days of peak demand, the demand already exceeds capacity of the pipelines into the City by up to 1.2 billion cubic feet.

According to the New York State, there are currently over 5,000 interruptible customers in the New York City metropolitan area. When the temperature drops below 15°F on any given day, there is not enough gas to serve everyone's needs at the present time, so a class of interruptible customer called "temperature controlled" is automatically disconnected from gas service. At this point, most of these customers switch to their alternate fuel[26]. The gas load in the New York City metropolitan area is currently growing at a rate of about 1% per year, which means that utilities serving New York City are in a position of having to secure additional capacity to meet firm customer load[27].

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[22] "2009 State Energy Plan DRAFT," New York State Energy Board, August 2009.

[23] Ibid.

[24] According to the report, the peak day modeling results reflect flow on the Iroquois pipeline into Long Island at levels below available pipeline capacity. These results are a function of a projected reduction in supply from Canada flowing into the Iroquois delivery point at the Canadian border and a projected shift [reduction] in gas demand for power generation.

[25] A 90% load factor means that the actual flows use 90% of the design capacity of a pipeline.

[26] New York State, Gas Policy Section, Office of Electric, Gas & Water, personal correspondence on October 7, 2009.

[27] Ibid.

5.2.1 Peak Shaving Using Stored Natural Gas or LNG

When a deficiency in natural gas pipeline occurs, local distribution companies can attempt to meet the gap in supply by using stored natural gas supplies (i.e. LNG). During off-peak periods, the local distribution companies liquefy and store excess natural gas in storage vessels within the service area. Then during peak periods, the LNG can be vaporized and used within the system. The storage capacity for New York State is 3.2 billion cubic feet on natural gas[28]. There are three facilities in or near the City – National Grid's Holtsville (Suffolk County) Site on Long Island, National Grid's Brooklyn Site, and Consolidated Edison's Queens Site – all of which have been in service since the late 1960s and early 1970s. On peak heating days, these three facilities supply about 15% to 20% of their respective companies' total peak day gas supply; and provide one percent of total natural gas supply over the winter heating season. The annual average utilization for these facilities is limited by the inability to rapidly refill the LNG tanks with system gas (due to ongoing normal natural gas demands) and the limitations on trucking LNG within the City[29]. These limitations, as well as the ban on construction, reconstruction, or enlargement of LNG facilities within the City[30], will make it difficult to cover the demand shortage during peak periods. According to the National Petroleum Outlook, increased imports of LNG will be required as the gap between demand and supply from domestic sources widens.[31]

Furthermore, the natural gas supplies (including LNG) are vulnerable to a wide range of risks that can cause disruptions in supply. Natural disasters are one such concern. Hurricanes Katrina and Rita (2005) not only caused significant destruction and production outages at gas rigs in the Gulf of Mexico, but also damaged the pipeline infrastructure that was used to supply the natural gas to the interstate pipelines. In addition, while the National Commission on Energy Policy notes[32] that "[e]xpanded [LNG] import capacity is clearly critical", local opposition to construction is expected, including opposition fed by public concerns (whether or not supported by technical evidence) over the vulnerability of natural gas facilities to fires, explosions, leaks, and terrorist attacks.

5.2.2 Summary of Pipeline Projects in the New York City Vicinity

There are several natural gas pipeline infrastructure projects have recently been completed in the region. These are summarized in Table 9.

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[28] "Northeast Natural Gas Market: Overview and Focal Points," Federal Energy Regulatory Commission, August 2009.

[29] "The Role of LNG in Supplying the New York Area's Future Demand for Natural Gas," Long Island University, April 29, 2004.

[30] See New York Environmental Conservation Law Section 23-1719, Non-Conforming Facilities; Conformance to Safety Criteria; Moratorium.

[31] "Annual Energy Outlook 2009", Energy Information Administration, United States Department of Energy, March 2009.

[32] "Ending the Energy Stalemate, A Bipartisan Strategy to Meet America's Energy Challenges," National Commission on Energy Policy, December 2004.

Table 9. Recently Completed Major Pipeline Expansions. Information from the New York 2009 DRAFT State Energy Plan			
Project	Pipeline Company	Description	Year In Service
Millennium Pipeline (Northeast 07 Project)	Millennium	New Pipeline from Corning, NY to Ramapo, NY, 525 MMcfd of new capacity	2008
Ramapo Expansion (Northeast 07 Project)	Spectra/Algonquin	Upgrade of Algonquin's facilities to interconnect with Millennium at Ramapo, NY to expand Algonquin's capacity by 325 MMcfd	2008
Market Access Expansion (Northeast 07 Project)	Iroquois	Upgrade of Iroquois' facilities to receive additional volumes through Algonquin and expand capacity by 100 MMcfd for delivery to Hunts Point, NY	2008

The newly constructed Millennium Pipeline, which originates in the Corning area where it interconnects with the new Empire Connector pipeline and terminates at an interconnection with the Algonquin pipeline in the Ramapo, New York area, adds a total of 525 million cubic feet per day (MMcfd), or approximately 525,000 decatherms per day (dt/day) of incremental capacity. However, because of the capacity limitations at the Ramapo delivery point, only a little over 300,000 dt/day can be delivered into the City[33],[34]. Existing customers currently hold the entire 300,000 dt/day capacity[35].

There are several natural gas pipeline infrastructure projects planned for the region. These are summarized in Table 10. They still require numerous regulatory approvals and business arrangements. Other natural gas pipeline infrastructure and LNG projects have been canceled, including the Broadwater and Islander East Pipeline projects.

Table 10. Planned Major Pipeline Expansions. Information from the New York 2009 DRAFT State Energy Plan			
Project	Pipeline Company	Description	Year In Service
Rockaway Delivery Lateral	Williams/Transco	Pipeline from Transco's offshore system in the Lower NY Bay to interconnect with National Grid on the Rockaway Peninsula. Capacity of 647 MMcfd.	FERC Pre-Filing 2012
Lower Manhattan Lateral	Williams/Transco	Pipeline from Transco's system in northern NJ to an interconnect with Con Edison in lower Manhattan	Proposal under development 2012 – 2013

[33] "2009 State Energy Plan DRAFT," New York State Energy Board, August 2009.

[34] New York State, Gas Policy Section, Office of Electric, Gas & Water, personal correspondence on October 7, 2009.

[35] Ibid.

Table 10. Planned Major Pipeline Expansions. Information from the New York 2009 DRAFT State Energy Plan			
NJ – NY Extension	Spectra/Texas Eastern	Pipeline from Texas Eastern's facilities near the existing NY delivery station at Goethals into NJ and crossing the Hudson River to interconnect with Con Edison in lower Manhattan	Proposal under development 2012 - 2013

5.2.3 Timing for Adding Natural Gas Infrastructure

To mitigate the natural gas infrastructure limitations to accommodate anticipated future natural gas demands, additional natural gas infrastructure (including additional stored natural gas or LNG capacity) would have to be added near and within the City as the limitations are with the pipelines to the City. The phase out of No. 6 and No. 4 fuel oils would only add to the natural gas demand and exacerbate the inability of the natural gas infrastructure to meet the City's peak demand levels, particularly for standby customers who are without natural gas during peak demand periods.

Adding storage or transport capacity to New York City's natural gas infrastructure would take many years due to the time needed to receive regulatory approvals (including the need to address environmental group and citizen concerns) as well as construction and testing. For example, the Millennium Pipeline project's application was first filed with FERC in December 1997. As a result of significant delays due to major routing and environmental concerns, Millennium did not receive FERC approval until December 2001/September 2002. Following these approvals, the applicant had to file an amended application with FERC to address inconsistencies with the Coastal Zone Management Act. Following filing of the amended application in August 2005, final FERC approval was received in December 2006 and subsequently received authorization to begin construction in June 2007. Millennium was finally put into service in December 2008, eleven years after the first FERC application was filed[36].

A second example is the canceled Broadwater LNG project proposed to be located offshore of Long Island. Broadwater made an initial FERC filing in January 2006, and received FERC approval more than two years later. It did not, however, receive the necessary Coastal Zone Management Act approval from New York State because of inconsistencies with the State coastal policy. The U.S. Department of Commerce denied an appeal by Broadwater and upheld the State's denial of approval[37].

Because of the extended timeframe for approval of any new gas pipeline infrastructure project in the New York City metropolitan area, consumers are increasingly vulnerable to disruptions along pipelines, outages at gas production and processing plants currently supplying gas to the City.

These vulnerabilities as well as spikes in demand due to unexpected temperature swings can

[36] "2009 State Energy Plan DRAFT," New York State Energy Board, August 2009.

[37] Ibid.

cause dramatic increases in natural gas prices. As the 2007 PlaNYC report notes, "During a cold snap in February 2003, natural gas prices went from $7.50 to $28/MMBtu in one day and momentarily reached $40/MMBtu."

LNG imports are expected to grow to become 14-17% of the national natural gas supply by 2025, although more recent projections have been declining due to the expected increase in shale gas production as well as competition from Japan and Europe. This will require the construction of seven to nine new re-gasification terminals and expansions of three of the four existing LNG terminals in North America. In addition to the significant time required for regulatory approvals and construction of the plant and pipelines to introduce the imported supplies into the interstate pipelines, additional time and effort would be needed to overcome environmental group and citizen concerns with construction of such LNG facilities within the City (as noted previously, construction, reconstruction, or enlargement of LNG facilities is currently banned within the City). Notwithstanding the fact that the proposed rule would phase out No. 6 and No. 4 fuel oils over time, the immediate shortages would not be addressed by existing capacity or the planned expansions.

It should also be noted that when natural gas infrastructure improvements are undertaken, they can result in substantial community disruption. Streets may need to be torn up for extended periods, resulting in noise, dust, and traffic and pedestrian interference. Property may also need to be acquired through eminent domain. Any analysis of the completed facilities must also take into account the energy consumption of natural gas compressors, and the potential for leakage of natural gas, whose principal component, methane, is a greenhouse gas.

6 Conclusions

Residual fuel oil is an integral, safe, and cost effective component of New York City's energy infrastructure. The phase out of residual fuel oils in New York City could have other potentially negative environmental, cost, energy supply, and fuel infrastructure implications that need to be weighed against the incremental air quality impact from the phase out. Maintaining residual oils in New York City's fuel mix will increase fuel diversity, will reduce fuel supply disruption risks, and can help to control energy costs. As opposed to a phase-out of residual fuel oils in commercial, apartment building, and residential boilers, promoting improved energy conservation and heating equipment efficiency could result in some of the same intended environmental benefits, without the economic implications of the proposed rule. In addition, many of the air quality impacts associated with residual fuel oil combustion can be reduced through improved equipment tuning and maintenance practices as well as the development and deployment of new oil burner technologies. For existing residual oil fired boilers, boiler efficiency could be improved through boiler tuning or retrofitting of new burners. This can reduce carbonaceous particulate matter, CO, NO_x, and hydrocarbon emissions for a given heat duty. With regard to emissions of the other criteria pollutants such as CO and PM, the reduction depends on the initial levels which are equipment and operations dependent. The changes can also reduce fuel consumption and thereby slightly lower the emissions of SO_x and ash. Additional emission reductions from fuel oil burning would also occur if seasonal limitations targeting the sulfur content of heating fuels are implemented in the future.

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Appendix A

Annual Fuel Costs for Typical Public Housing Apartments (NYC)

Higher Heating Values (Btu/gal, Btu/scf)				Retail Fuel Costs ($/MMBtu) from DOE EIA for New York State (All Sectors)[2]			
No. 6	No. 4	No. 2	NG	No. 6	No. 4	No. 2	NG
147,000	144,000	140,000	1,028	$ 6.82	$ 8.03	$ 12.87	$ 10.05

Customer #	Description	Annual Fuel Consumption (gal, 1000scf)				Annual Fuel Cost[1] ($)				Annual Cost Difference[1] ($) Relative to Baseline Fuel			
		No. 6	No. 4	No. 2	NG	No. 6	No. 4	No. 2	NG	No. 6	No. 4	No. 2	NG
1	Public Housing, No. 6 Oil	539,790	551,036	566,780	77,188	$ 541,161	$ 637,174	$ 1,021,223	$ 797,459	$ -	$ 96,012	$ 480,062	$ 256,298
2	Manhattan Apt. Bldg. (76 Apts.), No. 4 Oil	47,032	48,012	49,384	6,725	$ 47,152	$ 55,517	$ 88,980	$ 69,483	$ (8,366)	$ -	$ 33,462	$ 13,966
3	Manhattan Apt. Bldg. (58 Apts.), No. 4 Oil	55,944	57,110	58,742	8,000	$ 56,087	$ 66,037	$ 105,841	$ 82,650	$ (9,951)	$ -	$ 39,803	$ 16,612
4	Manhattan (92 Apts.), No. 6 Oil	98,916	100,977	103,862	14,145	$ 99,167	$ 116,761	$ 187,138	$ 146,134	$ -	$ 17,594	$ 87,971	$ 46,966
5	Manhattan (400 Apts.), No. 6 Oil	170,425	173,976	178,946	24,370	$ 170,858	$ 201,171	$ 322,425	$ 251,777	$ -	$ 30,313	$ 151,567	$ 80,919
6	Manhattan Apt. Bldg., No. 6 Oil	50,537	51,590	53,064	7,227	$ 50,665	$ 59,654	$ 95,610	$ 74,661	$ -	$ 8,989	$ 44,945	$ 23,995
7	Queens Apartments (126 Apts.), No. 6 Oil	77,848	79,470	81,740	11,132	$ 78,046	$ 91,893	$ 147,280	$ 115,009	$ -	$ 13,847	$ 69,234	$ 36,963
8	Manhattan Apts. (296 Apts.), No. 6 Oil	169,891	173,430	178,386	24,294	$ 170,323	$ 200,541	$ 321,415	$ 250,988	$ -	$ 30,219	$ 151,093	$ 80,666

[1] Assumes equal boiler efficiency

[2] Based on available data from DOE EIA from 2000 for New York State (all sectors)

Testimony before the Committee on Environmental Protection of the New York City Council Regarding Int. 194
By Michael N. Romita, Executive Vice President
Castle Oil Corporation
May 28, 2010

My name is Michael N. Romita. I am the Executive Vice President of Castle Oil Corporation, an independent fuel oil distributor in New York City. Castle was founded in 1928 by my grandfather and it remains 100 percent family owned and operated. From our operations in the Bronx, Castle supplies all grades of fuel oil to thousands of buildings and institutions in every borough of New York City. We employ union workers throughout our terminal, service, and delivery operations. On behalf of Castle, and in the interests of our customers and our employees, I appreciate the opportunity to comment on the proposed legislation.

