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Hon. Costa Constantinides, Chair

**June 12, 2019**

**Methane Emissions And The Creation Of A Department Of Sustainability And Climate Change**

**Int. No. 272:** By Council Members Richards, Brannan, and Rosenthal

**Title:** A Local Law to amend the administrative code of the city of New York, in relation to reducing methane emissions

**Administrative Code:** Adds a new section 24-806

**Int. No. 1055:** By Council Members Constantinides, Richards, Holden, and Rosenthal

**Title:** A Local Law to amend the administrative code of the city of New York, in relation to the examination, survey and mapping of all methane leaks in New York City

**Administrative Code:** Amends Section 24-424 by adding a new subdivision (d)

**Int. No. 1399:** By Council Members Constantinides, Rosenthal, and Levine

**Title:** A Local Law to amend the New York city charter and the administrative code, in relation to creation of a department of sustainability and climate change and repealing section 20 of chapter 1 of the New York city charter.

**City Charter:** Repeals section 20 of chapter 1 and adds new chapter 76

**Administrative Code:**  Adds a new title 33

1. **Introduction**

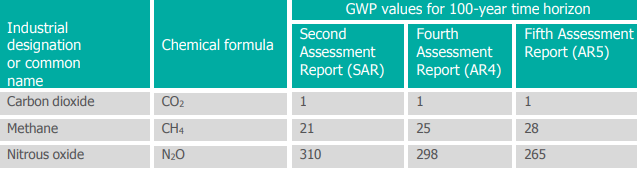
On June 12, 2019, the Committee on Environmental Protection, chaired by Council Member Costa Constantinides, will hold a hearing on Int. No. 272, in relation to reducing methane emissions, Int. No. 1055, in relation to the examination, survey and mapping of all methane leaks in New York City, and Int. No. 1399, in relation to creation of a department of sustainability and climate change and repealing section 20 of chapter 1 of the New York city charter. The Committee expects to receive testimony the New York City Department of Environmental Protection, the Mayor’s Office of Sustainability, environmental advocates and interested members of the public.

1. **Background**

* ***Methane***

Burning natural gas for fuel is considered by some to be better for the environment than burning coal or oil, as it emits less particulate matter and carbon dioxide (CO2).[[1]](#footnote-1) However, natural gas is primarily comprised of methane, which traps heat far more effectively than CO2, with a global warming potential value (gwp) calculated to be 20-30 times higher than CO2 over a hundred year period (see Figure 1).[[2]](#footnote-2) By some calculations, methane’s gwp is 80 times higher than that of CO2.[[3]](#footnote-3) This discrepancy can be explained by differences in how long these two gases typically remain in the atmosphere.[[4]](#footnote-4) Once released, carbon dioxide persists approximately 10 times longer than methane, meaning that over a 10 year period, methane can be up to 100 times more effective at trapping heat, but as it is removed at a faster rate, its potency at the end of a 100 year timeframe is significantly reduced, though still more potent than CO2 (methane 20-30 times CO2).[[5]](#footnote-5)

Figure 1: Global Warming Potential Values [[6]](#footnote-6)

