It’s Getting Hot in Here: Heating New York City

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Introduction

As a city of over 9 million citizens, New York City (NYC) is no stranger to wicked problems; with the issue of heating being no exception. The following document will address the interconnected factors that contribute to the complexity of this issue. Until 2010, most of the energy needed to heat residential homes and commercial buildings in NYC came from burning No.4 and 6 oil, a thick tar-like substance with biophysical and social issues surrounding its use (Frost, 2015). In 2010, a report for the Environmental Disease Fund found that 14% of fine particle matter emissions came from heating fuel, which contributes more to overall air pollution than traffic and power plants. Additionally, it was discovered that 1% of houses were contributing to 86% of overall soot (Mayor’s Office of Sustainability, 2014).

On the surface the solution to the problem seems simple and straightforward; shift from using No. 6 oil to the cleaner alternatives of natural gas or No. 2 oil. The local government set the

deadline of June 2015 for tenants to make the switch to cleaner heating. However, there are many buildings that have yet to make the switch. This map from NYC Clean Heat displays both buildings that are still using No. 4 or No. 6 oil, and those which have converted to cleaner fuels: https://www.nyccleanheat.org/spot-the-soot.

Moreover, this project will provide a comprehensive outline of the issues surrounding heating in NYC and the associated social, environmental, economic, and health impacts. Firstly, it will frame the problem of heating in NYC; secondly, it will display a mental map of the different stakeholders involved and will categorize the many tangents of the issue; thirdly, it will provide a detailed account of the global, international, and regional agreements, the federal, state, and local legislations, and the non-statutory and cultural traditions involved in the decision making process. Lastly, it will provide recommendations moving forward in solving the heating problem in NYC and the associated problems.

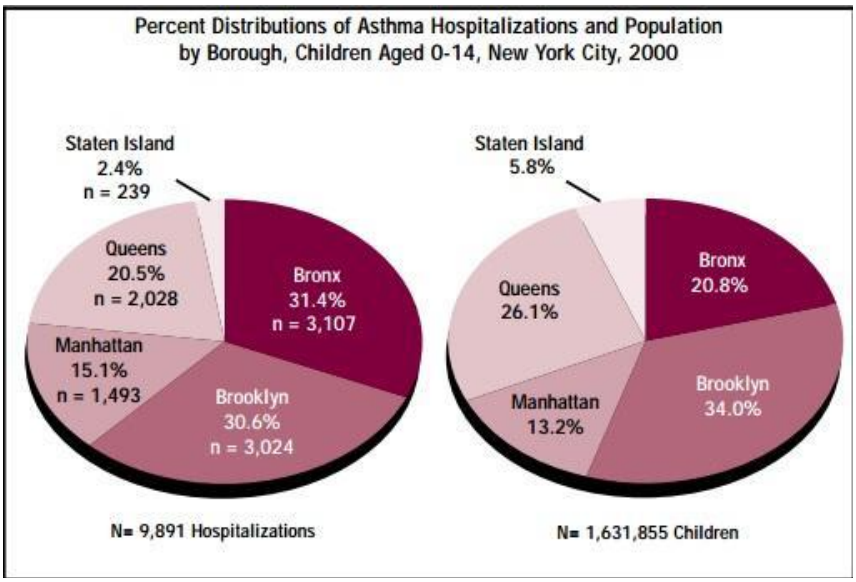
Framing the Problem

The broad issue of heating in NYC is composed of multiple environmental, social, and economic components – which are all intertwined. In order to frame this issue, we must consider what makes it hard to solve, and which issues surrounding it are most important and why.

One key element of this wicked problem, which makes it particularly difficult to solve, is the number of stakeholders involved. The local government is the main stakeholder, as they have the authority to implement policies regarding which heating methods can be used. Another main stakeholder in this issue are energy companies, who are all competing to provide New York City with different sources of energy. Thus, landlords in the city are key stakeholders, as they are the ones at the ground level who will be implementing any changes in policy the government makes. The main concern of the landlords is that energy sources must be as low cost as possible, and they are unhappy about paying $5,000-17,000 to switch boilers that burn natural gas (Gregory, 2014). Environmental groups such as the Environmental Defense Fund, PlaNYC, and Urban Green Council are concerned with which heating methods are being used in NYC and its impact on the environment. Finally, tenants of the most polluted areas are concerned about cost of heating and how different heating methods will affect their health, shown in Figure 1.

Peggy Shepard and Chuck Sutton march in Martin Luther King Jr. Day rally against North River sewage treatment plant. "We Act For Environmental Justice" (2015).