I. Overview

Together with the real estate community and organized labor, Castle has been actively engaged in discussions with the Mayor's Office of Long Term Planning and Sustainability and the Department of Environmental Protection concerning the proposed phase out of certain types of residual fuel oils (No. 4 and No. 6 fuel oils). This is a highly complex issue that involves a major change in the quantity and type of energy used in New York City. The issue encompasses a wide variety of important considerations including energy supply and availability, energy infrastructure, air quality, energy prices and price risks, affordable housing, and union jobs. It will have a great impact on consumers, businesses, and workers in the City.

II. Proposed Amendment

Under proposed City Council legislation addressing fuel oils used for residential and commercial heating, distributors of No. 4 fuel oil (a fuel used in apartment houses, schools and small business establishments), would be required to sell a fuel oil with a substantially lower sulfur content than is currently used today. The Department of Environmental Protection would be granted the discretion to establish a new, lower sulfur content between 0.10 (1,000 ppm) and 0.20 (2,000 ppm) percent.

440 Mamaroneck Avenue • Harrison, NY 10528-2424 • (914) 381-6500 • FAX (914) 381-6501
www.castle.us

Castle supports efforts to codify a lower sulfur standard for No.4 fuel oil in the broader context of other changes that it has discussed with the Bloomberg administration. However, in its present form, the draft legislation under consideration by the City Council does not fully consider the practicalities of the local fuel oil market and will cause significant harm to the City's homeowners and other consumers. It will result in higher energy prices and the risk of substantial, unanticipated price spikes.

These adverse consequences can be avoided, to a significant degree, as long as the new, lower sulfur standard for No. 4 fuel oil:

(1) is not set below 0.2 percent by weight (2,000 ppm); and

(2) does not become effective before 2015 when the market for lower sulfur blending components (ultra low sulfur diesel fuel (ULSD) or a lower sulfur home heating oil) that are used to produce No. 4 fuel oil has more fully matured.

III. Background

No. 4 fuel oil is a blend of No. 6 fuel oil and No. 2 heating oil in ratios designed to meet specific physical properties which make the fuel suitable for use in certain kinds of heating equipment. The current sulfur standard for both No. 4 and No. 6 fuel oil is 0.3 percent (3,000 ppm). The current sulfur standard for No. 2 heating oil is 0.2 percent (2,000 ppm).

To reduce the sulfur standard of No. 4 fuel oil currently, producers will have to blend No. 6 fuel oil with ultra low sulfur diesel (ULSD), a transportation fuel with a sulfur content of 0.0015 percent (15 ppm), or a lower sulfur No. 2 heating oil. Both are more expensive than the No. 2 heating oil used today to produce No. 4 fuel oil.

More importantly, reducing the sulfur content of No.4 fuel oil below 0.2 percent (2,000 ppm) (the current standard for No. 2 heating oil) will require the use of a much higher percentage of the more expensive blending component than is currently required. For example, today, a producer of No. 4 oil may use approximately 35 percent No. 2 heating oil in its blend. To meet a substantially lower sulfur standard -- below 2,000 ppm -- a producer will likely use about 65 percent of the lower and more expensive heating oil component. Thus, the cost of No. 4 fuel oil will be increased.

Historical data illustrates that the 0.1 percent sulfur standard at the low end of the proposed range would have cost consumers using No. 4 fuel oil about $0.20 more per gallon over the past three years – the only period for which ULSD pricing data is available. During certain periods, the price premium on this hypothetical fuel blend would have approached $0.60 per gallon. If forced to switch fuels, consumers of No. 6 fuel oil would have had to pay almost $0.40 and up to $1.00 more per gallon during this

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same period. These increases would fall hardest on the City's low-income and rent stabilized housing sectors and raise rents for tenants in these types of buildings by $76 to $91 per month. <u>These risks remain if the sulfur standard for No. 4 fuel oil is set below 0.2 percent even after 2015</u>.

The proposed timeframe of October 2015 for a 0.2 percent sulfur standard would provide the refining industry with sufficient lead-time to make lower sulfur heating oil readily available to markets throughout the Mid-Atlantic States and readily available for No. 4 fuel oil blending at more stable prices. The petroleum refining sector has publicly announced that it can begin producing low sulfur No. 2 heating oil (in the 0.05 percent or 500 ppm range) for the Mid-Atlantic States by 2015 and it has openly advocated this position on pending low sulfur heating oil legislation currently under consideration by the New York State Legislature. This timeframe also would place the City in a position consistent with various legislative efforts in surrounding states as well as coordinated regional government initiatives focused on responsibly phasing-in low sulfur No. 2 heating oil. These initiatives include the Mid-Atlantic / Northeast Visibility Union (MANE-VU) and the Northeast States for Coordinated Air Use Management (NESCAUM).

IV. Additional Verification of Availability and Reasonable Prices

As proposed by members of the real estate community, Castle further supports the introduction of a mechanism to determine whether an adequate supply of low sulfur heating oil exists at competitive prices and in quantities necessary to produce the expected demand of No. 4 fuel oil as the low sulfur deadline approaches.

V. Conclusion

Castle's position is allied with the City's major real estate organizations and organized labor. Collectively, we believe it is possible to reach a consensus with the City that moves consumers towards cleaner burning fuel oil in a responsible and practical fashion. However, if the sulfur standard for No. 4 fuel oil is set below 0.2 percent (2,000 ppm) at any point, and if the current sulfur standard is lowered prior to 2015, the City's actions will unnecessarily expose these consumers to much higher fuel prices and greater price volatility.

Thank you again for the opportunity to comment on the proposed legislation.

The following submissions are provided in support of my testimony:

The Economic Costs and Financial Risks of Reducing the Sulfur Content of No. 4 Fuel Oil in New York City (Preliminary Conclusions) (Energy Policy Research Foundation, Inc., May 2010).

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Potential Impacts of Proposed Amendments to Title 15, Chapter 2, Rules of the City of New York Pertaining to the Prohibition of the Use of No. 4 and No. 6 Fuel Oil (Environ International Corporation, December 2009).

Costs and Supply Risks to Prohibitions on the Use of No.4 and No.6 oil in New York City (Energy Policy Research Foundation, Inc., 2009).

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TENANTS & NEIGHBORS

THE STATEWIDE CENTER OF POWER FOR TENANTS

New York City Council Hearing on Intro No 194
May 28, 2010

Testimony of New York State Tenants & Neighbors Coalition

Thank you for the opportunity to comment on the proposed legislation. The New York State Tenants & Neighbors Coalition is a grassroots membership organization working to defend and expand tenants' rights and to preserve at-risk affordable housing.

We commend the New York City Council for this initiative, which we believe would reduce the impact that the city's buildings have on the natural environment and help to make our homes and communities healthier. However, we are concerned about the possibility that in rent stabilized buildings the increased costs of fuel oil could be passed off to tenants. One of the main factors that is taken into consideration when the Rent Guidelines Board makes its determination about what the rent increases should be for the city's approximately 1.1 million rent stabilized apartments is the cost of heating oil, as reported in the Price Index of Operating Costs. The fuel cost is a significant factor in determining the Price Index of Operating Costs: This year, the fuel component comprised roughly 13% of the price index; in 2009 it was 15%.

Under Intro 194, fuel costs could be up to 20% higher than they are currently, which could lead to the Rent Guidelines Board approving rent increases that would be unaffordable to many rent stabilized tenants, whose average household income is only about $35,000 per year, and approximately forty percent of whom have incomes within 200 percent of the federal poverty level. Additionally, these likely rent increases will also bring more of the city's rent regulated units that much closer to the $2,000 threshold at which they can be decontrolled and taken out of the affordable housing stock.

One potential solution might be to lower the price level at which the director can issue a waiver from the biodiesel requirements. We hope to discuss this possibility with members of this Committee and also strategize about other options for ensuring costs are not passed off to tenants.

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READ INTO RECORD

Comments on Intro. 194
John Banks, vice president, Government Relations
Con Edison Company of New York, Inc.

Good morning Chairman Gennaro and members of the Environmental Protection Committee. I appreciate the opportunity to comment on Intro. 194, which would require that all heating oil contain a percentage of biodiesel.

Con Edison is a supporter of the use of biodiesel – in fact, all 1,700 of our fleet trucks have been converted to use B-20 biodiesel fuel, 20 percent of which is derived from soybeans. This fuel mix offsets nearly 400,000 gallons of petroleum annually, and our newest vehicles contain special exhaust filters for additional emission reductions. Cleaner fuel means cleaner air for all of us.

However, we are concerned that the language currently contained in Intro.194 is vague when it comes to defining what is meant by a "building" or "heating system." Con Edison uses primarily natural gas for generation of electricity/steam, however, we do have oil back-up systems at our generating facilities in the event of a system interruption or for other operational needs. I have been advised that technically, our generating facilities would fall under the definition of a "building."

In addition, the company uses #2 and low-sulfur #6 at some facilities and we are concerned that the generators may be unable to handle a change in the fuel mixture. These generators are expensive and are monitored closely. Due to their size, nature, and cost, it is not feasible for us to experiment with fuel blends.

We respectfully request that the language is either clarified to exclude buildings that contain generators for the purpose of generating or distributing electricity/steam, or that an exemption is added for ALL generators, not just emergency ones as currently written.

Most of the soybeans grown in the US come from the Midwest and the Mississippi Corridor where the average farm operation is hundreds of acres. These are industrialized monoculture mega farms that devour and destroy enormous quantities of non-renewable and irreplaceable resources.

Powering the machines that plow, plant, harvest, cast fertilizers, spray pesticides, pump irrigation water, etc. is energy intensive. The fossil fuels consumed by on-farm operations release significant quantities of greenhouse gases and toxic air emissions.

Adding to soybean agriculture's formidable fossil fuel tally, large amounts of natural gas are needed to produce the nitrogen based fertilizers that promote their growth. These fertilizers break down in fields releasing nitrous oxides, a global warming agent hundreds of times more potent than CO_2. When these fertilizers leach from farm fields they poison drinking water and ravage marine ecosystems. Run-off from Midwestern farm fields ends up in the Gulf of Mexico where it contributes to a New Jersey-size "dead zone" almost entirely absent of marine life.

Making matters worse, 91 percent of the US soybean acreage planted in 2007 was genetically engineered to tolerate herbicides, a development that has boosted glyphosate applications several fold. Glyphosate, a powerful weed killer, is the third most common cause of pesticide illness in farm workers; exposure has been linked to rare cancers, miscarriages, and premature births.

Of the 70 million acres of soybeans grown in the US, less than 0.2 % is certified organic by the USDA. That means that at least 99% of the vegetable oil used to produce biodiesel is coming from conventional agro-industrial farms that are anything but environmentally friendly. This fact raises the fundamental question, **"How can biodiesel be environmentally friendly when it is primarily produced from crops that were cultivated using environmentally destructive practices?"**

Section 1 paragraph 2 of Introduction 194 states that: "estimates of the waste grease market in New York City show that it could supply between 1 and 1.5% of the No. 2 heating oil market in the City" and that a "blending requirement set at or slightly above that level will not raise sustainability or operational concerns". This claim is highly suspect considering the legislation contains no provisions specifying the type of feedstock that can be used to produce the biodiesel that would fill a B2 mandate.

Tri-State Biodiesel, which produces "good" biodiesel from recycled restaurant grease, has an unverified future annual production estimate of 5 million gallons. This is a drop in the bucket compared to the 100 million gallons of virgin feedstock biodiesel that will be available through Metro Fuel Oil when their Greenpoint refinery comes online. Nationally the same disparity between "good" and "bad" biodiesel is even more pronounced with recycled and waste vegetable oil accounting for less than 0.005 percent of the feedstock used to produce biodiesel. Without a certification system in place to ensure biodiesel sourcing and production practices are environmentally friendly, the dominance and availability of soy-based biodiesel virtually guarantees that a New York City B2 heating oil mandate would primarily source "bad" biodiesel.

In closing I would like to encourage the City Council to introduce an ultra low sulfur diesel heating oil mandate. By simply removing the sulfur from our heating oil we can dramatically improve the quality of the air we breathe daily while reducing oil consumption, and we can do it without raising the cost of home heating or depending on unsustainable and environmentally destructive biodiesel.

Thank you for your time and consideration.

Michael Heimbinder: HabitatMap : mheimbinder@habitatmap.org : 347.410.9499
NYC Council Testimony : Introduction 194 : 5/28/2010

Hi, my name is Michael Heimbinder. I'm the Executive Director of HabitatMap. HabitatMap is a Brooklyn based environmental health justice non-profit. I want to thank Councilman Gennaro and the Environmental Protection Committee for inviting testimony today regarding Introduction 194.