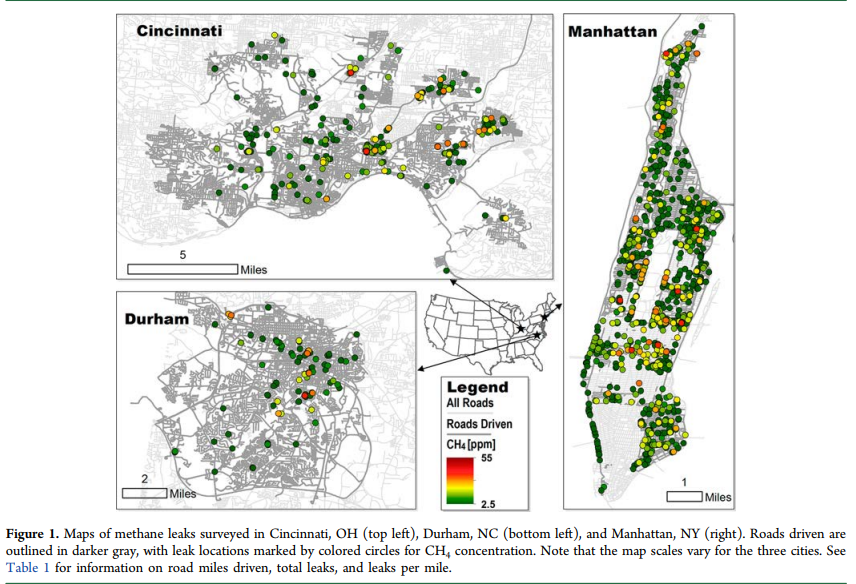


A study published by the Journal of Science in 2018 found that the domestic oil and natural gas industry leaks an estimated 13 million metric tons of methane a year from various points along the supply pipeline, 2.3% of the total annual extracted supply.[[7]](#footnote-7) The volume of gas lost to leakage would be enough to power 10 million homes for an entire year, or approximately 2 billion dollars’ worth.[[8]](#footnote-8) According to a study, 4% leakage is the point at which any emissions reduction gained from switching to natural gas from coal would be negated.[[9]](#footnote-9)

A recent partnership between Cornell University and Google, using methane sensors attached to streetview cars, sought to explore methane emissions from the ammonia fertilizer industry. The data collected suggests that this single industry is responsible for approximately 28 gigagrams of methane emissions annually, while the industry self-reports annual methane emissions of only 0.2 gigagrams per year. Additionally, the Environmental Protection Agency (EPA) states that all industrial processes in the United States combined produce only 8 gigagrams of methane emissions annually, suggesting that both government and industry estimates are vastly undercounting the amount of this potent greenhouse gas that is being emitted into the atmosphere every year.[[10]](#footnote-10)

In the context of New York City, a study published in the Environmental Science and Technology Letters Journal in July of 2015 identified 1,050 methane leaks along 247 miles of roadway tested in the borough of Manhattan (see figure 2).[[11]](#footnote-11) Another study using data collected in 2012, compared leakage rates from downtown Manhattan to midtown and uptown, and found that methane concentrations uptown were 1/4th of those found downtown and in midtown. The study then extrapolated their data to estimate that nearly 8 billion cubic feet (8 million dekatherms, or roughly 164 thousand metric tons[[12]](#footnote-12)) of methane, 8% of Manhattan’s total annual supply, is lost from the island’s natural gas infrastructure every year.[[13]](#footnote-13) A study by the Environmental Defense Fund, published in 2014, identified approximately 1,000 methane leaks across the borough of Staten Island.[[14]](#footnote-14) Comprehensive leak data for the Bronx, Brooklyn, and Queens appears to be unavailable at this time. Aside from the effects on climate change, methane leaks can also have more immediate public health consequences.

Figure 2: Methane Leak Sources and Concentrations as mapped by Gallagher Study[[15]](#footnote-15)



In 2014, a leaky gas pipeline at 116th street and Park Avenue in Harlem caused an explosion that killed 8 people, injured more than 50, and displaced over 100 families. The blast leveled two buildings, and caused Con Edison, the utility in charge of maintaining the leaky infrastructure, to pay out over 150 million dollars in settlements to the affected families.[[16]](#footnote-16) The National Transportation Safety Board identified “the failure of the defective fusion joint at the service tee, installed by Consolidated Edison Company of New York, Inc., in 2011, that allowed natural gas to leak from the gas main and migrate into the building where it ignited” as one of the probable causes for the accident.[[17]](#footnote-17) In 2009, a house in Floral Park, Queens, exploded after faulty wiring created a hole in a gas main, allowing methane to pool inside the home. The blast killed one person, and injured six others. In 2008, a man was severely injured after attempting to light a pilot light on his stove shortly after Con Edison had restored gas service to his building. He later succumbed to injuries caused by the explosion, which also injured 16 other people. The explosion was found to have been caused by a Con Edison worker who failed to adequately check for leaks in the area. In 2007, a cracked gas main caused a home in Sunnyside, Queens, to explode, killing a 69 year old woman. In 1996, a Presbyterian church in Queens exploded, destroying 2 neighboring houses, and injuring 10 people.[[18]](#footnote-18) The cause was determined to be an improper fitting that had been installed on a high pressure gas line by an unlicensed plumber, which was later inspected and ignored by a Con Edison employee.[[19]](#footnote-19)