The next point of discussion is the disproportionate impact on public health caused by the burning of heating dirty oil and the resulting air pollution. This has not been highlighted as the most important issue, as most citizens and tenants living in New York's poorest areas do not have an influence on how to solve this problem and are often overlooked when policies are formed. NYC has an incredibly diverse population in terms of race and socio-economic status, and this greatly impacts by how much they are exposed to the damaging effects of air pollution. Such impacts on health include increased risk of cardiovascular disease (Haley et al, 2009) and is particularly dangerous for those with asthma in ethnic minority areas (Garg et al, 2003) with low socioeconomic status (Mortimer et al, 2002). Furthermore, NYC is sparse, sprawling across 305 square miles and five boroughs, making it difficult to provide energy equally to all of these areas where people have a high demand for energy. An issue which comes into play here is that of environmental justice, which the Environmental Protection Agency (US EPA, 2012) defines as people being proportionately impacted by negative environmental consequences. However, Figure 2 shows that children in the Bronx and Brooklyn are more likely to be hospitalized due to asthma.



Garg, R. & Karpati, A. et al. (2003)

The high level of inequality in NYC leads to another important facet of why this is such a complex problem to solve. Although the local government has imposed a ban on burning dirty number 6 oil, a thick, tar like substance (Frost, 2015), in the hope that landlords will make the switch to using cleaner natural gas to heat their homes, many areas in New York City's poorest boroughs don't have access to gas pipelines, meaning they are forced to continue burning unhealthy dirty number 6 oil until the local government allow them access to gas mains. This is an example of environmental racism, which is a key issue in resource management in NYC.

The next most important issue is the climate of New York City; this issue would not be as complex if the city didn't have such a large temperature range between winter and summer, especially due to the urban heat island effect, resulting in increased energy needs for heating and air conditioning.

Click for a fully interactive mind-map

Governance Framework

Governance Practices and Key Decision Makers

Solving the heating problem in New York City requires global, international, and regional agreements to mitigate climate change through cleaner heating processes. Government legislation towards this goal exists on federal, state, and local levels. Non-statutory institutions and cultural settings are also highly relevant. The decision makers at each of these levels impact resolutions to the heating problem in New York City to varying degrees.

Global, International, and Regional Agreements

Globally and internationally, the key decision makers that contribute to solving New York City's heating problem are the United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol. The Kyoto Protocol strengthens the convention and provides a framework for action. The agreements of this convention and its resulting protocols are what guide New York City's plan to become the world's most sustainable city. For example, the UNFCC states that by 2050, developed countries must reduce their emissions by up to 80 percent to avoid the most dangerous impacts of climate change (UNFCC, 2014). It is this projection that guides New York City's *One City: Built to Last* plan.

Regionally, the most influential decision maker is the Mayor's Office of Long-Term Planning and Sustainability. In particular, Mayor Bill de Blasio's *One City: Built to Last* ten-year plan to transform New York City's buildings for a low-carbon future through transforming buildings into energy efficient entities. The aim is to ensure that the city requires less energy for heating, cooling, and power. The energy that these buildings use will need to come from renewable sources that do not contribute to air and water pollution or to the increase in global temperatures. Further, the city adheres to the 257 initiatives included in *PlaNYC: A Stronger, More Resilient New York*, which aim to make the city, its communities, and its infrastructure more sustainable and resilient (One City: Built to Last, 2014).

Federal, State, and Local Legislation

The U.S. Energy Department is the vanguard of decision-making on the level of federal government. Its mission "is to ensure America's security and prosperity by addressing its energy, environmental, and nuclear challenges through transformative science and technology solutions." Its goal is to include the expertise of citizens – in fields such as science, technology, engineering, national security, international affairs, business – in creating challenging and innovative solutions to climate change (U.S. Energy Department, 2015).

On the state level of government, the New York State Department of Environmental Conservation is a key decision maker in creating greener buildings in the state of New York. In the "Greening Buildings" section of their website, the department sites that more than 70% of New York's energy consumption comes from heating and cooling buildings (NYSDEC, 2015). It provides programs with methods to further lower energy consumption and operating costs, for example Cleaner, Greener Communities, and Climate Smart Communities (NYSDEC, 2015).

On the local level of government, and legislation pertaining directly to New York City in particular, the NYC Department of Environmental Protection (DEP) is the department at the forefront of the decision-making process. Their mission is to protect public health and the environment. The DEP provides a comprehensive account of the city's policy on heating oil. It also has many resources for citizens to learn how to adhere to these regulations (NYSDEC, 2015). The local government implemented the NYC Clean Heat program to phase out dirty heating oils (NYC Clean Heat, 2012), and is responsible for the aforementioned regional agreement—*One City: Built to Last* (One City: Built to Last, 2014).