If signed into law Introduction 194 would change the chemistry of the heating oil we currently consume in two ways: It would cap the sulfur content of No. 4 heating oil . . . and it would mix at least 2% biodiesel into all heating oil. I'd like to address these two changes separately as each raises fundamentally different issues for the environment, the heating oil industry, building owners, and New Yorkers.

Currently a handful of buildings burn the dirtiest No. 4 and No. 6 heating oil which contain up to 3,000 ppm sulfur. Emissions from boilers burning this dirty diesel are the largest source of fine particulate matter in New York City, accounting for nearly a third of the total. Able to penetrate into the deepest portions of the lungs, fine particulate matter contributes to premature death from heart and lung disease, cardiac arrhythmias, heart attacks, asthma attacks, and bronchitis.

Removing the sulfur from heating oil is the quickest and easiest way to dramatically improve air quality in New York City. By mandating ultra low sulfur diesel heating oil, which contains less than 15 ppm sulfur, we can cut fine particulate matter emissions from the City's boilers by more than two-thirds. Unfortunately, Introduction 194 will only remove sulfur from No.4 heating oil, which accounts for less than 10% of the New York City market, and it will only remove one-third to two-thirds of the sulfur, leaving upwards of 1,000 ppm sulfur in all heating oil and continuing to allow levels as high as 3,000 ppm.

This is a huge disappointment considering the enormous benefits and small costs of implementing an ultra low sulfur diesel mandate. Yes, there will be capital expenses for buildings that need to retrofit or replace their boilers so they can burn cleaner fuels, but these costs will only be incurred by the one percent of New York City buildings with the dirtiest boilers. In addition, increased boiler efficiency will help off-set a portion of these costs by decreasing fuel consumption and reducing maintenance expenses. And for low income buildings, variances and public subsidies can help ease the financial burden of making the transition to cleaner fuels.

In 2006 the EPA mandated that all on-road diesel vehicles fill up with ultra low sulfur diesel containing less than 15 ppm sulfur. If we require ultra low sulfur diesel for our cars and trucks then why should our homes and businesses be an exception? We need to get the sulfur out of our heating oil so New Yorkers can breathe cleaner air . . . and an ultra low sulfur diesel heating oil mandate is hands down the easiest way to get there.

Moving on, I'd like to address the legislation's two percent biodiesel requirement. Let me begin by simply stating, there are "good" biofuels and there are "bad" biofuels and the difference between the two is primarily determined by what feedstock is used and how that feedstock is produced. For instance, by producing biodiesel from recycled restaurant grease collected from New York City restaurants, businesses like Tristate Biodiesel lead the way in the production environmentally friendly biofuels. Unfortunately however, there just isn't enough "good" biodiesel to go around. According to the National Biodiesel Board, recycled and waste vegetable oil accounts for less than 0.005 percent of the feedstock used to produce biodiesel in the US.

In the US, subsidies and tariffs make soybean oil the dominant feedstock for biodiesel production. So when we evaluate whether were fueling up with "good" or "bad" biodiesel in the US, we primarily need to consider where our soybeans our coming from and how those soybeans are being produced.

Testimony of Caswell F. Holloway

Commissioner of the New York City Department of Environmental Protection

Intro 194—The Use of Clean Heating Oil in New York City

New York City Council Committee on Environmental Protection

May 28, 2010

Good morning, Chair Gennaro and members of the committee. I am Cas Holloway, Commissioner of the Department of Environmental Protection (DEP). Thank you for the opportunity to testify today on the use of clean heating oil in New York City, a PlaNYC commitment that Mayor Bloomberg reiterated in his 2010 State of the City address. Intro 194 takes a significant step towards fulfilling that commitment.

The Administrative Code (24-102) states the public policy of the City is to preserve, protect, and improve our air resources, and that every person is entitled to air that is not detrimental to quality of life. Under the City Charter, DEP has the authority to regulate and control the emission of harmful air pollutants into the open air. As you have already heard from Deputy Commissioner Kass, air pollutants such as particulate matter, sulfur dioxide, and sulfur oxides are associated with negative health impacts, including decreased lung function, aggravated asthma, respiratory symptoms, and premature death.

Approximately 14% of local emissions of particulate matter results from the combustion of fuel used for heat and hot water. There are three ways to reduce this pollution: burn cleaner fuel, burn less fuel, and clean emissions caused by burning dirty fuel with scrubbers or other technology. Our research and experience show that technologically, these "post-combustion" measures are not practical or affordable in residential or commercial buildings, and that it is far more cost-effective to remove pollutants from fuel before it is burned. Intro 194 adopts this approach by capping the amount of sulfur in heating oil, and instituting an across-the-board requirement that all heating oil contain at least 2% biodiesel fuel, which contains no sulfur or heavy metals. These requirements will result in substantial reductions in sulfur dioxide, particulate matter, and nitrogen oxide pollution.

New York City has a long history of taking decisive action to clean fuels and reduce local sources of pollution. In November 1953, smog killed between 170 and 260 people in the City; 10 years later it killed 200; and in 1966 it killed 169. A prior generation took decisive action to improve public health by banning the burning of bituminous, high sulfur coal; banning the use of residential incinerators; and capping the sulfur content of heating oil in the City in landmark local laws enacted in 1966 and 1971. Intro 194 continues the progression towards cleaner, sustainable fuel-burning requirements to protect the health of current and future New Yorkers.

In New York City, where we eliminated the burning of coal long ago, one of the most significant remaining sources of sulfur dioxide, particulate matter, and nitrogen oxide comes from the burning of No.4 and No.6 fuel oils. These fuels have the highest sulfur content of all fuels commonly used for heating. As you heard in greater detail from Deputy Commissioner Kass, sulfur dioxide, particulate matter, and nitrogen oxides can exacerbate asthma, and may contribute to other forms of respiratory and cardiovascular illness. Heavier residual fuel oils also contain larger amounts of impurities such as nickel, vanadium, and other metals. As a result, burning No. 6 fuel oil releases fine particulate matter with higher levels of nickel than either No. 2 oil or natural gas. No. 4 fuel oil is a mix of No. 6 residual oil and cleaner-burning No. 2 oil, and also emits significant amounts of nickel.

That boilers using No. 6 and No. 4 oil pollute more than the other fuels is readily observable by the general public. These boilers are commonly the subject of 311 complaints about the emission of smoke from a building chimney that is caused by incomplete combustion. That is because boilers using heavier grades of oil are more difficult to operate and properly maintain. In Fiscal Year 2009, there were approximately 2,200 complaints, which resulted in the issuance of approximately 500 violations.

Intro 194 has two principal components. First, it caps the allowable sulfur content in No. 4 fuel oil at 2,000 parts per million (ppm) of sulfur, or the equivalent of No. 2 fuel oil. The lowering of sulfur caps in No. 4 and No. 6 is important because most pollution from the building heating sector comes from the combustion of those grades of oil. Of the city's million buildings, less than 10,000 use No. 4 or No. 6 heating oil, while the rest use cleaner No. 2 oil or natural gas. In fact, New York City is one of the few places in the United States where No. 6 or No. 4 oil is still used as a heating fuel.

Intro 194 is part of a strategy that the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) and DEP have been working on to reduce the use of residual heating oil in an aggressive, but affordable and financially responsible way, over the next several decades. Our analysis shows that the use of low sulfur No. 4 oil would require few if any capital upgrades to existing No. 4 or

No. 6 boilers, and a very low increase in operating costs, even if the requirement was put in place immediately. In most cases, boilers would need to be tuned at a cost of $10,000 or less.

DEP issues permits for boilers over a certain size, generally greater than the units used in one- or two-family homes and smaller than those used in power plants (which is regulated by the State under Title V of the federal Clean Air Act). DEP regulates the heating units in all multi-family and commercially buildings in the city by issuing permits for new units and re-issuing those permits every three years. There are currently 66,893 DEP permits for combustion devices/boilers, of which (as I mentioned) only approximately 10,000 use No. 4 and/or No. 6 fuel oil. Of those, 6,211 use No. 6 oil and 3,865 use No. 4 oil. There are 799 dual fuel boilers, which burn natural gas and residual oil; 425 of those use natural gas and No. 6 oil and 374 use No.4 oil and natural gas. The remaining 48,341 registrations burn No. 2 or natural gas and there are 5,210 certificates of operation for No. 2 and 1,699 certificates of operation for natural gas.

In connection with Intro 194, DEP is considering a rule that would require that all equipment that currently burns No. 4 or No. 6 fuel oil would have to use low sulfur No. 4 fuel oil upon permit renewal. This would effectively require the conversion of all No. 4 and No. 6 boilers that we regulate to low sulfur No. 4 over the three-year cycle ending in 2015. At that point, the most polluting fuel – No. 6 oil – would no longer be used in New York City.

A shift from No. 4 and No. 6 oil to low sulfur No. 4 fuel oil would result in dramatically lower emissions of conventional pollutants. The projected minimum annual reduction in pollutants from the existing residual oil boilers will be 274 tons of particulate matter, 228 tons of fine particulates, 2,231 tons of nitrogen oxides, 3,698 tons of sulfur dioxide, and 76,778 tons of carbon dioxide. This is equivalent particulate matter 2.5 reduction of eliminating approximately 1.5 billion to 3.3 billion miles of heavy-duty truck traffic from New York City roads every year.

Moreover, we expect the use of low-sulfur No. 4 oil to reduce nickel emissions by completely displacing No. 6 oil, which contains higher levels of that pollutant, and by containing proportionally more No. 2 oil than former No. 4 blends. Finally, the use of low sulfur No. 4 instead of high sulfur No. 4 or No. 6 oil should substantially reduce 311 complaints about smoking boilers and the high maintenance costs for aging boilers that are inefficient to operate.

We have heard concerns about whether there will be enough low sulfur No. 4 oil to meet the demand, but we believe this concern is overstated. Producing enough low sulfur No. 4 oil to meet the increased demand will not be difficult. Existing No. 4 fuel oil is made by blending No. 6 and No. 2 oil to New York City's current sulfur specifications. Our market research shows that low sulfur No. 4 can be easily made by blending No. 6 oil with ultra-low sulfur No. 2 oil, which has a sulfur content of less than 15 ppm. I note that the 1966 and 1971 sulfur cap legislation also met opposition from those who feared market disruptions from a "boutique fuel" that would apply only in New York City. Our experience over the past forty years demonstrates that if the City shows leadership, the oil and real estate industries will adjust by producing and using fuel that meets New York City standards.

Intro 194 also requires that all grades of oil used in the City contain two percent biodiesel. In addition to the substantial air-quality benefits of this bill, the biodiesel requirement will also benefit our sewer infrastructure and improve water quality in New York Harbor.

A major source of oil needed to create biodiesel fuel is the yellow grease created by many of the City's more than 20,000 restaurants. Improper disposal of waste grease is a major cause of sewer back-ups. Restaurants are supposed to use grease traps to capture grease and dispose of it with their other refuse, but too many don't follow the rules. DEP received over 31,000 sewer back-up complaints in FY 2009, and the U.S. Environmental Protection Agency estimates that nationwide, fats, oil and grease are responsible for over 45% of sewer obstructions. As I'm sure the members of this committee know well, sewer back-ups can cause flooding, unsanitary conditions and property damage; and at our wastewater treatment plants grease must also be separated out and disposed of through the treatment process.

Restaurants and commercial food preparation establishments are the main producers of waste vegetable oil, or yellow grease. About one-half of the 22,600 restaurants in the City have their yellow grease picked up by a licensed hauler. DEP is now working with other agencies, industry and community stakeholders to develop an approach to increase the proper disposal of yellow grease. The biodiesel requirement in Intro 194 will greatly aid in this effort, because it will increase the demand for yellow grease, which we believe will accelerate existing waste-to-biodiesel recycling and help reduce the amount of grease being illegally dumped into our sewers.

As you heard from Deputy Commissioner Dan Kass of the New York City Department of Health and Mental Hygiene, the combustion of residual heating fuel oil has significant negative impacts on public health. I urge the Committee and the

Council to pass this bill, and to continue the steady progress that the City has made toward cleaner, sustainable energy sources in our growing City. This concludes my prepared statement. Thank you for the opportunity to testify, and I am happy to answer any questions you may have.

Testimony of Gene V. Pullo, President of METRO Terminals and METRO Biofuels Before the New York City Council Environmental Protection Committee Regarding Intro 194 May 28, 2010

Good morning Mr. Chair and members of the Environmental Protection Committee and thank you for the opportunity to testify on Intro 194 today. My name is Gene Pullo and I am President of METRO Terminals, a family owned fuel oil terminal and energy services company that has been continuously operating in Greenpoint, Brooklyn for 68 years.

In 1942, my grandmother, Pauline Pullo, started a small heating oil company because she felt that coal was dirty and represented the past while heating oil was a much cleaner product that represented the future. Over the years, we expanded our operation and are presently one of the largest independent fuel oil terminals and marketers in the New York Metropolitan Area.

In 2005, my brother Paul and I decided to take a page from our pioneering grandmother and invest in biodiesel, which had already been used extensively in Europe, and which we believed to represent a cleaner future for both motor fuel and heating oil in the United States.

Biodiesel is a renewable alternative fuel that can be produced domestically from various domestic feedstocks including soy and used cooking oil. When blended with heating oil, it improves air quality through the reduction of sulfur, nitrogen oxide and particulate matter; lowers our carbon footprint and reduces our country's dependence on foreign oil.