* ***Climate Change***

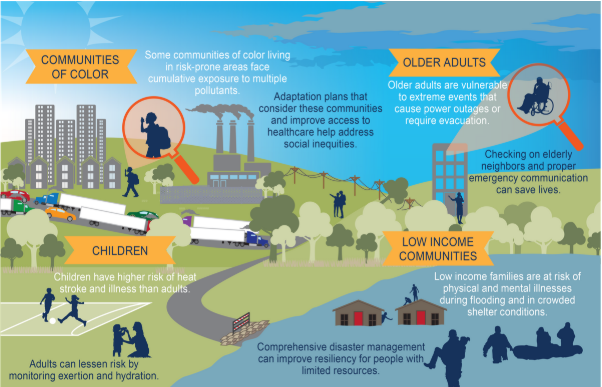
On May 11, 2019, the Mauna Loa Observatory in Hawaii, which has compiled atmospheric CO2 data since the 1950’s, recorded 415.26 parts per million (ppm) of CO2 in the atmosphere, the first time that the observatory measured a daily baseline above 415 ppm.[[20]](#footnote-20) According to the National Aeronautics and Space Administration (NASA), these are the highest CO2  levels the planet has seen in the past 800,000 years.[[21]](#footnote-21) A study published in 2017, in the climate change-focused journal The Anthropocene Review, estimates that human-linked factors during the past six decades are causing the climate to change 170 times faster than they would without human intervention.[[22]](#footnote-22)

According to the U.S. Global Change Research Program’s Fourth National Climate Assessment, median sea level rise along the US coastline has already increased an average of 9” since the early 20th century and temperatures have increased by an average of 1.8 °F in the same period.[[23]](#footnote-23) Both marine and terrestrial animals and plants have shifted their distribution ranges poleward in search of more habitable climates, and, as the ocean has absorbed approximately 25% of the carbon dioxide emitted by human activity, it has become increasingly acidic, making it more difficult for corals and other marine invertebrates to form vital calcium-based structures. [[24]](#footnote-24) A study published in Environmental Health Perspectives in 2017 estimates that over 3,000 people a year could be dying of heat-related illness in New York City by 2080 due to climate change, compared to an average of 638 heat-related deaths between 2000 and 2006, if no action is taken to address anthropogenic climate change.[[25]](#footnote-25)

Additionally, the correlation between mild winters and the survival of disease-spreading vectors is concretely established. In the northeast, mild winters generally mean higher than usual survivals of ticks and mosquitos through the cold months, leading to larger and earlier population booms upon the return of warm weather.[[26]](#footnote-26) New York City’s increasingly severe rat issues have been exacerbated by consecutive mild winters that allow them to feed and mate more easily throughout the year.[[27]](#footnote-27) A recent typhus outbreak in Los Angeles has been linked to its growing rat population and their attendant fleas,[[28]](#footnote-28) and some studies suggest that nearly 1 billion people could face their first exposure to mosquito borne diseases as the species that carry dengue, Zika, chikungunya, and malaria, continue to migrate poleward due to increasingly warm temperatures across the globe.[[29]](#footnote-29)

The effects of climate change are often inequitably distributed, with low income communities, communities of color, children, and senior citizens more likely to experience the deleterious effects. Low income communities often lack the financial and community resources to adequately respond to weather-related disasters, while communities of color are disproportionately likely to live in neighborhoods with environmental justice concerns. Children and seniors are more vulnerable to the effects of extreme weather than healthy adults. [[30]](#footnote-30)

Figure 2: Populations at higher risk of exposure to adverse climate-related health threats[[31]](#footnote-31)



According to a Union of Concerned Scientists study published in 2018, New York State ranks third in the nation for most homes at risk of coastal inundation by the end of the century.[[32]](#footnote-32) The East and Gulf Coasts of the United States are undergoing some of the fastest rates of sea level rise seen across the globe, with coastal flooding rates in 2012 averaging once every three months, up from once every 5 years in the 1950’s.[[33]](#footnote-33) Nationally, more than 300,000 homes with a collective value of $117.5 billion dollars, and 14,000 commercial properties valued at $18.5 billion dollars are at risk of chronic flooding within the next 30 years.[[34]](#footnote-34) In the state of New York, 15,500 homes representing a population of approximate 42,000 people and valued at approximately 8.5 billion dollars, mostly clustered in Hempstead, Babylon, and Queens, risk chronic inundation by 2045.[[35]](#footnote-35) By 2100, 143,000 properties housing approximately 366,000 people, and valued at approximately 98 billion dollars, risk the same fate.[[36]](#footnote-36) The homes at risk by 2045 contributed about 170 million in tax revenue by 2018 figures, and those at risk by 2100 represent 2 billion dollars of tax revenue.[[37]](#footnote-37) The 2,700 homes at risk in Queens by 2045 are largely concentrated in environmental justice communities.[[38]](#footnote-38)

Considering the far reaching effects that climate change has on human health, infrastructure, and the environment, it is imperative that the city create an agency dedicated to sustainability, resiliency, and a greener future. The agency would require the intellectual and budgetary power to make real change, so that we can ensure that New York City is able to adapt to whatever complications may arise from the changing climate, as well as doing everything in our power to stave off the worst effects of climate change while the opportunity still exists.