Non-Statutory Institutions and Cultural Traditions

Heat Seek NYC is an NGO comprised of New Yorkers dedicated to ensuring access to heating throughout the winter by encouraging landlords to heat their buildings more effectively whilst reducing running costs. They highlight that the heating problem in New York City creates a public health hazard and causes animosity between tenants and landlords. They aim "to empower tenants, landlords, community organizations, and the justice system to tackle [New York City's] heating crisis" (Heat Seek NYC, 2014).

The actions and cooperation of the landlords and tenants of New York City's buildings is what will cause these agreements and pieces of legislation to fail or succeed. Though citizens are most affected by the heating problem in New York City, there is no guarantee that their opinions will shape policy (Darby, 2010). This is clear in the government's failure to recognize the disproportionate effect issues surrounding heating in New York City have on ethnic minorities and low-income communities. This issue of environmental justice is overlooked by most policies and legislation. To solve the heating problem in New York City, agreements and legislation on all levels are relevant. Global, international, and regional agreements, federal, state, and local legislation, and non-statutory institutions and cultural traditions are all vital in combating climate change in New York City. They must work together with landlords and tenants to create a healthy and just environment for all New Yorkers.

Moving Forward

There are four key themes in which solutions to NYC's heating problem should address: health, economic, social, and environmental.

Health

Typically impacts on the environment are often the sole focus in campaigns for cleaner and renewable energy policies. However incorporating the detrimental health effects into the campaign for cleaner energy may lead to a greater impact. Individuals may more easily connect to health compared to climate change. A case could also be made for the economic benefits associated with improved health.

Despite the scientific evidence about the health impacts of pollution, educating the public on the negative health effects of pollution is challenging because chronic diseases develop slowly and over long periods of time. Additionally, chronic health conditions are influenced by a range of factors. Finally, it may be challenging to use the economic effects associated with these public health impacts as a compelling argument to the public because these effects are largely indirect (Pope and Dockery, 2006; Auerbach and Flieger, 1967).

Economic

NYC must work in concert with private energy providers, specifically natural gas companies, to ensure that every citizen has access to clean, affordable energy. This will require massive infrastructure projects to build pipelines to all neighbourhoods and will demand substantial capital.

Fortunately, this process has already begun with the completion of an expansion on of the existing Texas Eastern Transmission pipeline from Linden, New Jersey to Manhattan, New York (see fig. 3 containing the image and link to video). This project was competed on November 1, 2013 and has provided millions of New Yorkers with natural gas, with an estimated reduction of 6 million tons of carbon dioxide per year, the equivalent of removing 1 million cars from the road (SpectraEnergy).

This $1.2 billion, privately funded expansion was made possible with the approval of the Federal Energy Regulatory Commission (FERC) and carried out by Spectra Energy (SpectraEnergy).

This is a great start, but there are still million of residents without access to clean and/or adequate energy. Private energy companies are encouraged to work with the city in a mutually beneficial partnership to bring all New Yorkers the energy they need.

Social

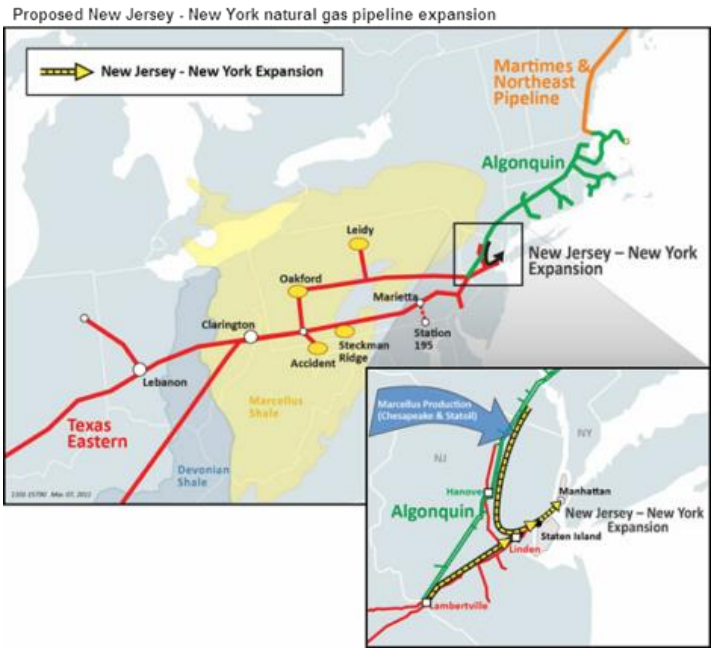


Fig. 3: Madrigal, A. (2013).