Biodiesel has exceeded international testing expectations. The American Society for Testing and Materials (ASTM) published fuel specs, a sign of growing industry demand as well as acceptance in the scientific community. Equipment manufacturers now warrantee their products to accept biodiesel. Most importantly, consumers of bioheating oil - as large as an 885 megawatt power plant and as small as a single family home - have reported overwhelmingly positive results.

Currently METRO sells BQ9000 quality-certified bioheating oil to residential, commercial and municipal building owners. We sell blends as low as B2 and as high as B20 in all grades of heating oil - 2, 4 and 6.

We are now in the final stages of building a 110-million-gallon-a-year biodiesel processing facility adjacent to our terminal in Greenpoint, Brooklyn, which will create 60 green collar jobs and hundreds of indirect jobs throughout the City and State.

METRO will be able to make biodiesel from a variety of raw materials that range from used cooking oil and soy to eventually algae and other next generation feedstocks. METRO has just entered into a partnership with the Doe Fund, an outstanding New York City-based non-profit that provide jobs to formerly homeless individuals. METRO will purchase the used cooking oil that Doe Fund employees collect from New York City area restaurants and process it into biodiesel. In most cases, the entire lifecycle of the biodiesel – from collection of the feedstock to consumption of the fuel – will be entirely within the five boroughs. However, while METRO expects to process a high volume of used vegetable oil, it is very important to retain the flexibility to use other sustainable feedstocks to ensure adequate supply and affordability.

Intro 194 requires that all heating oil contain at least 2% biodiesel. This is an easy call.

- B2 – which is 2% biodiesel – is usually priced the same as straight #2 heating oil.
- It requires no new equipment and no retrofitting.
- Its shelf life is the same as straight heating oil.
- It is widely available through a variety of sources in New York City.
- And when the EPA released its latest Renewable Fuel Standard (RFS 2) in February, biodiesel far exceeded the threshold that biofuels must be at least 50% better on Greenhouse Gas Reductions than petroleum.

New York City uses nearly 1 billion gallons of heating oil annually – the most of any city in the world. We're talking about displacing 20 million gallons of petroleum a year, eliminating nearly 320 million pounds of carbon and significantly reducing sulfur, particulate matter and other air emissions.

Intro 194 also requires a reduction in the sulfur content of #4 heating oil. METRO is one of the few terminals that blend this product. As an additional step toward improving overall air quality, we have been helping our customers switch from straight 4 and 6 oil to biodiesel blended 4 and 6 oil – and to great success. However, more can be done. We support a lower sulfur #4 oil, as outlined in the bill.

Intro 194 will positively impact millions of people that live, work and breathe the air in New York City. It balances the need to go green with the need to ensure that it is done responsibly and affordably. The saying – "a little goes a long way" – comes to mind. But what also comes to mind is something that my grandfather once told me and stuck with me my entire life: "without change, there will be no progress."

Thank you. I would be happy to take any questions.

COAL, GASOLINE, FUEL OIL TEAMSTERS, CHAUFFEURS, HELPERS, OIL BURNER INSTALLATION, MAINTENANCE, SERVICEMEN, AND HELPERS OF NEW YORK CITY AND VICINITY, NASSAU AND SUFFOLK COUNTIES, NEW YORK

Teamsters Local Union No. 553

Affiliated with the International Brotherhood of Teamsters
265 West 14th Street, Suite 305, New York, NY 10011-7189
Phone: 212-929-6828 Fax: 212-691-8025

Demos P. Demopoulos
Secretary - Treasurer

John "Jack" Dresch
President

Testimony of Demos P. Demopoulos, Secretary-Treasurer & CEO of Teamsters Local 553
Secretary-Treasurer of Teamsters Joint Council 16, New York

Before the Committee on Environmental Protection of the New York City Council
Hearing of May 28, 2010, Regarding Int. 194

Good morning Chairman Gennaro and members of the Committee on Environmental Protection. I am Demos P. Demopoulos, Secretary -Treasurer and Executive Officer of *Teamsters Local 553*, one of the oldest Teamster Locals in New York, chartered in 1907, representing over 1,500 workers of the gasoline, jet fuel, heating oil industry, and *Horse Carriage Drivers*. I am also Secretary - Treasurer of *Teamsters Joint Council 16*, which represents 125,000 Teamsters in New York City, an affiliate of *The International Brotherhood of Teamsters* representing 1.4 million members.

I testify today in support of Intro 194. I appreciate Councilmember Gennaro's hard work on this issue and that of the Speaker and her office. I do have some minor concerns which I hope to continue to discuss regarding timetable and sulfur content. I look forward to offering my congratulations on this legislation.

The Teamsters support efforts to make the fuels used to heat and move New York "*greener*". We are advocates for the passage of S1145A in Albany, to mandate lower sulfur No. 2 oil throughout New York State. The Teamsters are involved nationally, with strong support from Mayor Bloomberg, with the "*Clean and Safe Ports Campaign*", that would allow trucks and equipment used in ports to use low sulfur diesel and bio-fuels reducing vehicle emissions.

New York's heating oil companies must be able to remain competitive with the monopolistic natural gas companies. This is important, not only to protect good union jobs, benefits, and the families they support, but also consumers, the real estate community, (commercial and residential), condo and co-op owners, home owners, rent paying apartment tenants, hospitals and schools. Affordable housing must come with affordable heat.

Thank you for this opportunity.

New York Oil Heating Association, Inc.

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Testimony of John Maniscalco, CEO of the New York Oil Heating Association Before the New York City Council
Environmental Protection Committee
Friday May 28, 2010

Good Morning Chairman Gennaro and members of the Environmental Protection Committee. My name is John Maniscalco and I am the CEO of the New York Oil Heating Association, New York City's primary heating oil trade association that has been advocating on behalf of heating oil terminals, retailers and heating oil-associated businesses for 71 years. Our members are primarily family owned businesses located throughout all five boroughs.

Thank you for the opportunity to testify on Intro 194 which requires that all heating oil sold in the City of New York contain at least 2% biodiesel beginning in the 2011 heating season. In other words, all heating oil must be what is called a B2 blend or higher. NYOHA strongly supports this measure.

Today, heating oil in New York City is already, by far, the cleanest heating oil sold anywhere in the United States. However, there are additional steps that we can take to further improve this critically important fuel for 1.1 million heating oil households in New York City. Intro 194 represents a significant step in accomplishing this – and should be passed as soon as possible.

Biodiesel has proven successful in several different blend levels and all heating oil grades. Several of our member companies have been selling biodiesel up to a B20 blend for many years now and report high customer satisfaction. Several more companies would like to start selling biodiesel to their customers, which is cleaner than traditional heating oil, but have been reluctant for a variety of reasons including lack of available tank storage that would be required for a separate fuel. Requiring all heating companies to stock and sell a bio-blended product creates a new standard and ensures a level playing field.

Approximately 1 billion gallons of heating oil are sold in New York City. Requiring that 20 million of those gallons be replaced by a renewable fuel that has zero sulfur is highly significant. While fossil fuels such as petroleum and natural gas are not going to be replaced entirely by renewable fuels, a B2 bioheating oil requirement is a good and necessary step toward making our country more energy independent. Eventually, we hope to be in a place where B20 becomes the standard.

This all being said, I have some specific concerns that I ask this Committee to consider. The bill requires all heating oil dealers to provide, on an annual basis, information about the fuel it is selling including volume, percentages of biodiesel and "the average sulfur and ash content of each fuel sold that year in each of the five boroughs." First of all, short of a costly lab analysis, I am unaware of how to calculate ash content or what exactly that means. Secondly, I am concerned about providing numbers that are specific to each borough because most of my companies' computer systems are not set up to capture this information either by borough or zip code. And while I understand that the City is trying to get the most accurate read of heating oil usage possible, I am very concerned that these requirements would impose an unfair economic burden on these already heavily regulated companies.

The bill recognizes NYOHA's role as an industry representative by enabling NYOHA to act as an aggregator of fuel data so as to protect member companies from revealing proprietary information about their volume and customer base. In the same vein, I would like to see NYOHA consulted by the City before issuing any waivers to agencies or building owners. NYOHA is uniquely positioned to provide useful market information pertaining to most waiver criteria including cost and supply of biodiesel and would like the opportunity to weigh in with the City.

NYOHA's concerns about quality, supply and cost are largely answered in the bill's language, although I believe that the 20% price disparity threshold that is required for waiver consideration is too high. A 15% threshold would give consumers and the industry a higher degree of comfort.

It is critically important that the biodiesel meets ASTM D 6751-07b and that the heating oil meets ASTM D 396, as stated in the bill. We have to know, as an industry and as consumers, that our heating fuel product is adequately quality tested. It is also important that the City does not limit permissible feedstocks beyond what the federal government will soon already limit, per the Renewable Fuel Standard. For example, while we support the use of every last drop of used vegetable oil in New York City for biodiesel, limiting or legislatively prioritizing any single feedstock may result in supply and cost issues. Currently the bill allows multiple feedstocks and does not place any artificial limits on percentages of used vegetable oil or any other feedstock. Those provisions must remain in tact.

Finally, Intro 194 imposes a lower sulfur standard for #4 oil. #4 oil is a blend of #2 and #6 oil, the latter being heavy residual oil. The #4 and #6 market is highly specialized within the heating oil industry and is a good degree smaller than the #2 oil market. Very few companies handle these products. The bill empowers the Commissioner – I presume of DEP – to impose anything between 1,000ppm and 2,000ppm. I would like to point out to the Committee that at the highest end of this spectrum, #4 oil would have the same sulfur content as #2 oil and therefore yield the same environmental benefits as when a 6 oil building converts to 2 oil. As for whether this can technically be accomplished in an economical manner by the 2012 time frame stated in the bill, I would defer to those terminals in New York City that produce this product and encourage that you listen to any concerns they may have.

Thank you.

Testimony of Don Scott before the Committee on Environmental Protection
May 28, 2010, 10 a.m.

Good afternoon Chairman Gennaro and members of the committee. I appreciate the opportunity to testify before you today. My name is Don Scott. I serve as the Director of Sustainability for the National Biodiesel Board. It was my pleasure to present to this committee on February 25 of 2009 about the environmental and health benefits of biodiesel. I would like to resubmit those remarks as part of my written testimony today.

In addition, there have been many significant developments in lifecycle analysis in the past year that further document the benefits of biodiesel and provide more certainty that biodiesel is a sustainable alternative to petroleum diesel.

In late September of 2009, the United States Department of Agriculture published an updated study on the Energy Life-Cycle Assessment of Soybean Biodiesel that concluded the renewable energy ratio for soy biodiesel is now 4.56 to 1 and predicted to reach 5.44 to 1by 2015. This means that for every unit of energy put into producing biodiesel, 4.56 units of usable energy are produced in a usable form. This is important, because while our conventional petroleum supplies are finite and diminishing, biodiesel allows us to capture renewable solar energy and use that energy in a sustainable way. The strong trend of increasing energy efficiency is due to farming and biodiesel production techniques that continually improve. Such improvements include more adoption of no-till and conservation tillage practices, which promote more carbon sequestration into soil, reduce soil erosion, reduce fuel used to power tillage equipment, and support the use of safer pesticides. A steady trend of yield increases produce more crop from the same or fewer acres and eliminates the inputs such as fuel and herbicides on additional acres.

While this study included the planting, growing, harvesting and processing of soybeans and soybean oil used for biodiesel production, I should remind you that biodiesel is the most diverse fuel in production and can be made from a great variety of feedstocks including animal fats, recycled cooking oils, and waste grease reclaimed from municipal wastewater. In 2009 soy-based biodiesel was the largest single feedstock source, but accounted for less than 46% of the total biodiesel volume. That means more than half of the biodiesel produced in the US is coming from various other feedstocks, and we expect this diversity to increase as the industry matures. We expect to see increased utilization of recycled and waste greases, and significant research is underway to bring algae-based biodiesel to the commercial marketplace. Our collective thirst for fuel and unfortunate addiction to petroleum means there is room in the biodiesel industry for all the sustainably harvested oils. Supporting the growing biodiesel industry encourages investment and research to bring additional renewable options to the market.

In February of this year, the USEPA published their final rule implementing the Energy Independence and Security Act. This final rule included full lifecycle green house gas emissions for biodiesel from animal fats and waste greases and soybean-based biodiesel. EPA found those forms of biodiesel to be 86% and 85% better than petroleum diesel. Even with the inclusion of indirect emission from international land use change, EPA concluded that soy biodiesel is still 57% better than 2005 baseline petroleum diesel. As biodiesel production improves and the remaining sources of petroleum become more difficult to extract and refine, the benefits of biodiesel are sure to continue to improve relative to petroleum.

Even though we generally support EPA's final GHG assessment of direct emissions, EPA did not fully utilize the latest data that shows how efficient soy farming and biodiesel production is today. EPA recognizes that biodiesel production will get more efficient between now and 2022. However, biodiesel production is more efficient today, than EPA gave credit in their projections to 2022. This underestimates the benefits of biodiesel compared to petroleum now and in the future.

EPA received significant comments from numerous experts during the public comment period for their proposed rule. One significant change EPA implemented in response to comments from environmental organizations was to reduce the carbon payback time for biofuels from 100 years to a mere 30 years. This modification to the analysis of indirect emissions significantly raised the bar measuring the benefits biofuels offer in comparison to petroleum. Thirty years is a very short carbon payback time, when you consider that it took millions of years to sequester the carbon that exists in fossil fuels.

