Peak Efficiency:

How Regulating Electricity Demand Could Save Lives in New York City

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This policy brief discusses an on-going inter-disciplinary study to measure whether laws that reshape local electricity demand can achieve significant health benefits in New York City. A collaborative effort of legal, economic, and public health researchers, the study will answer three crucial questions that should inform New York's energy planning decisions:

- Which state and local regulations on energy efficiency, conservation, and renewables can reduce or shift electricity demand in New York City away from peak hours of energy consumption, or significantly lower overall consumption?
- How will the local electricity market's price signals and local New York City power plants respond to that changing demand?
- Will plant-specific responses at pollution-intensive electricity generators have any distinguishable health impacts for local populations?

Fine particulate matter is a dangerous air pollutant—New York City estimates that exposure may be responsible for 8,000 hospital visits and 3,000 deaths each year. No previous study has quantitatively calculated the direct health effects for individuals in close proximity to urban electricity-generating units. Support for this project was provided by a grant from the Robert Wood Johnson Foundation's Public Health Law Research program.

This policy brief makes the following observations:

- Two recent legal developments increase the urgency for cities like New York to find local solutions to air quality-related health burdens. First, in June 2012, EPA proposed tightening the minimum air quality standards that every state must meet. Second, in August 2012, a federal court struck down a rule that would have required upwind states to reduce their emissions into regions like New York City, effectively placing more responsibility on local policymakers to achieve air quality targets through local controls.
- Particulate matter's composition varies by source, as may its effects: local sources could have different health consequences than emissions from long-range sources.
- Local power plants are a significant source of particulate matter in New York City. To ensure grid reliability, 80% of the city's electricity supply must come from local plants. Some electricity generators within the city are "peaking units," ramping up during times of peak electricity demand; some generators burn residual oil, a particularly dirty fuel.
- Because pollution-intensive and peaking plants are sensitive to changes in local energy demand, "peak-shaving" laws that reduce or shift demand can be powerful tools for improving air quality and controlling adverse health impacts.

Deadly and Local

New York Urgently Needs Local Air Quality Solutions

The Dangers of Particulate Matter

The air we breathe is filled with fine particulate matter, 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 so small they can travel deep into human lungs or even slip directly into the bloodstream.

People exposed to elevated concentrations of these small particles, or $PM_{2.5}$, experience cardiovascular and respiratory ailments comparable to those expected for a non-smoker who lives with a smoker. The adverse health impacts can be quite severe: heart attacks, chronic bronchitis, childhood acute bronchitis, thousands of lost work days, and, ultimately, premature death.[1] According to New York City's estimates, $PM_{2.5}$ causes 8,000 hospital visits and 3,000 deaths each year in the metropolitan area.[2]

The small size of fine particulate matter also allows it to hang in the air and travel far from its original source, contributing to high ambient air concentrations in distant regions. In fact, the majority of $PM_{2.5}$ in New York City is attributable to emissions from long-range sources in upwind states.[3] Nevertheless, local sources like power plants, home heating fuel, and vehicles make significant contributions to the poor air quality in urban areas such as New York City.[4]

Though the phenomenon has not yet been well studied, the characteristics and health effects of local $PM_{2.5}$ may be distinct from long-range $PM_{2.5}$. Long-range sources could emit particulate matter with different chemical compositions than local sources, or the chemical compositions could change over time as pollution is transported from long distances. Indeed, some early research suggests locally generated particulate matter may be responsible for most of the adverse health effects of air pollution.[5] As a result, local governments may be undervaluing the potential health benefits of policies that target local pollution sources.