Issues of environmental justice and racism do not have quick solutions, as these issues are embedded in structures that have formed over hundreds of years. A progressive solution to this problem is allowing communities in Harlem and the Bronx to meet with policymakers throughout the year to raise concerns about the levels of soot and to work together to form a more inclusive policy. The aim of this solution is to move forward to a more equal city where all citizens have a say in the governance of resources. Furthermore, what heating method NYC uses is strongly connected to the community's health, which is a key issue identified in low socio-economic communities for improvement (Velez, 2013). The initial steps for this solution would be to advertise for people who are concerned with an environmental issue to come together to meet with a representative from the local government. This could be the first step in tackling environmental injustice in NYC. Furthermore, as mentioned previously, a solution could be building gas pipelines in all boroughs of New York City so everyone of all socio-economic status' can have access to cleaner natural gas. However, due to institutionalized inequality, the financial burden and consequences such as the disruption building of pipelines would cause, this solution may not be feasible.

Environment

The irrefutable impact heating in New York City has on the environment should continue to be at the forefront in future decision making. The local government should make an effort to invest more in supporting initiatives that advertise the damage burning No. 4 and No. 6 heating oils have on public health and the environment. However, all of the current environmental initiatives rely on the participation and cooperation of New Yorkers. Therefore, the social, economic, and health impacts require more attention as they are all interconnected with environmental issues. It is vital that the citizens, landlords and tenants, in New York City are aware of their impact on climate change and are given the opportunity and guidance to mitigate the detrimental effects that their actions have on public health and the environment. The Mayor's One City: Built to Last plan is a transparent initiative which aims to ensure the highest energy performance standards are available in every borough of NYC and claims to

be driven by stakeholder feedback (One City: Built to Last, 2014). While the initiatives proposed in the Mayor's ten year plan are making clear progress in improving NYC's air quality, they are not meeting the idealistic goals they propose. This is clear as issues of environmental injustice are still prominent in the poorest boroughs of NYC.

References

Peer Reviewed Articles

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C. Arden Pope III & Douglas W. Dockery (2006) Health Effects of Fine Particulate Air Pollution: Lines that Connect*, Journal of the Air & Waste Management Association*, 56:6, 709-742, DOI: 10.1080/10473289.2006.10464485

Balint, P. J., Desai, A., Stewart, R. E., & Walters, L. C. (2011). Risk and Uncertainty in Environmental Management. *Wicked Environmental Problems* (7-32). Washington DC: Island Press.

Camann, D. E., Kinney, P. L., Perera, F. P., Tonne, C. C., & Whyatt, R. M. (2004). Predictors of Personal Polycyclic Aromatic Hydrocarbon Exposures among Pregnant Minority Women in New York City. *Environmental Health Perspectives*, 112, 754-759.

Cohen, S. (2011). *The Centrality of Energy. Sustainability Management: Lessons fromand for New York City, America, and the Planet* (pp. 40-74). New York, NY: Columbia University Press.

This chapter, from the book "Sustainability Management: Lessons from and for New York City, America, and the Planet," addresses two discourses surrounding the Property Assessed Clean Energy (PACE) program. Firstly, in his section titled "Financing Green Energy", Cohen explores PACE as a public policy solution and its ability to help building owners save money while reducing their environmental impacts. The main difficulty, however, is in the private sector. Landlords have little incentive to invest in expensive energy-efficient retrofits that "will accrue savings to their tenants but not to themselves" (53). He acknowledges that this is especially difficult in New York City because rents are strictly regulated. However, PACE legislation provides communities with the ability to designate a district in which property owners can finance energy efficiency or renewable energy improvements to their property. The debt is then added to the property tax bill. His second argument, "The Federal Government Attacks Creative Local Green Energy Finance," discusses the ways in which the federal government has failed to support this "positive and effective means of financing green energy" (52). Federal housing agencies have attacked PACE and "demonstrated an obtuse hostility toward green energy initiatives" (54).

Corburn, J., Osleeb, J., & Porter, M. (2006). Urban Asthma and the Neighbourhood Environment in New York City. *Health & Place, 12, 167-179.*

Darby, S.(2010). *Natural Resource Governance: New Frontiers in Transparency and Accountability*. London.

Haley, V. Talbot, T. and Felton, H. (2009). Surveillance of the Short-Term Impact of Fine Particle Air Pollution on Cardiovascular Disease Hospitalizations in New York State. *Environmental Health*. Volume 8. Issue 42.

The authors of this article work for the New York State Department of Health and New York State Department of Environmental Conservation. This article looks at the relationship between fine particle matter and cardiovascular disease in New York State. Although it doesn't directly relate to New York City, this source is noteworthy as it includes an analysis of the who is more likely to get a cardiovascular disease based on vulnerability of the population, healthcare that's available to them, how exposed they are to fine particle matter and what the matter is made up of.