In summary, EPA was very thorough in making sure biofuels, including biodiesel, were examined with a very high level of scrutiny, while overlooking indirect impacts of petroleum fuels; and even direct impacts such as the crisis that is currently impacting over 2,000 square miles of the Gulf of Mexico.

It should also be noted that EPA has not yet published lifecycle analysis for palm oil and other vegetable oil-based biodiesels. Until EPA publishes lifecycle analysis on these other feedstocks, and verifies that they meet the definition of advanced biofuel, these feedstocks are not eligible for the federal Renewable Fuel Standard.

The science of evaluating biodiesel continually evolves. In March of 2010, the latest soy lifecycle inventory in existence was released by the United Soybean Board. This inventory was conducted in accordance with the standards on lifecycle assessment developed by the International Standards Organization, including ISO 14040:1997(E) and ISO 14044:2006. This latest lifecycle inventory, using data not previously available to EPA or other agencies, found that:

- Soybean yields increased 12 percent between 2000 and 2007;
- The annual production of soybeans in the US sequesters an amount of carbon dioxide equivalent to taking 21 million cars off the road;
- Soybean crushing facilities reduced their energy consumption by 45 percent, increased yield of oil by 11 percent increased yield of protein meal by 4 percent; and
- Twenty percent less energy is needed to produce biodiesel compared to previous estimates.

This study goes on to conclude that biodiesel is superior to petroleum production, not only in global warming potential, but in acidification potential, smog formation potential, and human toxicity for cancer and non-cancer related illnesses.

Mr. Chairman, once again, thank you for the opportunity to be here today and thank you for your leadership on issues related to biodiesel and green energy. The National Biodiesel Board is committed to rigorous scientific analysis of biodiesel and its environmental impacts. As always, we are glad to answer any questions you may have.

Testimony of Don Scott before the Committee on Environmental Protection
February 25, 2009, 10 a.m.

Good afternoon Chairman Gennaro and members of the committee. I appreciate the opportunity to testify before you today.

My name is Don Scott. I serve as the Director of Sustainability for the National Biodiesel Board. I am an environmental engineer with over a dozen years experience protecting natural resources. I left my position as chief of surface water resources for the state of Missouri and joined the biodiesel industry because I realized our society's most critical need is for renewable fuels that are environmentally friendly. We must transition to more sustainable alternatives to fossil fuels if we are to maintain our current standard of living that affords us the great strides we have made in this country protecting clean air and plentiful clean water. It is toward these goals that I offer my services to this industry and to this committee.

The US biodiesel industry was founded a mere 15 years ago to offer a healthier, homegrown fuel that can invigorate economies throughout the US, and increase energy independence. The US biodiesel industry has consistently sought to provide a sustainable solution to America's energy needs. Biodiesel offers significant greenhouse gas emissions reductions compared to its petroleum counterpart and has the greatest energy balance of any U.S. produced transportation fuel. This means biodiesel is the most sustainable alternative currently available for light duty vehicles, heavy equipment, freight, public transport buses, and heating oil.

The most comprehensive lifecycle inventory for biodiesel was conducted in 1998 by the United States Department of Agriculture (USDA) and the Department of Energy (DOE). This analysis considered every bit of energy and associated greenhouse gas (GHG) emissions emitted in the production of soy biodiesel. This included everything required to plant, grow, harvest, transport, and crush soybeans, as well as the energy required to convert surplus soybean oil to biodiesel and transport it to a retail fuel station. The inventory showed that for every unit of energy invested in this process, 3.2 units of energy were returned[1]. This study was recently updated by USDA and the University of Idaho which found that today 4.56 units of energy are returned. This increase from 3.2 to 4.56 in 10 years is a result of improvements in farming and production technology. These continual improvements in efficiency are expected to yield 5.44 units of energy per unit of input by 2015[2].

The USDA/DOE lifecycle inventory also concluded that biodiesel use reduces greenhouse gas emissions by 78% compared to petroleum diesel[1]. It can be expected that this reduction is also improving as a result of efficiency improvements. This reduction is obtained because the carbon emitted as biodiesel is burned was originally pulled from the atmosphere by a soybean plant. In effect, the carbon is being naturally recycled with no net addition of CO2 to the atmosphere. This is in stark contrast to petroleum which pulls carbon, in the form of crude oil, from deep within the Earth's crust and spews that carbon into the air as it is refined or burned. It is this process of unlocking millions of years of sequestered carbon from buried fossil fuels that is responsible for 80% of human-induced greenhouse gas emissions and is the leading cause of global warming that threatens our earth and our way of life[3]. If we want to reverse global warming, we must find alternatives to fossil fuels.

Reversing the impact of fossil fuels on climate change will not happen overnight. That is why we must begin a transition to renewable fuels immediately. We must also act quickly to protect human health. A twenty percent biodiesel blend in heating oil can reduce nitrogen oxide emissions by 20 percent and reduce sulfur oxide emissions by 83 percent[4]. Biodiesel in engines can reduce polyaromatic hydrocarbons, which have been identified as cancer causing compounds, by 50 to 90 percent. B20 use can reduce the estimated risk of premature death due to air toxics by up to 5 percent in regions that use biodiesel[5].

The original USDA/DOE lifecycle analysis was done on soy biodiesel production because soy was and remains our nation's largest available source of surplus natural oils. Biodiesel can be made from any under-valued vegetable oil or animal fat. Considerable volumes of biodiesel are made from recycled cooking oil, especially in urban areas; and technology is blossoming for biodiesel made from waste greases. The New York metropolitan area produces enough recycled cooking oil to make 20 million gallons of biodiesel each year, and enough waste grease to make an additional 30 million gallons[6]. Waste greases include sources such as restaurant grease traps. Removing these waste greases from municipal wastewater streams has significant environmental benefits. The City of San Francisco is building a plant to convert waste grease to biodiesel[7]. San Francisco officials estimate that $3.5 million dollars in public works expenditures could be saved every year if they could eliminate sewer backups related to waste greases in their sewers[8].

Alternative sources for biodiesel are growing in proportion to the total volume. The versatility of biodiesel to utilize the growing number of alternative sources while meeting a consistent ASTM specification for biodiesel, #2 diesel fuel, and heating oil stimulates advancements like the development of renewable fuel from algae. Many biodiesel plants can use a variety of feedstocks, which helps their economic sustainability in times of fluctuating markets. Biodiesel is a great fuel now. Public support fosters its potential to get even better.

Biodiesel is the most sustainable liquid fuel available today. And still one of its most compelling attributes is that this young industry has the opportunity to play an even greater role in a sustainable energy future. The US biodiesel industry is not only generating a product with documented health and environmental benefits, it has aggressively committed to continually increase its sustainability. The National Biodiesel Board has developed a Sustainability Task Force and a set of sustainability principles to ensure the highest degree of sustainability for our country and our industry. These principles support biodiesel that significantly reduces greenhouse gases compared to petroleum, improves food security, and protects natural resources such as soil, water and air[9]. Biodiesel made from a wide variety of materials, including soybeans, animal fats, recycled and waste greases, and algae meet that standard.

The National Biodiesel Board is not alone in focusing attention on the sustainability of biodiesel. International organizations such as the Roundtable on Sustainable Palm Oil are implementing criteria for feedstock production to ensure that biofuels are neither causing nor being blamed for unsustainable practices associated with burning forests or illegal logging.

Our objective is to ensure that the future will encourage new research and innovation; incorporate sound science and knowledge based on credible, transparent data; create mechanisms for continual assessment and improvement; and provide the opportunity for biodiesel to realize its full potential as a sustainable, domestic energy source.

Mr. Chairman, once again, thank you for the opportunity to be here today and thank you for your leadership on issues related to biodiesel and green energy.

1. USDA/DOE 1998, Life Cycle Inventory of Biodiesel and Petroleum Diesel for Use in an Urban Bus.
2. Dev Shrestha , University of Idaho, presentation at the 2009 National Biodiesel Conference and Expo, San Francisco, CA Feb 2, 2009.
3. U.S. Climate Change Science Program 2009, Global Climate Change Impacts in the United States.
4. Massachusetts Oilheat Council & National Oilheat Research Alliance, Combustion Testing of a Biodiesel Fuel Oil Blend in Residential Oil Burning Equipment, 2003.
5. National Renewable Energy Laboratory, Impact of Biodiesel Fuels on air Quality and Human Health, 2003
6. Calculated from lb/person estimate given by National Renewable Energy Laboratory 1998, Urban Waste Grease Resource Assessment.
7. Gavin Newsom press conference San Francisco, CA, Feb 4, 2009.
8. C. Ving, City of San Francisco, presentation at the 2009 Sustainable Biodiesel Summit, San Francisco, CA, Jan. 31, 2009.
9. www.biodiesel sustainability.org

NATIONAL BIODIESEL BOARD

National Biodiesel Board
605 Clark Avenue
P O Box 104898
Jefferson City, MO 65110-4898
(573) 635-3893 *phone*
(800) 841-5849
(573) 635-7913 *fax*
www.biodiesel.org

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On January 25, 2009, the National Biodiesel Board testified before the New York City Committee on Environmental Protection on the benefits of using biodiesel in heating oil. Among the other witnesses before the committee was a representative from an organization called Habitat Map. The testimony given on behalf of Habitat map was plagued with inaccurate data and false statements. The National Biodiesel Board has analyzed the written testimony provided by Habitat Map and hereby provides corrections to Habitat Map's misleading information.

Habitat map claims biodiesel can do little to improve air quality. The truth is, a twenty percent biodiesel blend in heating oil can reduce nitrogen oxide emissions by 20 percent and reduce sulfur oxide emissions by 83 percent[1]. While the switch to Ultra-Low Sulfur Diesel (ULSD) in heating oil can also reduce sulfur emissions, biodiesel provides greater reductions in nitrogen oxide emissions as well as reductions in particulate matter and polyaromatic hydrocarbons. A combination of biodiesel and ULSD would provide the optimum air quality improvements with direct health benefits to the citizens of New York City.

Habitat map claims biodiesel will encourage environmentally destructive farming practices. The truth is, the National Biodiesel Board supports improvements in environmental and economic performance as evidenced by our sustainability principles (see: http://www.biodieselsustainability.org/principles.html). We also believe that biodiesel is currently the most advanced renewable motor fuel available and holds the most promise to put new advancements into real-world application.

The development of new feedstocks is the industry's greatest opportunity for advancement. The existence of 176 biodiesel production facilities with over 2 billion gallons of capacity for processing new feedstocks is stimulating advancement in the commercialization of algae, waste grease recovery, and lipid recovery from municipal wastewater[2]. These advanced feedstocks need a healthy, thriving biodiesel industry to convert those oils into a fuel than can displace petroleum in buses, trucks, tractors, other heavy equipment and fuel efficient light-duty diesel vehicles and hybrids.

Habitat map claims biodiesel will have no impact on foreign oil consumption. The truth is, biodiesel is made in the US from a variety of locally-grown feedstocks. Those feedstocks include: soybean oil; canola oil; cotton seed oil; recycled cooking oil; reclaimed waste grease; oil from algae; and animal fats from beef, pork, and poultry processing. The biodiesel industry has built over 176 production facilities all across the US that can use domestically produced feeedstocks to displace foreign petroleum used in this country. The US biodiesel industry has set a goal to displace 5% of on-road petroleum diesel by 2015[3]. The 700 million gallons produced in 2008 puts us on a path to reach that goal.

Habitat map claims biodiesel will drive up food prices. The truth is, the link between the growth in biodiesel and the rise in food prices is a misperception perpetrated in large part by the Grocery Manufactures Association's (GMA) multi-million dollar media campaign to blame biofuels for the dramatic rise in grocery prices and distract consumers from their own record profits. You can read more at http://www.foodpricetruth.org/ . The circumstantial link between volumes of biofuel and rising food commodity prices has proven unfounded in recent months as commodity prices have dropped sharply while biodiesel production continues to rise. 2007 biodiesel production in the US was approximately 500 million gallons. 2008 production was nearly 700 million gallons. The drop in food commodity prices as a result of the drop in oil prices exposed the GMA's faulty reasoning.

Biodiesel uses the most diverse raw material supply of any commercially available fuel and is based on local and regional resources including vegetable oils, animal fats, recycled oils and waste greases. Biodiesel from soybean oil is ultimately a net positive for the food supply for many reasons. First, soybeans are grown for their 80% protein-rich meal which is used for food and feed. The 20% oil portion is used for salad dressing, frying oil, and processed foods like the gooey filling in convenient store desert cakes. While using soybean oil can slightly impact the cost of those products, it causes the protein meal to be priced lower than it ordinarily would. This makes healthy protein for food and feed cheaper and more abundant. There is a good explanation of how soy biodiesel makes soy protein meal less expensive at http://www.biodieselsustainability.com/soybean.pdf . Soy protein is a valuable tool in fighting hunger through school feeding programs around the world. The availability of school meals not only helps children learn, but it gives an incentive for families to send children, particularly girls to school. The approximately 400 million gallons of biodiesel made from soybeans in the United States in 2007 alone, co-produced enough soybean meal to equate to 115 billion rations of protein for school feeding projects like the one our World Soy Foundation supported with the Adventist Development and Relief Agency in Ghana.

Habitat map claims biodiesel will devour millions of dollars in taxpayer subsidies. The truth is, domestic economic growth as a direct result of the biodiesel industry generates more tax revenue that is costs. The biodiesel industry has contributed significantly to the domestic economy. The 51,893 jobs that are currently supported by the U.S. biodiesel industry reflect the beginning of the industry's potential to create jobs and economic growth in the U.S. economy. Biodiesel has added $4.287 billion to the Gross Domestic Product. Biodiesel has the potential to support more than 78,000 jobs by 2012. The NBB estimates that for every 100 million gallons of biodiesel that is produced from algae, 16,455 jobs will be created and $1.461 billion will be added to the GDP.