Our study will make an important contribution to understanding the direct health impacts from local, urban sources of $PM_{2.5}$, helping states and municipalities like New York better gauge the importance of local pollution programs. To our knowledge, no previous study has quantitatively calculated the direct health effects due to local electricity-generating units.[6]

Recent Legal Developments Raise the Stakes

For common pollutants like fine particulate matter, the U.S. Environmental Protection Agency sets minimum standards for ambient air quality, nationwide. Each state is then responsible for achieving those standards, by developing an implementation plan that must meet EPA's approval. Fifty-five areas spread across the United States, containing a combined population of over 100 million "breathing Americans," do not currently meet EPA's minimum standards for $PM_{2.5}$.[7] Despite making important air quality improvements, New York City remains one such area that has yet to meet EPA's current minimum standards for fine particulate matter.[8]

Two recent legal developments make the situation even more pressing for local jurisdictions. First, in June 2012, EPA proposed a significant revision to its minimum standards for $PM_{2.5}$.[9] Once the new, more stringent standards are finalized, areas that cannot achieve that target air quality will have to revise their strategies to come into compliance. Given that New York City is still out of compliance with the old standard, a new standard will surely pose a challenge for New York's implementation plans. Achieving compliance in New York may depend on expanding the suite of regulatory tools to include new, cost-effective options for lowering local emissions.

Second, in August 2012, the D.C. Circuit Court of Appeals overturned EPA's Cross-State Air Pollution Rule (also known as the Transport Rule).[10] The Transport Rule was designed to prompt upwind states to control emissions that significantly impact the air quality in downwind states. Given that most of New York's particulate matter comes from out-of-state, New York was counting on the Transport Rule to help it achieve compliance with the current particulate matter standards.[11] Though EPA will almost certainly try to redesign and replace the Transport Rule, that process will take time. Meanwhile, the Court did allow elements of an older version of the rule to continue operating temporarily (the Clean Air Interstate Rule),[12] but the loss of the Transport Rule potentially leaves some states with a hole in their $PM_{2.5}$ attainment plans.

Together, these legal developments put pressure on jurisdictions like New York City to find local solutions to their $PM_{2.5}$ pollution problems, thus making it more desirable for local governments to enact and measure the effectiveness of peak-shaving programs. Our study will help state and local governments draw the line from efficiency, conservation, and renewable electricity policies, to emissions reductions and direct health benefits.

Power Tools

Controlling Local Emissions by Controlling Demand

New York City Has Dirty, Local Power Plants

While some New Yorkers may be surprised, electricity generators dot the New York City landscape. To reduce the danger of an energy grid failure, New York City's utilities are required to use local power plants for at least 80% of supply (including a few plants just across the Hudson River).[13] To achieve that level of supply, there are dozens of electricity-generating units located within New York City limits. For example, the map shown on the next page marks the location, relative size, and dominant fuel type of power facilities along the East River; each dot represents a facility that may contain many individual generating units.[14] Which generators operate at any given time, and what fuel they burn, depends on the electricity market, which is shaped by consumers' energy demands.

Nuclear, coal-fired, and natural gas-burning units generate electricity at relatively low marginal cost, and typically operate around-the-clock to meet the base energy demand in New York state. Within the city, some of the larger base-load facilities instead burn relatively higher cost, petroleum-based fuels, including distillate oil and residual oil. This fuel choice is driven sometimes by the design and age of the plant, and sometimes by natural gas price spikes.

Residual oil is the viscous fuel leftover after cleaner, more refined distillations of petroleum are sold for other uses. Emissions from residual oil are especially dirty and produce high levels of $PM_{2.5}$.[15] For example, a previous research project by our team on home heating fuel found that switching all residential and commercial boilers in New York City from residual oil to cleaner natural gas would generate $22 billion worth of health benefits, including 259 lives saved per year.[16] Reducing the operating time at electricity generators that burn residual oil could, therefore, deliver important health benefits.