Data was obtained from New York State hospitals, where the researchers looked at how many people had been admitted with cardiovascular problems. For each of these people, they took their address geocoded them to be able to place this information on a map. Information on poverty was obtained from Census data. Temperature, humidity, and air pressure data were obtained from the National Climatic Data Center. To collect data on fine particle matter, a sample is collected on a filter for 24 hours at ambient temperature and humidity. This sample is then weighed and the mass concentration was calculated. The methods chosen are appropriate as the data was collected from non-bias sources, however due to financial restraints the fine particle matter readings could only be collected every 3 days, which could impact the results. Although the research did not find a link between poverty and susceptibility to air pollution, they do point out that area level poverty may not represent individual risk.

Hughes, J. V. (2014). *Mayor de Blasio Plans Sustainable Retrofit Pilot Program for NYC. National Real Estate Investor*, Retrieved from http://search.proquest.com.ezproxy.library.ubc.ca/docview/1619926706?accountid=14656

Jabareen, Y. (2014). An Assessment Framework for Cities Coping with Climate Change: The Case of New York City and its PlaNYC 2030. *Sustainability*, 6, 5898-5919.doi:10.3390/su6095898

This article proposes "a new conceptual framework for assessing city plans based on the idea of sustainability and planning countering climate change" (5898). It applies this framework to assess PlaNYC. Through this assessment, Jabareen identifies both the merits and the shortcomings of the plan. He claims that "PlaNYC promotes greater compactness and density, enhanced mixed land use, sustainable transportation, greening, and renewal and utilization of underused land" (5859); however, he states that it addresses future uncertainties concerning climate change with purely institutional measures. Though PlaNYC has an ambitious goal and promises a "greener, greater New York," Jabareen reveals that PlaNYC has not made the radical shift to which it aspires. The plan inadequately addresses social planning issues that are crucial to New York City in that it fails to identify the problems facing vulnerable communities as a result of climate change. The article asserts that a critical shortcoming of the plan is that it lacks a systemic procedure for public participation through the city's neighbourhoods, as well as among different social groupings and other stakeholders. While the plan calls for an integrative approach to climate change on the institutional level, Jabareen proves that it fails "to effectively integrate civil society, communities, and grassroots organizations into the process" (5898).

K.M. Mortimer, L.M. Neas, D.W. Dockery, S. Redline, I.B. Tager. 2002. The Effect of Air Pollution on Inner-City Children with Asthma. *European Respiratory Journal.* Volume 19. Issue 4.

This source is a peer-reviewed article for the European Respiratory Journal which looks at the effects of air pollution on inner city children with asthma in 8 inner city areas. Two of the areas considered are East Harlem and The Bronx in New York City. As these are districts of NYC and areas with low socioeconomic status and high rates of poverty, this is highly relevant to my research question. The paper contains an extensive reference list, showing how broad the research was, making this paper particularly noteworthy. Methods included taking data from the National Cooperative Inner City Asthma Study and obtaining air pollution information from the US Environmental Protection Agency. The findings of the research show that in the summer, pollution is related to increased respiratory problems for children with asthma, even at pollution levels below the US's air quality standards. This is highly relevant to my research as it shows the government's air quality standards are set too high and this is causing adverse health effects for vulnerable children in poorer areas of the city.

Kinney, P. Chillrud, S. Ross, J. Spengler, J. Ramstrom, S. 2002. Exposures to multiple air toxics in New York City. *Environmental Health Perspectives*. Volume 110. Supplement 4.

This source is a research article co-written by 5 academics for the journal Environmental Health Perspective. Patrick Kinney works at Mailman school of public health, Steven Chillrud and James Ross are from Columbia University and John D. Spengler and Sonja Ramstrom work at Harvard University. The article analyses the correlation between public health defects and air toxic pollutants in major cities, specifically looking at the levels of air pollution around a public school in Harlem, New York City. Research was focussed on data and methods from TEACH (Toxic Exposure Assessment, Columbia and Harvard) in New York City. This is a wider study which aims to understand pathways and levels of personal exposures to potentially toxic air pollutants in inner city areas of New York City (Lamont Doherty Earth Observatory, 2004). Although this research is helpful for me to understand the link between air pollution and low socio-economic areas, the paper is slightly dated as the field experiments were carried out in 1999. Main argument of the paper is to expose the wide range of toxic pollutants children attending high school in inner New York are exposed to. This is highly relevant to my research, as it highlights the lack of environmental justice in New York, as minorities are more likely to be in areas with poorer air quality. The article looks at how 60% of Hispanic people live in areas failing to meet national ambient air quality standards, linking this to the fact that minorities are associated with low socio-economic areas in cities. Furthermore, the research looks at a wide range of air toxics, including black carbon. This is helpful for my research as soot is a major problem in New York City.