Habitat map claims biodiesel will increase greenhouse gas emissions. The truth is, a lifecycle inventory conducted by the USDA and DOE determined that biodiesel reduces greenhouse gas emission by 78% compared to petroleum diesel[1]. This reduction is obtained because the carbon emitted as biodiesel is burned was originally pulled from the atmosphere by a soybean plant. In effect, the carbon is being naturally recycled with no net addition of CO_2 to the atmosphere. This is in stark contrast to petroleum which pulls carbon, in the form of crude oil from deep within the Earth's crust and spews that carbon into the air as it is refined or burned. It is this process of unlocking millions of years of sequestered carbon from buried fossil fuels that is responsible for 80% of human-induced greenhouse gas emissions and is the leading cause of global warming that threatens our earth and our way of life[3]. This analysis of soy biodiesel conducted by USDA and DOE considered every bit of energy and associated greenhouse gas (GHG) emissions emitted in the production of soy biodiesel. This included everything required to plant, grow, harvest, transport, and crush soybeans, as well as the energy required to convert surplus soybean oil to biodiesel and transport it to a retail fuel station. In 2008, US biodiesel production was nearly 700 million gallons. By displacing 700 million gallons of petroleum, we reduced GHG emissions equivalent to removing 980,000 vehicle form the roadway. No other fuel can claim real-world reduction in GHG emissions of the same magnitude. The USDA/DOE study conducted in 1998 also showed that the energy balance for biodiesel was 3.2 units of energy output per unit of fossil energy input. That analysis was recently updated by the University of Idaho which found the energy balance is now 4.56 to 1 and predicted to reach 5.44 to 1 by 2015. This improvement is due to increased crop yield, improvements in farming and processing efficiency. Since carbon emissions and energy go hand in hand, it would stand to reason that biodiesel's GHG emissions are also getting better with time.

Habitat map claims biodiesel is a renewable fuel made from non-renewable resources. The truth is, biodiesel is a diesel replacement fuel that is made from agricultural oils, fats and waste greases that meets a specific commercial fuel definition and specification. The fuel is produced by reacting renewable feedstock with an alcohol to remove the glycerin and result in an alkyl-ester that meets the D6751 fuel specifications set forth by ASTM International. Alkyl-esters have physical properties similar to diesel fuel which makes them compatible with heating oil and diesel fuel injection equipment. However, the alkyl-ester chemical compound is different than a diesel fuel molecule. These chemical differences result in biodiesel's nontoxic and biodegradable characteristics as well as reductions in harmful emissions. Biodiesel is one of the best-tested alternative fuels in the country and the only alternative fuel to meet all of the testing requirements of the 1990 amendments to the Clean Air Act. Methanol is the most commonly used alcohol in the transesterification process and constitutes approximately 10 percent of the material used to make biodiesel. Renewable ethanol and renewable methanol can be used for a 100% renewable fuel. The USDA/DOE study conducted in 1998 also showed that the energy balance for biodiesel (using methanol) was 3.2 units of energy output per unit of fossil energy input. More on that inventory can be found at these sites:

- 2 page fact sheet: http://www.biodiesel.org/pdf_files/fuelfactsheets/LifeCycle_Summary.PDF
- 60 page summary: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19980501-gen-203.pdf
- 300 page report: http://www.biodiesel.org/resources/reportsdatabase/reports/gen/19980501_gen-339.pdf

This positive energy balance takes into account the energy used to plant, grow, harvest, transport, and process soybean oil into biodiesel and transport it to the point of use. That analysis was recently updated by the University of Idaho which found the energy balance is now 4.56 to 1 and predicted to reach 5.44 to 1 by 2015. This improvement is due to increased crop yield, improvements in farming and processing efficiency.

Habitat map claims subsidies and tariffs make soybean oil the dominant feedstock. The truth is, biodiesel is an advanced biofuel as defined by the Energy Independence and Security Act. It is the first, and currently the only, advanced biofuel to have achieved market commercialization. While biodiesel has been in development for many years, the roots of its US commercialization can be traced back to January 2005, when the biodiesel tax credit (There are no tariffs on biodiesel in the US.) took effect. The biodiesel tax credit has been the most effective alternative energy incentive program in US government history. In the last 4 years, the biodiesel industry has built more than 100 renewable refineries, added over 50,000 green jobs to the economy, over $4.2B to GDP, and has generated federal, state, and local tax revenue that far exceeds the cost of the program.

As the first, and currently, the only advanced biofuel to be commercialized, biodiesel is driving research and innovation in plant science technology. Nonexistent or yet-to-be-commercialized fuels do not drive markets and innovation. Biodiesel can be made from any natural vegetable oil, animal fat, or oil from algae. The current US biodiesel industry is very diverse in the types of feedstock in use. Many production facilities use multiple feedstocks. Animal fats and recycled greases constitute a greater proportion of production in recent volume growth. While the amount of biodiesel produced each year has grown, the amount of virgin vegetable oil used has remained steady. The existing 176 biodiesel plants are stimulating development of new feedstocks such as waste greases and algae. These new feedstocks can readily be used in existing biodiesel production facilities. The National Biodiesel Board has a feedstock development program and welcomes collaboration to advance the commercialization of oil from algae and other sources. A summary of the leading alternative feedstocks is available at http://www.biodieselsustainability.org/gao.pdf.

Habitat map claims the fossil fuels consumed by on-farm operations release significant quantities of greenhouse gases and toxic air emissions. As described above, the USDA/DOE lifecycle inventory took into account all fuel, energy, fertilizer, and chemicals used in the process of making soy biodiesel and concluded that biodiesel use reduces greenhouse gas emission by 78% compared to petroleum. That study also concluded that biodiesel reduces wastewater production by 79% and reduces hazardous waste production by 96% compared to petroleum. There have been numerous studies by other agencies and academic institutions that prove the reduction in harmful diesel exhaust emissions when biodiesel is used. The USEPA has surveyed the large body of biodiesel emissions studies and concluded that biodiesel reduces total unburned hydrocarbons by 67%, reduces carbon monoxide by 48%, reduces particulate matter by 47%, reduces sulfates by 100%, reduces polyaromatic haydrocarbons (PAHs) by 80%, reduces nitrated PAHs by 90%, and reduces ozone forming potential of speciated hydrocarbons by 50%. These results are published at http://www.biodiesel.org/pdf_files/fuelfactsheets/emissions.pdf . As pointed out above, biodiesel in heating oil application also reduced oxides of nitrogen (NOx), which can sometimes be raised in diesel engines using biodiesel. The different type of combustion from a diesel engine to a boiler or furnace results in reduced NOx emission in heating oil applications.

Habitat map claims that nitrous oxides are a more potent global warming agent than CO_2. While it is true that nitrous oxides have a more potent greenhouse gas effect than CO_2, it should be pointed out that the 78% greenhouse gas reduction of biodiesel is measured in CO_2 equivalents, which factors in the potency of other gases such as nitrous oxides. This statement by Habitat Map should not mislead readers into thinking that all greenhouse gases are not accounted.

Habitat map claims a rainbow of toxic pesticides are sprayed on soybeans in an effort to combat weeds and insects. Habitat Map also claims soybeans genetically engineered to tolerate herbicides boosted glyphosate applications, and that glyphosate is a dangerous pesticide. This colorful description paints a misleading portrait of US agriculture. US farmers have a long tradition of employing technological improvements to produce a growing bounty of food commodities. These technologies allow farmers to produce higher crop yields on less acres with less inputs. This results in decreased energy use (less passes over the field with a tractor), less soil erosion, and more land available for natural habitat. Very recent improvements in plant science have been paired with advancement in herbicide development. Glyphosate is one of these new advancements. Glyphosate is much more environmentally friendly than the pesticides it replaces, representing a net benefit for the environment and a trend of continual improvement[10]. Pesticide handling and use is one of the most highly regulated industries in the world. Scientists and public officials have seen fit to regulate that aspect of food production to ensure public safety is protected. Biodiesel uses a co-product of food production. No new acres or unsustainable practices are put into production for the purpose of producing more vegetable oil. In fact, traditional plant breeding had reduced the oil content of soybeans, because the protein meal represented a higher commercial value. By providing an economic benefit from the co-product soybean oil, biodiesel makes farming more economically sustainable and drives innovation for further environmental improvements. One of the potential feedstocks for biodiesel is mustard seed. If biodiesel development drives the cultivation of mustard to be more commercially viable, a valuable co-product of the mustard oil is residual cake which has strong potential market value as an organic pesticide[11].

In terms of U.S. soybean farmers, GHG-friendly no till practices increased from 6 to 22% from 1990 to 2004. According to the U.S. Environmental Protection Agency, herbicides used today are 10 times less toxic than those used before the 1990s. From 1990 to 2002 yields increased from 34.1 to 42.7 bushels per acre and are expected to increase as much as 10 percent in the next two years due to new seed varieties. And, finally, it is important to remember that soybeans do not require nitrogen fertilizer – unlike corn, they make their own nitrogen.

Habitat map claims the US is on track to produce 3.3 billion gallons of billion gallons of biodiesel in 2009 and that quantity would consume nearly every acre of US soybean. The truth is, US biodiesel production in 2009 is likely to be considerably less than that. Currently, there are 176 active biodiesel production facilities in the US with a capacity to produce 2.6 billion gallons. However, 2008 saw the largest volume of biodiesel ever produced in the US at just under 700 million gallons. This was up from 500 million gallons in 2007. In 2007, approximately 400 million gallons of biodiesel was made from virgin soybean oil. The rest was made for animal fats, recycled greases and other feedstocks. In 2008, the amount of biodiesel made from virgin soybean remained constant at 400 million gallons. The growth in biodiesel production was made primarily of other feedstocks. Absent a change in current market forces or federal energy policy, the biodiesel industry could see a significant drop in sales for the first time since the fuel's introduction, to as low as 300m gallons.

Habitat map claims 6 percent petroleum displacement will not secure our energy independence. The truth is, the US biodiesel industry has set a goal to displace 5% of on-road petroleum diesel by 2015. This volume is equivalent to the amount of diesel used in America refined from Iraqi and equivalent to one quarter of the diesel refined from Persian Gulf crude. Freeing the US from reliance on politically unstable parts of the world such as the Middle East is the most critical thing we can do for energy independence.

Habitat map claims clearing new land for energy crops releases 420 times more $C0_2$ than the fossil fuels they replace. The truth is, the estimates for CO_2 released during land conversion vary widely. For certain land types, more carbon can be sequestered during farming operations than in the land's previous state. However, the more important thing to note is that no new land needs to be cleared to meet the US goal of displacing 5% of petroleum diesel. The Energy Independence and Security Act of 2007 requires that biodiesel meeting the requirement of advance biofuel cannot be made from feedstock from land that was cleared after enactment of the law. Additionally, The US biodiesel industry has adopted a sustainability principle that states "Biodiesel shall contribute to climate change mitigation by significantly reducing lifecycle greenhouse gas emissions as compared to fossil fuels. Producers shall strive to continuously improve that reduction."

Habitat map claims biodiesel will exhaust domestic soybean acreages. The truth is, biodiesel used approximately 12 percent of US soybean oil production in recent years. This far from exhausts the annual surplus of soybean oil in the US the results from the production of soy protein meal, nor does it stop the export of whole beans for use in other countries.

Habitat map claims switching land from food to fuel raises food prices. The truth is, biodiesel requires no change in land use. Biodiesel requires no additional acres of soybeans. Eighty percent of each soybean is protein meal with a high food value. Approximately twenty percent of each soybean is oil. This oil can be used for food uses such as deep-frying foods and manufactured items such as candy bars. When the market for vegetable oil for these products is low, such as when triggered by New York City's ban on trans fats, the surplus oil can be used for biodiesel with no change in land use. Biodiesel helps ensure the availability and reduces cost for food commodities as described above.

Habitat map claims demand for corn based fuels in late 2006 pushed up the cost of dairy, eggs and meat. The truth is, food prices are impacted much more by the rising price of fuel (petroleum). By adding capacity to the fuel production sector, biofuels helped reduce fuel prices by 10-15% in the period described. As described previously, biodiesel lowers the feed inputs for dairy and poultry.

Habitat map claims biodiesel directives in Europe pushed up the cost of palm oil in Southeast Asia threatening food security of millions. The truth is, Malaysia is implementing a program to fell 700,000 hectares of palm plantations to control palm oil prices. Palm oil prices are so low, due to excess supply, the local government is implementing these measures to maintain the economic sustainability of the industry for all the products it produces, primarily food.

Habitat map claims hundreds of government programs have been created to support virtually every stage of production and consumption relating to biodiesel. The truth is, the handful of public policies that support biodiesel production and use are the result of our democratic process that deem the benefit of these programs to be in the public interest. Many of those benefits have already been described in this document. In addition to those, biodiesel offers ecological benefits. Biodiesel has strong attributes that make it more environmentally friendly than petroleum diesel, and no other fuel rivals it as a replacement in today's diesel fleet or diesel engines of tomorrow. Biodiesel is nontoxic and biodegradable. More info can be found at http://www.biodiesel.org/pdf_files/fuelfactsheets/Environment_Safety.pdf. Biodiesel reduces wastewater production by 79% and reduces hazardous waste production by 96% compared to petroleum diesel. These reductions were quantified in a comprehensive life cycle inventory conducted by the USDA and DOE. A summary can be found at http://www.biodiesel.org/pdf_files/fuelfactsheets/LifeCycle_Summary.PDF .