1. **Legislation**

Int. No. 272 would require the DEP to survey leaks within city-owned buildings once every five years and repair the leaks. It requires an annual report on the methane leaks in city-owned buildings, which must include the repairs made and an estimate of the methane emissions reduced. At least once in every five years, DEP is required to transmit to each gas corporation recommendations regarding repairs and other work undertaken by such corporation to address methane leaks, including but not limited to prioritization of such repairs. At the same time, DEP shall also transmit a copy of such recommendations to the Mayor and the Speaker of the Council. Responses to the recommendations shall also be transmitted to the Mayor and the Speaker. This local law also requires every building in the city to be surveyed for methane leaks including every dwelling unit upon vacancy. This local law would take effect immediately.

Int. No. 1055 would require that the Mayor designate an office or agency to examine, survey and map all methane leaks and to provide written notification to any relevant gas utility of the city’s intent or the city’s grant of consent to open the ground on any public way to survey the area for the presence of natural gas. Where natural gas leaks are identified, this proposed local law would require repair or replacement of any aging, leak-prone or leaking natural gas infrastructure located on or in any public way responsible for a large volumetric leak. Where any leaking natural gas infrastructure that is the source of a large volumetric leak is not repaired within ninety days after notice, the designated agency shall repair the leak and seek cost recovery on behalf of the city. This local law would take effect 120 days after it becomes law, except that the commissioner of environmental protection may take all actions necessary for its implementation, including the promulgation of rules, prior to such effective date.

Int. No. 1399 would repeal the existing Mayor’s Office of Long-term Planning and Sustainability to be replaced by a new Department of Sustainability and Climate Change, to be led by a commissioner. The commissioner would be responsible for all matters relating to resiliency of critical infrastructure, the built environment, coastal protection and coastal communities and climate change. The commissioner would also be responsible for all matters pertaining to recovery and resiliency and sustainability. The commissioner would have the power to develop and coordinate the implementation of policies, programs and actions to meet the long-term needs of the city, to develop measurable sustainability indicators and to take actions to increase public awareness and education regarding sustainability and climate change. The proposed legislation also creates a sustainability advisory board with representatives from the environmental, environmental justice, planning, architecture, engineering, oceanography, coastal protection, construction, critical infrastructure, labor, business and academic sectors. The legislation requires reporting on existing or revised sustainability indicators and population projections. The commissioner will be required to develop and coordinate the implementation of a comprehensive, long-term sustainability plan for the city for a period of at least 30 years. The plan is required to set milestones, interim and long-term goals, to be updated every four years and to include annual reports on the city’s progress in improving the sustainability indicators. Finally, the legislation creates an interagency green team to pilot and facilitate the use of innovative technologies, design and construction techniques, materials or products that may have significant environmental and sustainability benefits and to assist innovative projects in addressing local regulatory requirements. This local law would take effect 120 days after it becomes law.

Int. No. 272

By Council Members Richards, Brannan, and Rosenthal

..Title

A Local Law to amend the administrative code of the city of New York, in relation to reducing methane emissions

..Body

Be it enacted by the Council as follows:

Section 1. Chapter 8 of title 24 of the administrative code of the city of New York is amended by adding a new section 24-806 to read as follows:

§ 24–806 **Reducing methane emissions. a. As used in this section:**

**Department. The term “department” means the department of environmental protection.**

**Dwelling unit. The term “dwelling unit” has the meaning ascribed to such term in the housing maintenance code.**

**b. 1. At least once in every five years, the department shall, with the cooperation of all relevant agencies, survey each part of each city-owned building to identify any methane leaks at such building.**

**2. Where the department identifies a methane leak at such a building, the department shall promptly notify each agency that has jurisdiction over such building and the city shall undertake repairs to stop such leak.**

**3. Within three months after the end of each fiscal year, the department shall, with the cooperation of all relevant agencies, report to the mayor and the speaker of the council on (i) methane leaks identified at city-owned buildings during such year, (ii) repairs undertaken to correct methane leaks identified at city-owned buildings during such year and (iii) an estimate of the amount of methane emissions reduced as a result of undertaking such repairs.**