The methods carried out to complete the field research included two field campaigns (winter and summer, 1999) with 8 weeks of fixed-site ambient monitoring on the school roof and on a roof at the Lamont Doherty Earth Observatory (LDEO) in Palisades, New York, in order to compare levels of air pollution within and outside the city centre. Questionnaires were handed out to chosen students in the class who were non-smokers and from non-smoking households. These questionnaires included questions such as listing hobbies that take place outside and home heating and cooking methods. The students were then given an instrument which sampled air quality, which they carried around in a customized backpack.

The field methods carried out by TEACH were excellent, as they captured a wide range of data. Although taking readings from the LDEO is an effective control, it could be more

effective to take readings from a school in a wealthier area to be able to make a direct comparison between socio-economic status and air quality students are exposed to.

Larson, I. M. (2011). Keeping PACE: Federal Mortgage Lenders Halt Local Clean Energy Programs. *Missouri Law Review*, 76, 1-30. Retrieved from http://scholarship.law.missouri.edu/mlr/vol76/iss2/10

Shah Anoop S V, Lee Kuan Ken, McAllister David A, Hunter Amanda, Nair Harish, Whiteley William et al. 2015. Short term exposure to air pollution and stroke: systematic review and meta-analysis. *BMJ.* Volume 350.

This article was published in the BMJ, which is the oldest weekly medical journal and was voted as the medical journal with the 5th most impact. As this paper was published in 2015, it will contain the most up to date data on the correlation between air pollution and stroke sufferers. Although it does not directly relate to New York City, it considers air pollution within an urban setting, which can be related to my research question. Methods used included searching databases such as Global Health, Cumulative Index to Nursing and Allied Health Literature and Web of Science. The researchers did not collect their own data on fine particle matter, but relied on data from other pieces of literature where field data had been collected on a daily basis as to ensure a low risk of bias. This paper is noteworthy as it contains many references, which demonstrates the wide range of literature the authors considered when compiling their analysis. The study found that particulate matter and gaseous pollutants both showed a strong temporal relation with mortality from stroke and admission to hospital for stroke. This source is relevant to my research as it highlights that the association of air pollution and strokes is highest within low and middle income families, which relates to my question of environmental justice within an urban setting. However, one limitation to the study is that the researchers did not have access to primary data, so could not determine if there was an overlap of patients who visited more than one hospital.

Silverman, Seth (2015) Scaling Residential Retrofits in New York City: Financing, Standardization, and Streamlining, *Environmental Claims Journal*, 27:1, 60-92, DOI: 10.1080/10406026.2014.1002351

Solecki, W., Rosenzweig, C., Blake, R., Sherbinin, A. de, Matte, T., Moshary, F., Rosenzweig, B., et al. (2015). New York City Panel on Climate Change 2015 Report Chapter 6: Indicators and Monitoring. *Annals of the New York Academy of Sciences*, 1336(1), 89-106. Retrieved from http://doi.wiley.com/10.1111/nyas.12587

Sufiyan, A. M. (2013). Initiatives of global cities in environmental sustainability: A case of London and New York city. *Journal of Sustainable Development,* 6(3), 1-15. Retrieved from http://search.proquest.com.ezproxy.library.ubc.ca/docview1416212221accountid=14656

Howard, B., Saba, A., Gerrard, M., & Modi, V. (2014). Combined heat and power's potential to meet New York City's sustainability goals. *Energy Policy*, 65, 444-454. Retrieved fromhttp://www.sciencedirect.com/science/article/pii/S0301421513010550

Government Documentation

New York City Mayor's Office of Long-Term Planning and Sustainability (n.d.). *Assessment of New York City Natural Gas Market Fundamentals and Life Cycle Fuel Emissions*. Retrieved

fromhttp://www.nyc.gov/html/planyc2030/downloads/pdf/nyc_combined_natural_gas_report.pdf

City of New York (2014). *Inventory of New York City Greenhouse Gas Emissions.* Retrieved from: http://www.nyc.gov/html/planyc/downloads/pdf/

This is a report created by the mayors office outlining statistical data on the changes in greenhouse gas emissions from 2008-2013, with a focus on city-wide buildings. This report analyzes government and city wide emissions and is full of raw data, particularly important is the analysis of the years after policy was put in place to reduce emissions (i.e. initiative to phase out no. 4 and 6 oil).The report ends with the Citywide GHG Emissions Summary comparing the kinds of energy uses, sector and the subsequent emissions produced. Though this report is published by the acting government and is consequently biased, the raw statistical facts are significant for this research and they are very extensive in their scope

City of New York (2014). *One City: Built to Last*. Retrieved from http://www.nyc.gov/html/ builttolast/assets/downloads/pdf/OneCity.pdf

This is the key report that Mayor de Blasio and his team created to outline their plan to curb carbon emissions in New York with a particular focus on the reduction in carbon associated with heating; the cornerstone being the launch of the Energy and Water Retrofit Accelerator. This is a ten year plan and involves the retrofitting of both private and public buildings with the aid of government subsidies and initiatives. The report is very optimistic and again biased as it is produced by the government; the extent to which the policies will be implemented is yet to be seen. The report is extensive and is rich with data analysis, it is significant because it outlines the many initiatives of the government of New York and also provides data on the progress already made with the overarching goal of 80% reduction in emissions by 2050.