Habitat map claims everyone form soybean farmers to biodiesel distributors get handouts compliments of the taxpayer. The truth is, the biodiesel tax credit program generates twice as much revenue for the federal government than the cost of the program. In this regard, the biodiesel industry is working for every American and paying dividend in environmental protection and energy security.

Don Scott, PE
Director of Sustainability
National Biodiesel Board
www.biodieselsustainability.org

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Rohit T. Aggarwala
Director of Long-Term Planning and Sustainability
City of New York

At the New York City Council
Committee on Environmental Protection
Respecting Proposed Intro 194

May 28, 2010

Good morning, Chair Gennaro and members of the committee. I am Rohit T. Aggarwala, director of the Mayor's Office of Long Term Planning and Sustainability. Thank you for the opportunity to testify today on Proposed Intro 194 which relates to the use of clean heating oil in New York City. This bill would help us to achieve a key PlaNYC initiative, and we have appreciated the opportunity to work with the Council on this important legislation.

In PlaNYC, the City set the goal of achieving the cleanest air of any large American city. Since then, we have made progress in measuring air quality, in regulating emissions from school buses and for-hire vehicles, and in reducing pollution from ferries, private trucks and construction vehicles. Increasing the use of alternative fuels is an important component of PlaNYC's goals to reduce greenhouse gas emissions, improve local air quality, and diversify our energy supply. PlaNYC also committed to realizing a lower sulfur level in heating oil and to reduce the use of residual fuels which, as mentioned, contain larger amounts of impurities such as sulfur, nickel, vanadium, and other metals; and whose combustion releases PM2.5 with higher levels of toxic air pollutants.

To fulfill our PlaNYC commitment we have begun the conversion of one hundred school boilers from #4 and #6 heating oil to cleaner fuels over 10 years. We have completed conversions at three schools and will complete seven more conversions this summer. We've also started construction at eleven schools and have designed conversion plans at another fourteen schools. In addition, we began installation of fuel catalysts and economizers at schools to reduce fuel consumption and improve environmental quality. City agencies such as DCAS, HHC, and HPD have planned conversions for their boilers from residual to cleaner fuels.

We also take great pride in the fact that the City's Department of Parks and Recreation, the Department of Sanitation, the Department of Transportation, and other agencies have introduced biodiesel to their fleets of heavy-duty diesel vehicles. We also successfully completed a pilot project of 20% biodiesel blended with #6 heating oil to test the operational viability, costs and emissions benefits of using biodiesel blends at the 1.2 million square foot Betts Avenue maintenance garage operated by the NYC Department of Sanitation in Queens. After a season of testing, there were no surprises- the boilers ran optimally, there was an observed reduction in the emissions from the plant using 20% biodiesel, and both filters and screens required less maintenance and cleaning than was the case with regular #6 residual oil without a biodiesel component.

While progress has been made locally and at the federal level on the adoption of biodiesel blends as alternatives to petroleum fuels, there has been less progress in reducing the amount of sulfur that exists in heating oils, especially in the State and in

New York City. Most oils used for heating today are refined from crude petroleum oil, just like diesel fuel for road applications. Unlike the transportation sector, where the EPA has mandated the used of low sulfur and then ultra low sulfur diesel, the federal government has not set standards for the composition of heating oil, which contains much higher levels of sulfur. The higher sulfur content of heating oil means that it produces more pollutants than current road fuel or other types of heating fuels.

When we last testified on this topic in January of 2008, we were reluctant to support a citywide sulfur cap in heating oil given imminent developments in state and regional regulations. However, New York State DEC regulatory action to reduce the sulfur content in heating oil did not take place as expected in 2008. The Mid-Atlantic and Northeast states worked on a coordinated strategy for low sulfur oil in member states, whereby inner zone states (NJ, NY, DE, and PA) will require heating oil to contain 500 ppm sulfur or less by 2012 and 15 ppm or less by 2016. However, individual states were left to implement this timeframe and enact the sulfur caps agreed to by all the MANE-VU states and most member states have taken no action thus far to decrease pollution from heating oil. Instead, the timeframe for the transition has been deferred further and further into the future. Most recently, the City actively supported New York State legislation that would achieve this goal, however, the State legislature also failed to enact a statewide sulfur cap on #2 heating oil.

For these reasons, the City's commitment to reduce emissions from heating oil—particularly the disproportionately high emissions from buildings that burn the highly polluting #4 and #6 residual heating oils—is stronger than ever. Residual oil pollution is unique to large buildings in NYC. Most residual heating oil consumption in the United

States is in New York State and, within the state, in the City. Small buildings and single family homes use #2 oil. As my colleagues from the Administration have testified, residual heating oil is the largest single source of local air pollution.

Introduction 194 requires all heating oil used in any building in the city to be at least 2% biodiesel. The bill also prescribes a cap on the amount of allowable sulfur in #4 heating oil, leading to reductions in the particulate matter from this fuel source. The sulfur content in #4 heating oil is currently 3000ppm and Intro 194 would define a range between 1000 and 2000ppm. I will first comment on the biodiesel provision of Introduction 194 and will then comment on the sulfur cap provision of the same bill.

Bioheating fuel blends – the mix of heating oil with biodiesel – do not require boiler retrofits or changes in the existing fuel distribution network. The use of bioheating fuel would lower emissions of air pollutants and greenhouse gases, reduce maintenance costs, provide other operational benefits, strengthen the alternative fuels market, support regional farmers and local businesses, and increase energy independence and the diversity of supply. The Administration believes that the biodiesel requirement specified in Introduction 194 is feasible based on the current state of investment in the domestic industry. Already, one local company has built a refinery with a capacity to produce 110 million gallons of biodiesel a year, and another company is proposing to refine waste restaurant cooking oil into 3 million gallons of biodiesel a year, at two separate facilities in Brooklyn. To fulfill this mandate, the City will require approximately 20 million gallons of biodiesel for blending with the heating oil consumed annually in New York City. This volume can easily be procured by local and regional biodiesel suppliers. Further, estimates of waste vegetable oil available from the City's

22,822 restaurants vary but stay within a range between 13 and 53 million gallons. Additional waste cooking oils are generated by limited service establishments, local food manufacturing and other food service industries. This represents more than ample supply of feedstock for the majority of the biodiesel volume required by Introduction 194. Estimates by Cornell University and NYSERDA show that potential waste vegetable oil production in NYC could yield 32-85% of the biodiesel needed for B2 mandate and the local biodiesel industry maintains that it could service 50-75% of a B2 mandate with locally-derived waste vegetable oil.

Because local collection, processing and delivery is possible, the Administration believes that Introduction 194 should specify that at least 50% of the feedstock used to create the biodiesel needs to be certified to be recycled restaurant grease (waste vegetable oil). The U.S. EPA's 2010 Final Renewable Fuel Standard determines that biodiesel produced from domestic soybean oil reduces greenhouse gas emissions by 57% compared to petroleum diesel fuel (a significant improvement over the oil we consume now); while its uncertainty analysis states that the greenhouse gas emissions reduction could be as high as 85%. EPA's standard incorporates land use changes and other lifecycle factors in determining the final score of each feedstock. Biodiesel from waste vegetable oil (WVO) scores an 87% reduction compared to petroleum diesel fuel. As long as the legislation remains at a 2% level, and some restriction is placed on the feedstock or sourcing of the fuel to ensure that widespread negative land-use impacts do not result, we no longer have the concerns that we once did relating to food-supply and land-use impacts of a biodiesel mandate.

The other provision of Intro 194 would give the Commissioner of Environmental Protection the power to regulate the sulfur concentration of #4 heating oil to a level between 1000 and 2000 parts per million. As Commissioner Holloway has testified, this will have a significant impact on air quality at a low cost, and is part of the City's overall thinking on cleaner air.

I know that few people oppose cleaner air; they only oppose higher costs. Over the course of the last year, we have thoroughly considered the costs of several different courses of action on heating oil. Unfortunately, I expect that you will hear misleading information, verging on scare tactics, around the cost implications of addressing heating oil. I'd like to share what we know and believe to be the case, and I ask that you bear these points in mind as you hear the morning's testimony.

The New York City Council first passed limits on the sulfur content of heating oil in 1966. At the time, oil and energy interests considered the law "not practical"; it was argued that the cleaner standards imperiled the traditional supply of heating oil to the East Coast from Venezuela, and that the new standards of oil were incompatible with existing building equipment.[1] However, after the sulfur cap and other clean air rules were adopted, the oil industry actually was able to comply with the new rule two years ahead of schedule, in 1969 rather than in 1971.[2]

As a result of the current sulfur cap in place, the #6 and #4 dirty heating oil sold in New York City is not the same as that sold elsewhere in New York State. This means that its price is higher, and that it is already blended specifically to meet New York City

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[1] "Council acts to curb pollution of air," New York Times, April 15, 1966; "City asks Con Ed to act speedily to cut pollution," New York Times, January 5, 1967; "Laws requiring cleaner fuel pose problem for many building owners in U.S.," New York Times, September 22, 1969.

[2] "City begins drive on dirty fuel oil," New York Times, August 2, 1969.

standards. Over the last year, some analyses that I have seen have cited very high figures for how much more expensive low-sulfur #4 oil will be compared to regular #4 oil, and particularly to #6 oil, but these analyses usually fail to take into account the fact that New York City #6 oil is not the same as New York State #6 oil or the national average. When you hear a percentage increase, please ask whether the figures are New York City-specific. Any comparison using New York State or national prices for #4 and #6 oil is invalid. And, of course, this bill deals only with #4 oil – so a comparison with #6 oil is not directly relevant to the provisions of Intro 194.

Because #4 oil is a blend of #6 and #2 oils, and because #6 oil cannot be made significantly cleaner than the current standards require, Intro 194 would essentially require suppliers to create #4 using a portion of low-sulfur or ultra-low-sulfur #2 oil. This feedstock is readily available because ultra-low sulfur #2 oil is the current standard for diesel oil in the United States.

Some have argued that ultra-low sulfur diesel oil is wildly more expensive than dirtier #2 heating oil, and that this price premium will make the low-sulfur #4 cost-prohibitive. I do not believe this to be the case. The current premium of ultra-low-sulfur diesel is 8 cents per gallon over the cost of #2 heating oil. With #4 oil consisting of between 35% and 65% #2 oil, any increase in costs attributable to the #2 component can be, at most, 3 to 5 cents per gallon, or 2-4%.

Some have argued that, as a transportation fuel, ultra-low-sulfur diesel fuel is more volatile in price than home heating oil. However, the fact is that virtually all of the fluctuations in gasoline, diesel oil, and heating oil are due to the fundamental price of a barrel of crude oil. With the peak driving season being the summer – the period of least usage of heating oil – the majority of transportation-related fluctuations will not affect building owners' prices.

Finally, some have argued that, by adding a new use for ultra-low-sulfur diesel fuel, Intro 194 would cause a shortage of supply that would lead to massive price spikes in diesel fuel and thus also in heating oil. The fact is that the market for diesel fuel so dwarfs the market for #4 oil in New York City that this seems difficult to believe. In 2008, our best data indicates that trucks and buses consumed 175 million gallons of diesel fuel in the five boroughs alone, and diesel consumption in New York State was over 1.2 billion gallons in 2007, the most recent year for which we have good data.[3] The total consumption of #4 oil in New York City is 84 million gallons; even at a high concentration of 65% diesel fuel, converting #4 oil to low-sulfur standards would increase annual diesel demand by 54 million gallons a year—a small fraction of the 1.2 billion figure. Thus, it is unlikely to have dramatic affects on the overall regional supply or price of ultra-low-sulfur diesel. Data based on the unique spike in early 2008 – a combination of the highest point of oil prices, an overheated economy, and a phase-in of new nationwide fuel standards – should not be used as an example of what is likely to happen.

The other area of concern is the impact that Intro 194, and any other action on heating oil, might have on the rents that New Yorkers pay, particularly in rent-regulated buildings. Here, too, some analyses have cited Rent Guidelines Board documents but misused information. According to the Rent Guidelines Board's most recent 2010 Price

[3]Energy Information Administration, "Transportation Sector Energy Consumption Estimates, Selected Years, 1960-2007, New York", available at http://www.eia.doe.gov/emeu/states/sep_use/tra/use_tra_ny.html; accessed May 27, 2010. Figure listed is 29.146 million barrels, at 42 gallons to the barrel.

Index of Operating Costs report, (dated April 27, 2010), fuel costs are between 10 and 11% of the total operating costs of the rent-regulated apartment buildings in New York City. However, it is important to note that the majority of these costs are, in fact, cleaner #2 oil; only 1.47% of total operating costs are #4 oil, and even the sum of #4 and #6 oil together is only 3.946% (page 12). Thus, the potential price impact of Intro 194 on the operating costs of rent regulated buildings is the 2-4% price impact of the ULSD component on the 1.47% portion of costs that is #4 oil. It would in no case make sense to assume a rent increase based on the total fuel costs when prices would rise for only a fraction of those costs. Furthermore, it is not at all clear that the trends observed by the Rent Guidelines Board suggest that dirty heating oil is, in fact, a smart long-term plan for residents. According to the same report, "Over the past 11 months, fuel oil prices increased by 6.7%. The price for #2 oil, which comprises more than half of this component, declined 1.9%. In contrast, prices for #4 and #6 fuel oil increased, rising 15.6% and 22.5%, respectively" (page 6).

Overall, Intro 194 is a bill that will improve air quality and public health, encourage green jobs, foster the recycling of the city's waste grease, and accomplish all of this at a modest cost. I encourage the Council to act on Intro 194 soon, and we look forward to working with the Council on the details of the bill.