**c. At least once in every five years, the department shall transmit to each gas corporation, as such term is defined in section 2 of the public service law, recommendations regarding repairs and other work undertaken by such corporation to address methane leaks, including but not limited to prioritization of such repairs, and shall at the same time transmit a copy of such recommendations to the mayor and the speaker of the council. Upon receiving responses from such a corporation with respect to such recommendations, the department shall provide a copy of such responses to the mayor and the speaker of the council. Such recommendations and responses thereto, and copies thereof, may be transmitted electronically.**

**d. For each building located in the city, the owner thereof shall, in accordance with rules promulgated by the department, survey each part of such building to identify any methane leaks at such building, except that (i) for a dwelling unit, as such term is defined in the housing maintenance code, such unit shall be surveyed upon vacancy and (ii) no such part, including a dwelling unit, need be surveyed more often than once in any five-year period.**

§ 2. This local law takes effect immediately.

SS/JJD

LS 3922/Int. 1831-2017

LS 649

1/5/2018

Int. No. 1055

By Council Members Constantinides, Richards, Holden, and Rosenthal

..Title

A Local Law to amend the administrative code of the city of New York, in relation to the examination, survey and mapping of all methane leaks in New York City

..Body

Be it enacted by the Council as follows:

Section 1. Section 24-424 of title 24 of the administrative code of the city of New York is amended by adding a new subdivision (d) to read as follows:

(d) An office or agency designated by the mayor shall examine, survey and map all methane leaks, both hazardous and nonhazardous annually within the city. The mayor shall also provide written notification to any relevant gas utility of the city’s intent or the city’s grant of consent, to any other entity to open the ground on any public way for any nonemergency purpose including to survey or map leaking natural gas infrastructure. Such notification may also allow the gas utility to survey the area to be opened for the presence of natural gas and to repair or replace any aging, leak-prone or leaking natural gas infrastructure located on or in any public way. Where any leaking natural gas infrastructure is the source of a large volumetric leak, having a migration area of five hundred square feet or more, that is not repaired within ninety days after notice to the relevant gas utility, the designated agency shall repair the leak and seek cost recovery on behalf of the city.

§ 2. This local law takes effect 120 days after it becomes law, except that the commissioner of environmental protection may take all actions necessary for its implementation, including the promulgation of rules, prior to such effective date.

SS

LS # 4838

4/25/16

Int. No. 1399

By Council Members Constantinides, Rosenthal, and Levine

..Title

A Local Law to amend the New York city charter and the administrative code, in relation to creation of a department of sustainability and climate change and repealing section 20 of chapter 1 of the New York city charter.

..Body

Be it enacted by the Council as follows:

Section 1. Chapter 1 of the New York city charter section 20 is hereby REPEALED and a new chapter 76 to read as follows:

Chapter 76

DEPARTMENT OF SUSTAINABILITY AND CLIMATE CHANGE

§ 3150. Department; commissioner.

§ 3151. Definitions.

§ 3152. Powers and duties.

§ 3153. Sustainability advisory board.

§ 3150. Department; commissioner. There shall be a department of sustainability and climate change the head of which shall be the commissioner of sustainability and climate change. The commissioner may appoint deputies, including a deputy commissioner of external affairs within available appropriations.

§ 3151. Powers and duties. a. The commissioner shall be responsible for matters relating to resiliency of critical infrastructure, the built environment, coastal protection and coastal communities and climate change. The commissioner shall also be responsible for all matters pertaining to recovery and resiliency and sustainability.

b. The commissioner shall also have the power to:

1. Develop and coordinate the implementation of policies, programs and actions to meet the long-term needs of the city, with respect to its infrastructure, environment, climate change and overall sustainability citywide, including but not limited to the categories of housing, open space, brownfields, transportation, water quality and infrastructure, air quality, energy; resiliency of critical infrastructure, the built environment, coastal protection and coastal communities; and regarding city agencies, businesses, institutions and the public;

2. Develop measurable sustainability indicators, reviewed annually, which shall be used to assess the city's progress in achieving sustainability and improving resiliency citywide; and

3. Take actions to increase public awareness and education regarding sustainability and climate change.

§ 3152. Sustainability Advisory Board. There shall be a sustainability advisory board. The sustainability advisory board members shall include, at a minimum, representatives from environmental, environmental justice, planning, architecture, engineering, oceanography, coastal protection, construction, critical infrastructure, labor, business and academic sectors which shall be appointed by the mayor. The advisory board shall also include the speaker of the city council or their designee and the chairperson of the council’s committee on environmental protection or their designee.