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Holt, Charles A. and Shobe, William and Burtraw, Dallas and Palmer, Karen L. and Goeree, Jacob K. (2007) *Auction Design for Selling CO2 Emission Allowances Under the Regional Greenhouse Gas Initiative.* Retrieved from Regional Greenhouse Gas Initiative: https://www.rggi.org/docs/rggi_auction_final.pdf

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New York State Department of Environmental Conservation (2015) *Developing a Portfolio of Solutions.* Retrieved from: 2 < http://www.dec.ny.gov/about43166.html>

New York State Department of Environmental Conservation (NYSDEC) (2015). *Guidance for Owners of Petroleum Tanks that Store No. 4 or No. 6 Heating Oil in New York City.* Retrieved from:<http://www.dec.ny.gov/chemical/84435.html>

United States Environmental Protection Agency (2015). *Air Quality Statistics Report for New York-Northern New Jersey-Long Island for 2014*. Retrieved from: http://www3.epa.gov/airdata/ad_rep_con.html

This source is a list of statistics generated by the US Environmental Protection Agency, which was set up to protect health and the environment through policy decisions (USEPA, 2015). This website allows me to choose a state or city in the US and view the air quality statistics for a selected year. This is relevant to my research as I can see how much fine particle matter and carbon is in the air in New York compared with other areas in the USA. A list of EPA air quality standards are listed with the data, allowing me to compare the statistics for New York with the EPA's standards. From this information, I can see that New York's fine particle matter is very close to the EPA's standard. I could then compare this data with health data from New York to see if there is a correlation between air pollution and health defects. A limitation to this source is that because it is just raw data, there is no explanation of the methods involved in obtaining the data. This raw data source is particularly noteworthy as there is an accompanying article which describes what the columns of data mean and information on what the report tells you (EPA, 2015). However, data for 2015 is not available yet, which is another limiting factor to my research.

United States Environmental Protection Agency. (2015) *Clean Air Act Requirements and History.* Retrieved from: < http://www2.epa.gov/clean-air-act-overview/clean-air-act-requirements-and-history >

Sklerov, F. (2011) *Department of Environmental Protection and Department of Buildings Unveil New Program to Streamline Approval Process For Upgrading Boilers*. NYC Environmental Protection. Retrieved from: http://www.nyc.gov/*html/dep/*html/press_releases/11-39pr.shtml#.VjJkQ_mrTNM>

The Official Website of the City of New York: Office of the Mayor. (2015) *Mayor de Blasio Launches Retrofit Accelerator, Providing Key Support for Buildings to go Green as NYC Works Toward 80X50*. Retrieved from http://www.nyc.gov/html/gbee/html/challenge/nyc-carbon-challenge.shtml

World Health Organization (2014). *WHO Indoor Air Quality Guidelines: Household Fuel Combustion.* Retrieved from WHO: http://www.who.int/indoorair/guidelines/hhfc/*en/*

Grey Literature

Environmental Defence Fund (2015) *New York City Slams Harmful Soot Pollution Retrieved from*: <https://www.edf.org/health/air/new-york-heating-oil>

This is an article from the Environmental Defence Fund, who are one of the world's largest environmental organizations, who find solutions to problems whilst protecting natural systems and benefiting human health. The article discusses that the EDF, in collaboration with the city, set up NYC Clean heat, which helps building managers switch from dirty No.6 oil to cleaner heating fuels. Although this reference is quite short, it supplies information surrounding why they developed NYC Clean Heat, mainly due to the health problems associated with soot in NYC, which is relevant to my research. This article is noteworthy and reliable as it is written by the organisation who are committed to helping the residents of New York City experience a cleaner environment. Furthermore, they are tackling the issue of environmental justice by helping building managers make the switch to a cleaner heating method, as managers in poorer areas may not have had the funds to make the switch.