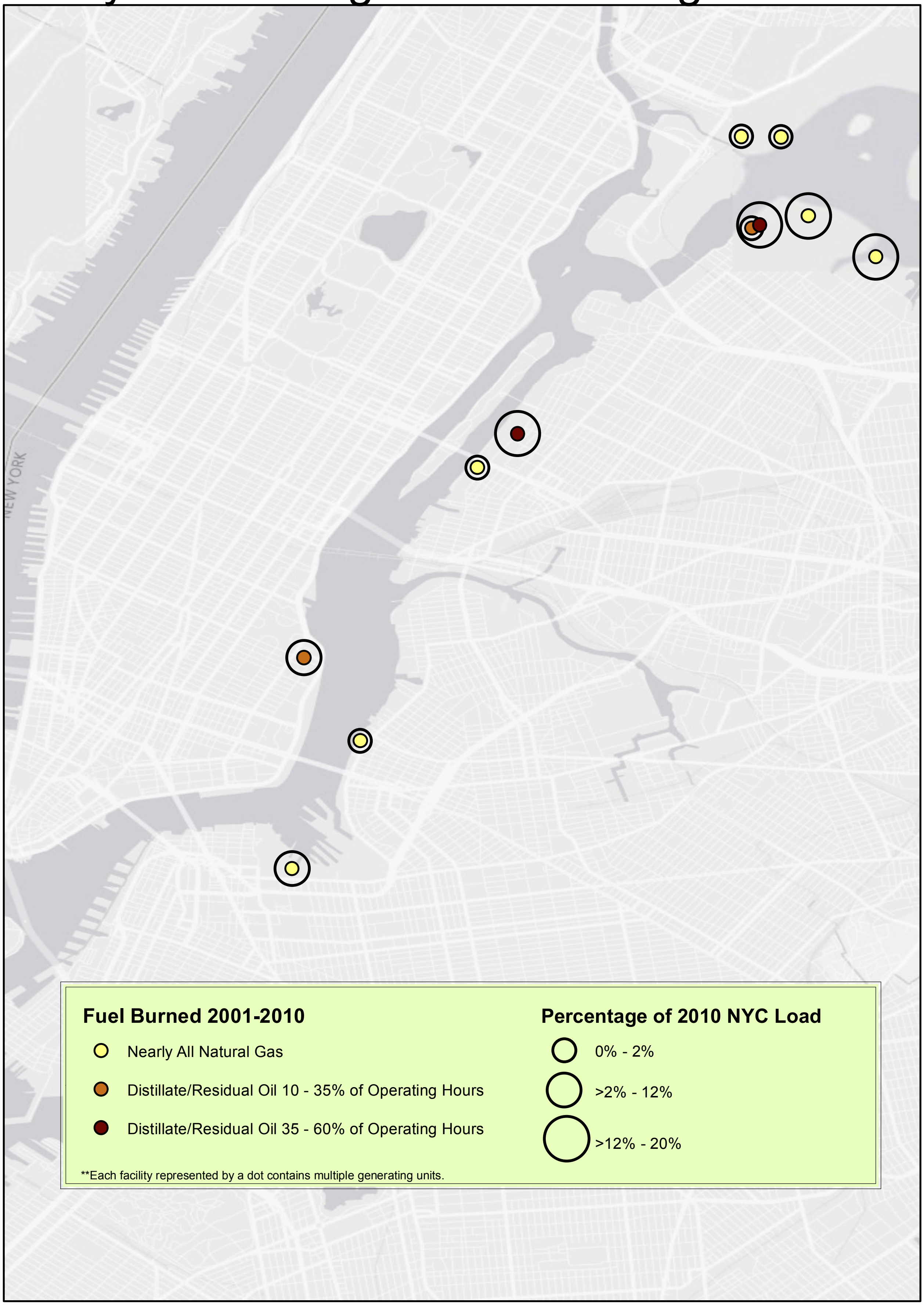
New York City also has some electricity generators that operate as "peaking" units. When electricity demand peaks (for example, with summertime air conditioning use), the price consumers are willing to pay for electricity goes up, and these additional units activate.[17] Local peaking electricity generators are especially sensitive to changes in electricity demand. By reducing the city's demand peaks, the operating time at these facilities could drop significantly—and their emissions would fall correspondingly.