NYC™
Health

Testimony

of

Daniel Kass
Deputy Commissioner, Division of Environmental Health
New York City Department of Health and Mental Hygiene

before the

New York City Council Committee on Environmental Protection

regarding

Intro. 194 Clean Heating Oil in New York City

May 28, 2010

250 Broadway
New York

Good morning Chairperson Gennaro and members of the Committee on Environmental Protection. My name is Daniel Kass, Deputy Commissioner for Environmental Health at the New York City Department of Health and Mental Hygiene. On behalf of Commissioner Farley, I would like to thank you for the opportunity to testify regarding Intro 194 related to use of clean heating oil in NYC. I will briefly touch on the health risks of pollution attributable to the use of residual fuel combustion, the health benefits of the proposed reduction in sulfur content, and the emissions reduction that will be associated with this bill.

There is a large body of scientific evidence linking exposure to air pollution to adverse health outcomes and premature mortality. The air pollutants that are most prevalent in New York City are mainly products of fuel combustion, and include fine particles ($PM_{2.5}$) and gaseous pollutants such as nitrogen dioxide (NO_2) and sulfur dioxide (SO_2).

Fine particles are small airborne pieces of solid material composed of many different elements and metals. Once inhaled, fine particles can penetrate deep into the lungs, causing inflammation of the airways and blood vessels. Research has shown that chronic exposures to fine particles can increase the prevalence and severity of respiratory and cardiovascular illnesses, and premature mortality. Cardiovascular disease in NYC is the number one cause of death, killing over 22,500 people each year.

Nitrogen dioxide is emitted when fuels are burned at high temperatures. It causes irritation of the lungs and has been linked to emergency department visits and hospital admissions for respiratory illnesses, including asthma. Nitrogen oxides also contribute to the formation of ozone and $PM_{2.5}$.

Sulfur dioxide is produced by burning sulfur-containing fuels. In New York City, where we long ago eliminated the burning of coal, the principal source of sulfur dioxide is from the burning of No. 4 and No. 6 fuel oils, which have the highest sulfur content of all the fuels commonly used for heating. Sulfur dioxide can exacerbate asthma, and may contribute to other forms of respiratory and cardiovascular illness. Residual fuel oil emissions contain large amounts of sulfur, nickel, vanadium, and other metals. As a result, burning No. 6 residual fuel oil releases $PM_{2.5}$ with relatively higher levels of nickel. Likewise, No. 4 fuel oil, which is a mix of No. 6 residual oil and cleaner-burning distillate oil, also increases airborne nickel concentrations.

Growing scientific evidence suggests that fine particles from residual oil burning may have especially strong adverse health effects. Laboratory research, including animal exposure studies and human cell studies, suggest that these particulates can directly impact the respiratory and cardiovascular systems, as well as cause changes in the immune system. Two recent epidemiologic studies show that $PM_{2.5}$ with higher nickel content may have greater health effects in humans than other particulates.

In 2007, PlaNYC charged the Health Department with developing the New York City Community Air Survey (NYCCAS), one of the largest urban air pollution studies conducted to date. Launched in December 2008, NYCCAS involves measurements of street-level air pollution at 150 locations throughout the city, in every season of the year.

NYCCAS set out to evaluate how air quality varies across the city. Our first report on winter-time air pollution, released in December 2009, demonstrated that the strongest predictor of $PM_{2.5}$ and SO_2, was the density of nearby buildings, and specifically the density of buildings burning fuel oil. Another way to state this is that areas with the greatest concentration of buildings burning these fuels had the highest levels of levels of $PM_{2.5}$ and SO_2.

Earlier this week, we issued a second report, detailing the variation in airborne concentrations of the metal nickel across New York City. The principal source of nickel in New York City is from the burning of No. 4 and No. 6 oil. Nickel levels were highest in neighborhoods with the highest density of boilers burning these fuels, principally in Manhattan and the Bronx, and in parts of Queens. Nickel levels in areas with a high density of No. 4 and No. 6 oil burning units were nearly four times those in areas with low density of these units. In fact, the difference in the number of these boilers explained about 60% of the variability in nickel across the city.

NYCCAS air monitoring also found that sulfur dioxide levels were 1.5 times greater in areas of high, compared to low, density of No. 4 and No. 6 burning units, explained by the high sulfur content of residual fuel oils. Again, the difference in the number of these boilers explained about 50% of the variability across the city.

The levels of these pollutants in NYC contribute to significant illness and loss of life, and scientific evidence suggests that the combined exposures to multiple urban air pollutants may be especially harmful. Preliminary analyses indicate that current $PM_{2.5}$ levels in New York City are associated with potentially thousands of premature mortalities and hospital admissions due to respiratory and cardiovascular illness annually. By extension, even modest incremental reductions in the emissions of these most harmful pollutants will have significant public health benefits and increase life expectancies. Although the precise health benefits of a residual oil phase-out strategy are currently unknown, epidemiological evidence indicates that reducing exposures to harmful air pollutants, particularly those linked to No. 4 and No. 6 fuel combustion would result in a reduction in the number of asthma hospitalizations, heart attacks, reduced prevalence of cardiovascular disease, and reductions in the number of premature deaths.

Thank you for the opportunity to testify. We would be pleased to answer any questions.

AMERICAN LUNG ASSOCIATION®
IN NEW YORK

Testimony of
Michael Seilback, Vice President, Public Policy & Communications
American Lung Association in New York
May 28, 2010

Good morning Chairman Gennaro and members of the Environmental Protection Committee. My name is Michael Seilback, VP Public Policy & Communications for the American Lung Association in New York.

I, along with many of the people in this room, testified before this committee over one year ago about biofuels. The fact remains that over one million New York City residents still have asthma, 300,000 of which are children. I hope that this hearing will lead to action by this council to clean up the heating oil New Yorkers use to heat their homes.

New Yorkers are exposed to some of the most unhealthy air pollution levels in the country. Just last month we released the newest version of our State of the Air report. Once again, it shows that the outdoor air quality in the five boroughs is toxic. Long term exposure to particle pollution and ozone can permanently damage lung tissue and have been shown to shorten lives. Additionally, just yesterday the City's DOHMH came out with a report which once again illustrates the profound effect that air pollution from heating oil is having on New Yorkers.

In order to significantly improve the air quality right here in New York City, our Association has long advocated for cleaning up home heating oil. The combustion of sulfur-laden home heating oil contributes significantly to the high ambient concentrations of ozone and fine particles found in New York State – particularly in New York City and the surrounding counties. To that end, we are strong advocates for the use of biodiesel in the home heating sector to address this significant source of pollution. We also are strong advocates for the mandatory reduction of sulfur in heating oil, similar to what we have seen in the on-road and off-road sectors.

Since it has such a high level of sulfur, combustion of home heating oil makes it the second largest source of sulfur dioxide emissions in the State, second only to the power sector.

In New York City alone, nearly one million households heat their homes each winter with heating oil. Over 79% of the State's consumption of heating oil occurs in the New York Metropolitan area, contributing to New York City's poor air quality. Yet most New Yorkers are not aware that this is a significant source of pollution in their homes and that alternative, cleaner fuels exist for home heating purposes. The use of a b2 Bioheat blend is one such alternative that New York City should require as a cleaner, cost efficient option.

Unlike the use of biofuels in some other sectors, Bioheat has been shown to reduce emissions of all pollutants. Promoting the use of Bioheat, consisting of 2% biodiesel in combination with low or ultra low-sulfur fuel, will begin to reduce the sulfur dioxide and NOx emissions from heating oil use. As bioheat blends up to b20 are used, a very significant air quality and public health benefit will be gained.

With regards to Intro 194, the American Lung Association in New York supports the bill, but we do have some recommendations regarding the details. We agree with many of our environmental colleagues that the bill should have a robust Waste Vegetable Oil (WVO) component. As you know waste vegetable oil could be both produced locally and refined locally, therefore drastically reducing some of the life-cycle problems we see from some other sources of biodiesel.

With regards to the sulfur component, we continue to work on the state level to pass legislation to require the use of ULS (15ppm) #2 heating oil, and with the Bloomberg Administration on ways to phase out the use of #6 heating oil.

In this legislation, we believe that the sulfur level of #4 HHO should be capped at no more than 1500ppm for #4 residual fuel effective in 2011. These sulfur reductions will have immediate public health benefits. The time is now to clean up the air that we breathe. Pass Intro 194 and bring New York City closer to a day where the air we breathe is not making people sick.

Thank you for the opportunity to comment.

THE COUNCIL
THE CITY OF NEW YORK

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I intend to appear and speak on Int. No. ________ Res. No. ________
☐ in favor ☐ in opposition BIOHEAT BILL

Date: ________

(PLEASE PRINT)

Name: BRENT BAKER

Address: 209 E. 7th ST #SW

I represent: TRI-STATE BIODIESEL

Address: 531 BARRETTO ST.

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☐ in favor ☐ in opposition

Date: ________

(PLEASE PRINT)

Name: Commissioner Cas Holloway

Address: 59-17 Junction Blvd

I represent: DEP

Address: ________

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THE CITY OF NEW YORK

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☒ in favor ☐ in opposition

Date: ________

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Name: Isabelle Silverman

Address: 257 PAS

I represent: EDF

Address: ________

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☒ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: MICHAEL SEILBACK

Address: 116 John St, 30th FL NY NY

I represent: American Lung Association in NY

Address: ___

THE COUNCIL
THE CITY OF NEW YORK

Appearance Card

I intend to appear and speak on Int. No. 194 Res. No. ___

☐ in favor ☐ in opposition ☒ comments

Date: 5-28-10

(PLEASE PRINT)

Name: Mary Ann Rothman

Address: 1101 Riverside Drive NYC 10024

I represent: Council of NY Cooperatives & Condominiums

Address: 250 W 57 St # 730 NYC 10107

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☐ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: MICHAEL N. ROMITA

Address: ___

I represent: CASTLE OIL CORP

Address: 440 Mamaroneck Ave., Harrison, NY 10528

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☒ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: Angela Sun

Address: 570 Lex

I represent: REBNY

Address: ______

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THE CITY OF NEW YORK

Appearance Card

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☐ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: Steven Dallas

Address: 215 East 72nd Street New York, NY 10021

I represent: New York League of Conservation Voters

Address: 30 Broad Street New York, NY 10004

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☐ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: Michael Heimbinder

Address: 107 S. Elliott, #2, Brooklyn

I represent: HabitatMap

Address: 107 S. Elliott, #2 Brooklyn

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☐ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: Don Scott

Address: ~~[illegible]~~

I represent: National Biodiesel Board

Address: P.O. 104898 Jefferson City, MO 65110

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☑ in favor ☐ in opposition

Date: 5/28/10

(PLEASE PRINT)

Name: RICHARD NELSON

Address: ________

I represent: ~~NBB~~ National Bio Diesel Board

Address: Jefferson City, MO

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Appearance Card

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☑ in favor ☐ in opposition

Date: ________

(PLEASE PRINT)

Name: Gene Pullo

Address: ________

I represent: METRO Terminals

Address: ________

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Date: ____

(PLEASE PRINT)

Name: Anna Kirch

Address: 16 Diamond St.

I represent: Urban Justice Center

Address: 123 William Street

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☒ in favor ☐ in opposition

Date: ____

(PLEASE PRINT)

Name: Harvey Epstein

Address: 172 East 4th St

I represent: Urban Justice Center

Address: 123 William Street

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☐ in favor ☐ in opposition

Date: ____

(PLEASE PRINT)

Name: DAN KASS

Address: DEPUTY COMMISSIONER

I represent: DOHMH

Address: ____

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Date: 5/28/10

(PLEASE PRINT)

Name: ROHIT AGGARWALA

Address: 253 BROADWAY 10TH FL

I represent: MAYOR'S OFFICE

Address: ______

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THE CITY OF NEW YORK

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☐ in favor ☐ in opposition

Date: ______

(PLEASE PRINT)

Name: CAS HOLLOWAY

Address: ______

I represent: COMMISSIONER, DEPT OF ENVIRONMENTAL PROTECTION

Address: ______

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THE CITY OF NEW YORK

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☒ in favor ☐ in opposition

Date: ______

(PLEASE PRINT)

Name: RICH KASSEL

Address: c/o NRDC 40 W. 20 St, NY 10011

I represent: Natural Resources Defense Council

Address: 40 W. 20 St.

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☑ in favor ☐ in opposition

Date: ______

(PLEASE PRINT)

Name: John Maniscalco

Address: 183 Madison Ave NY NY

I represent: New York Oil Heating Assn

Address: ______

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☐ in favor ☐ in opposition

Date: MAY 28, 2010

(PLEASE PRINT)

Name: JASON A SCHWARTZ

Address: 601 W. 57TH ST #32R 10019

I represent: INSTITUTE FOR POLICY INTEGRITY

Address: 245 SULLIVAN STREET #472 10012

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THE CITY OF NEW YORK

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Date: 5/28/10

(PLEASE PRINT)

Name: Demos Demopoulos

Address: ______

I represent: TEAMSTERS 553

Address: ______

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☑ in favor ☐ in opposition
Date: 5/28/10

(PLEASE PRINT)

Name: GENE V. PULLO
Address: 5 RIVERVIEW TERRACE
I represent: METRO TERMINALS
Address: 500 KINGSLAND AVENUE

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☐ in favor ☑ in opposition
Date: 5/28/10

(PLEASE PRINT)

Name: FRANK RICCI
Address: ______
I represent: RSA
Address: ______

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