Environment New York (2015), *Go Solar New York.* Retrieved from: <http://www.environmentnewyork.org/programs/nye/go-solar-new-york>

We Act For Environmental Justice (WE ACT) (2015). *Peggy Shepard and Chuck Sutton march in Martin Luther King, Jr. Day rally against North River Sewage Treatment Plant.* Retrieved from:https://d3n8a8pro7vhmx.cloudfront.net/weact/pages/545/attachments/original/1442521216/WE_ACT_for_Environmental_Justice_17th_Anniversary_Report.pdf?1442521216. Accessed 27/11/15

Popular Media

Frost, E. (2015). *MAP: Dozens of NYC Buildings Illegally Burning Dirty Oil Past Deadline.* DNAInfo. Retrieved from: <https://www.dnainfo.com/new-york20150826/upper-west-side/map-dozens-of-nyc-buildings-illegally-burning-dirty-oil-past-deadline>

This source is a news article is from DNAinfo.com, which reports on local news in New York and Chicago. The author is Emily Frost, who is a producer/reporter for the Upper West Side of New York. The main argument of this report is that although the deadline for New York residents to stop burning No.6 oil has passed, some residents continue to do so, which is leading to continued risk of asthma and heart attacks. There are no references within the text, which would be beneficial for the reader to find out where the author obtained the health data from. Although it is unreferenced, it gives information on the timeline used by the New York government for when they want to phase out the use of No.6 oil.

There is a map of New York which shows the buildings which are still burning No.6 oil, and a number of them are in Manhattan's wealthiest districts in the Upper West Side. This is helpful to my research as it shows that even the wealthiest in New York are not immune to the effects of dirty oil. It also allows me to consider that although No.6 oil continues to be burned in wealthier districts of New York such as Manhattan, by using my Asthma Facts (2003) raw data source I can see that Manhattan has the lowest percentage of children being admitted to hospital for asthma hospitalizations, and poorer boroughs such as The Bronx have a much higher rate. Although this source doesn't contain references for the data presented, it is noteworthy and relevant for my research as it gives a picture of the local use of No.6 oil.

Gregory, K. (2014). *Cost Among Hurdles Slowing New York City's Plan to Phase Out Dirty Heating Oil*. Retrieved November 28, 2015, from http://www.nytimes.com/2014/04/07/nyregion/cost-among-hurdles-slowing-new-yorks-plan-to-phase-out-dirty-heating-oil.html?_r=0

This source is from The New York Times and was written by Kia Gregory, who has written many articles for the newspaper, primarily regarding issues in Harlem, one of New York's poorer districts. This reference is particularly noteworthy as it gives the residents of some of New York's most polluted areas a voice, providing significant insight to their concerns regarding their health and air pollution. The author interviewed one New York resident who is concerned for her grandson's health so keeps the windows closed, and another who is concerned to move to an apartment on a higher level, closer to the chimney. This article also highlights issues of environmental injustice, where the poorest districts in New York don't have access to gas mains, which means they will continue to burn No.6 oil, resulting in them being more at risk to health issues connected to air pollution. The sources for this article are reliable as they are the ones who are experiencing New York's heating problem at ground level.

Madrigal, A. (2013). *New York City's Energy Infrastructure Transformed Last Month and Nobody Noticed.* Retrieved November 28, 2015, from http://www.theatlantic.com/technology/archive/2013/12/new-york-citys-energy-infrastructure-transformed-last-month-and-nobody-noticed/282043/

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Data Sources

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Public Health Impacts and Resiliency (2015). *Annals of the New York Academy of Sciences*, 67-88. Retrieved from: doi: 10.1111/nyas.12588

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New York State Energy Profile. (2015). *U.S. Energy Information Administration.* Retrieved from: EIA Web site: http://www.eia.gov/state/print.cfm?sid=NY

U.S. Energy Information Administration: Independent Statistics & Analysis. (2015) *The Residential Energy Consumption Survey Program (RECS). Household Energy Use in New York: A closer look at energy consumption.* Retrieved from http://www.eia.gov/consumption/residential/reports/2009/state_briefs/pdf/ny.pdf

This is a collection of data produced by the U.S. Energy Information administration on household energy use in New York in 2009. It brings to light the fact that New York households consume an average of 103 million Btu per year, 15% more than the U.S. average. Consequently electricity consumption in New York homes is much lower than the U.S. average due to the use other fuels for major energy thus producing more carbon. The data collected also shows what kinda of fuels being used by household which is very significant for this research as a main topic is the switch from burning oil to greener energy and as this data was collected in 2009 it was before the accelerated retrofitting and other carbon offsetting initiatives. The RECS gathers energy characteristics through personal interviews from a nationwide sample of homes, and cost and consumption from energy suppliers. This method of data collection is more or less sound but there is of course room for error in statistical analysis and inaccuracy in personal accounts

Multimedia

Heat Seek New York (2015). *Heat Seek New York is a Civic Hacking Project.* Retrieved from: <http://heatseeknyc.com/about>

NYC Clean Heat (2015). *Spot the Soot Interactive Map.* Retrieved from: https://www.nyccleanheat.org/spot-the-soot

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