Laws that reduce and shift demand away from peak hours ("peak-shaving" policies), or that lower overall energy consumption, may therefore be powerful tools for controlling adverse health impacts. While economists have analyzed environmental impacts of electricity generation, few studies link energy efficiency and conservation programs to population health outcomes,[18] and none trace the effects of regulation-driven demand changes back to impacts on the operation of specific plants.[19] Our study will explore how state and local peak-shaving policies can reduce or shift electricity demand in New York City by promoting efficiency, conservation, and renewables; how local power plants will respond to that changing demand; and how those plant-specific responses will deliver significant health benefits for local populations.

New York Has the Tools to Implement Peak-Shaving Policies

Peak-shaving policies can either reduce or shift consumers' demand for electricity, or they can increase the supply of cleaner sources of electricity. Energy efficiency and conservation programs

Electricity Generating Facilities Along the East River



can be a particularly cost-effective method for reducing or shifting demand: not only will demand drop as consumer conserve energy, but consumers' electricity bills will drop as well.[20]

New York City has begun developing several of these peak-shaving tools. Our study will delve into at least five policy categories.[21]

- *Regulatory authority:* State and local governments have constitutional and statutory authority to regulate certain areas of energy policy. For example, New York state sets uniform building codes, but then local jurisdictions like New York City retain authority to adopt and enforce more stringent energy efficiency requirements.[22]
- *Financial incentives:* State and local governments can shape energy demand through financial incentives, such as permit fee waivers or property tax abatements for green buildings. For example, New York City offers property tax abatements for green roof and solar panel installations.[23]
- *Proprietary functions:* Governments have tremendous power to directly reduce electricity consumption and shape the market through purchasing power. Cities own property (such as government buildings, schools, and airports), sometimes own utilities, and operate millions of streetlights, traffic lights, and park lights. For example, New York City has policies on the municipal procurement of energy efficient products.[24]
- *Persuasive powers:* Governments can explore voluntary programs, develop informational campaigns to raise social awareness about energy efficiency, and build partnerships with local utilities and consumer groups. For example, in September 2012, New York City released an inventory of energy use scores for large, non-residential buildings. This inventory is the first step in an educational campaign that will include a grading system to help potential buyers and lease-holders assess long-term electricity costs.[25]
- *Enforcement strategies:* Even where state or federal law preempts direct local regulation, cities often remain the locus of implementation. Cities can use tactics like expedited permitting to reward certain peak-shaving behaviors and can choose how aggressively to pursue enforcement. For example, a city could condition waivers to zoning restrictions upon buildings meeting certain standards for energy efficiency and conservation.

However, many other potential tools have not yet been explored. Our study will comprehensively characterize and catalogue New York's efforts to dates. This database will help New York City identify which approaches have been underutilized, and will enable researchers to make future cross-jurisdictional comparisons of different cities' peak-shaving efforts, successes, and failures.

Overcoming the Obstacles to Implement Peak-Shaving Tools

A few major challenges confront any jurisdiction that wants to implement peak-shaving policies to improve its local air quality. First, any individual policy may not on its own achieve a significant reduction in emissions: switching to more efficient bulbs in traffic lights, for instance, may not single-handedly bring New York City into attainment with EPA's standards for particulate matter. Second, measuring the precise air quality benefits from any individual policy presents substantial analytical challenges. While energy efficiency laws have sometimes been justified by the financial savings they promise for consumers, counting these private, financial benefits has proved somewhat controversial;[26] therefore, accurately estimating the public health benefits of energy efficiency laws is especially important.

These challenges help explain why some states and cities have been slow to adopt and apply peak-shaving policies in certain areas. For example, to date only four states have attempted to count energy efficiency and renewable energy programs in their implementation plans to meet EPA-set air quality standards (Texas, Connecticut, the District of Columbia, and Louisiana, all to meet EPA's ozone standards).[27]

But recently, in July 2012, EPA released updated guidance on how states can utilize energy efficiency tools to meet the air quality goals that EPA sets.[28] States now have clearer instructions on how to bundle multiple policy tools together, allowing them to incorporate a suite emerging and voluntary programs that will collectively reduce electricity demand and improve air quality. Similarly, EPA has provided states with sample methodologies for how to quantify those air quality improvements.

Though the path is certainly clearer, cities and states wanting to use energy efficiency tools to meet either EPA standards or their own air quality goals will still require significant planning and quantitative work. Our study will help New York City take the first steps down that road, by showing how certain bundles of peak-shaving programs could collectively achieve distinct air quality improvements, and ultimately connecting that result to improved health outcomes for local populations.

Methodology

A Preview of the Planned Research Steps

Specific Aims and Hypothesis

Our research begins with the hypothesis that peak-shaving policies will have a measurable impact on public health, specifically on cardiovascular disease hospitalization and mortality. To test this hypothesis, we will complete the following research steps:

- Examine the policy levers available to reshape electricity demand, describe the effectiveness of existing energy policies, and estimate their relationship to the electricity market;
- Quantify the relationship between electricity load, market price, power plant operating times, and power plant emissions in New York City; and,
- Determine the association of daily activity of local power generators on cardiovascular hospital admissions and mortality.

The connection between electricity demand and health benefits should inform local energy planning decisions nationwide, but New York City is a natural choice for an initial case study. High-quality health statistics and energy data are readily available for New York City. The number of local, peaking power generators that operate at some times but not others creates a natural variable to test. Finally, the City's deep interest in energy policies means this case study can provide substantive guidance to policymakers actively engaged in this issue. In particular, publication of our results should coincide with the completion of an updated New York State Energy Plan in the spring of 2013.

Research Steps

The first question we will analyze is: What energy policy options are available? Our legal scholars will conduct research to describe general constraints on and opportunities for state and local energy policies, as well as investigate the national trends potentially affecting the observed distribution of policy choices at the local level. The research will focus on cataloging the full range of policy options available to our case study municipality, New York City. We will also assess the historical record, and likely future success, of different peak-shaving techniques, based on available economic studies. Drawing on this research, we will then estimate the possible range of demand effects for different suites of legal interventions: identifying regulatory packages capable of shifting demand by 1-5%, 5-10%, and so forth. We will explore these packages' legal feasibility, practicality, and relevant cost considerations.

The second stage of the analysis will estimate the impact of energy policies on electricity load and prices in New York City. Merging data on electric load levels, energy prices, emissions, electric generators' operating times, weather, and other factors, we will calculate the response of specific electric generators to certain percent changes in demand and in the power market, using a regression analysis. We will also estimate how lowering demand will decrease the emissions of target air pollutants.

The third stage of the analysis will calculate the health impact of electricity generation at local power generators, with a particular emphasis on peak-following plants and plants using fuel sources with the highest relative emissions. Our health analysis will focus on cardiovascular hospital admissions and mortalities in the five counties of New York City. Using a time-series model and controlling for factors like temperature and seasonal effects, we will estimate the excess risk of cardiovascular illness and death associated with activity at local power plants.

Finally, we will synthesize information from the policy, economic, and health analyses to quantify the health benefits of reducing activity at peak-following power plants and estimate the health benefits of shifting demand away from local plants with the highest relative emissions.

Conclusion

We plan to complete our research and publish our results over the course of the next year. During that same time period, EPA will likely finalize its more stringent minimum standards for air quality, New York State will likely revise its Energy Plan, and interest in tools for energy efficiency and peak-shaving will continue to grow in local jurisdictions across the country. We hope that our work will be well-timed to inform future energy planning decisions in cities nationwide, helping them to achieve air quality goals and deliver substantial health benefits to their local populations.

Notes

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[2] City of New York, *PlaNYC: Update April 2011*, at 122 (2011).

[3] R. Lall & G.D. Thurston, *Identifying and Quantifying Transported vs. Local Sources of New York City PM2.5 Fine Particulate Matter Air Pollution*, 40 ATMOSPHERIC ENVIRONMENT S333 (2006).

[4] City of New York, *PlaNYC: A Greener, Greater New York*, at 120 (2007).

[5] K. Ito, R. Mathes, Z. Ross, A. Nádas, G. Thurston, & T. Matte, *Fine Particulate Matter Constituents Associated with Cardiovascular Hospitalizations and Mortality in New York City*, 119 ENV. HEALTH PERSPECTIVES 467-473 (2011). A few studies have indicated reductions in local polluting activities can produce measurable improvements in community health in excess of estimates based on decreases in mass concentration alone. *See* C.A. Pope, *Particulate Pollution and Health: A Review of the Utah Valley Experience*, 6 JOURNAL OF EXPOSURE ANALYSIS AND ENVIRONMENTAL EPIDEMIOLOGY 23 (1996); L. Clancy et al., *Effect of Air-Pollution Control on Death Rates in Dublin, Ireland: an Intervention Study*, 360 LANCET 1210 (2002).

[6] *See* U.S. EPA, *The Benefits and Costs of the Clean Air Act from 1990 to 2020* (2011).

[7] *See* Review of the National Ambient Air Quality Standards for Particulate Matter, 77 Fed. Reg. 38,890 (June 29, 2012).

[8] PlaNYC 2011, *supra* note 2, at 123.

[9] 77 Fed. Reg. at 38,890.

[10] EME Homer City Generation v. EPA, No. 11-1302 (D.C. Cir., Aug. 21, 2012).

[11] Petition from J. Jared Snyder, NYS Office of Air Resources, to Judith Enck, EPA Regional Administrator, Clean Data Petition for the 2006 24-Hour PM2.5 NAAQS (May 5, 2011), *available at* http://www.dec.ny.gov/chemical/75338.html ("Additional future measures, such as the federal Transport Rule and more stringent motor vehicle emissions limits, will further guarantee ongoing compliance.").

[12] *See EME Homer City Generation*, *supra* note 10; *see* North Carolina v. EPA, No. 05-1244 (D.C. Cir., Dec. 23, 2008) (remanding CAIR without vacatur).

[13] *See* E. Sussman et al., *Fostering Progress through Law and Regulation*, 18 NYU ENVTL. LJ 55 (2010).

[14] The percentage of oil burned at each facility was calculated from sulfur dioxide emissions rates, using EPA emissions factors. The map does not show steam-generating units or recently retired units, like the Charles Poletti facility that was replaced in 2010 with a combined cycle natural gas plant.

[15] A. Markandya & P. Wilkinson, *Electricity Generation and Health,* 370 LANCET 979 (2007); K. Cromar & J. Schwartz, *Residual Risks: The Unseen Costs of Using Dirty Oil in New York City Boilers* (Policy Integrity Report, 2010).

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[17] P. Simshauser, *The Emergence of Structural Faults on the Supply Side in Deregulated 'Energy Only' Electricity Markets,* 39 AUSTRALIAN ECONOMIC REVIEW 130 (2006); D.C. Mountain & E.L. Lawson, *A Disaggregated Nonhomothetic Modeling of Responsiveness to Residential Time-of-use Electricity Rates,* 33 INTERNATIONAL ECONOMIC REVIEW 181 (1992); E. Or &

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[21] *See* K.A. Trisolini, *All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation*, 62 STANFORD L REV. 669 (2010); Sussman et al., *supra* note 13.

[22] New York State Energy Planning Board, 2009 STATE ENERGY PLAN: VOLUME 1, at 88 (2009).

[23] 1 Rules of the City of New York §§ 105-01 to -02.

[24] Local Law No. 119 (2005).

[25] New York City Office of Long-Term Planning and Sustainability, LOCAL LAW 84 BENCHMARKING REPORT (2012).

[26] *See* Gayer & Viscusi, *supra* note 20.

[27] U.S. EPA, *Roadmap for Incorporating Energy Efficiency/Renewable Energy Policies and Programs into State and Tribal Implementation Plans*, at App. K (2012).

[28] *Id.* EPA started releasing some guidance to states on these issues in 2004.

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