§2. The administrative code of the city of New York is amended by adding a new title 33 to read as follows:

TITLE 33

DEPARTMENT OF SUSTAINABILITY AND CLIMATE CHANGE

§ 33-101 Definitions.

§ 33-102 Sustainability indicators.

§ 33-103 Population projections.

§ 33-104 Long term sustainability plan.

§ 33-105 Sustainability advisory board.

§ 33-106 Interagency green team.

§ 33-101 Definitions. As used in this chapter, the following terms have the following meaning:

Commissioner. The term “commissioner" means the commissioner of sustainability and climate change.

Department. The term “department” means the department of sustainability and climate change.

§ 33-102 Sustainability indicators. No later than December 31, 2019 and biannually thereafter, the commissioner shall identify a set of indicators to assess and track the overall sustainability and resiliency of the city with respect to the categories established pursuant to section 3151 of the New York city charter. Such sustainability indicators shall include, but not be limited to, progress in reducing all greenhouse gases as measured by the greenhouse gas inventory, progress in the implementation of resiliency measures to address sea level rise, steps to protect disadvantaged and vulnerable populations from extreme hot or cold days, progress in reducing greenhouse gas emissions resulting from buildings, progress in reducing greenhouse gas emissions generated by city operations, prevention of biodiversity loss, increasing the number and quality of trees in the city urban forest, waste diverted from landfills, increases in renewable energy generation, air quality improvements and such other indicators as the commissioner shall identify. The commissioner shall prepare and make public a biannual report on the city's performance with respect to tracking such sustainability indicators, which report may be prepared and presented in conjunction with the mayor's management report.

a. The report shall include but not be limited to: 1. The city's progress in achieving sustainability citywide, which shall be based in part on the sustainability indicators developed pursuant to this chapter and in part on the city response to the most recent report of the New York city panel on climate change; and

2. Any new or revised indicators that the commissioner has identified or used to assess the city's progress in achieving sustainability citywide, including when an indicator has been or will be revised or deleted, the reason for such revision or deletion.

§ 33-103 Population projections. No later than April 22, 2020, and every 2 years thereafter, the department of city planning shall release or approve and make public a population projection for the city that covers a period of at least 20 years, with intermediate projections at no less than 10 year intervals. Such projections shall include geographic and demographic indicators.

§ 33-104 Long term sustainability plan. a. The commissioner shall develop and coordinate the implementation of a comprehensive, long-term sustainability plan for the city. The long-term sustainability plan shall include incorporation of the projections of the New York city panel on climate change for a period of at least 30 years. Such plan shall include and not be limited to an analysis of long-term planning and sustainability indicators identified in section 33-102 and shall set interim goals associated with each indicator established and may include any additional categories established by the commissioner. The city will seek to implement or undertake to achieve each interim goal by no later than April 22, 2030 and long-term goals that the city will seek to implement or undertake to achieve each goal by no later than April 22, 2050.

b. No later than April 15, 2020, and no later than every 4 years thereafter, the commissioner shall develop and submit to the mayor and the speaker of the city council an updated long-term sustainability plan, setting forth goals achieved associated with each category established pursuant to this chapter and goals achieved pursuant to any additional categories established by the commissioner.

c. Such updated plan shall take into account most recent reports of the New York city panel on climate change and the population projections, including geographic and demographic indicators required pursuant to section 33-104 of this section. An updated plan shall include implementation milestones for each policy, program and action contained in such plan.

d. An updated plan shall report on the status of the milestones contained in the immediately preceding updated plan. Where any categories, goals, policies, programs or actions have been revised, added or deleted from an updated plan, or where any milestone has been revised or deleted from an updated plan, the plan shall include the reason for such addition, revision or deletion. The commissioner shall seek public input regarding any updated plan before finalizing and submitting such plan pursuant to subdivision b of this section.

e. Review and reporting. No later than April 22, 2020, and no later than every April 22 thereafter, the commissioner shall prepare and submit to the mayor and the speaker of the council a report on the city's performance with respect to the identified sustainability indicators and long-term planning and sustainability efforts. The report shall include, at a minimum:

1. The city's progress made to implement or undertake policies, programs and actions included in the sustainability plan or updated sustainability plan required by subdivision e of this section, since the submission of the most recent plan or updated plan or report required by this paragraph; and

2. Any revisions to policies, programs or actions in the previous long-term sustainability plan, including the reason for such revision.

§ 33-106 Sustainability Advisory Board. The advisory board shall meet, at a minimum, twice per year and shall provide advice and recommendations to the commissioner regarding the provisions of this chapter.

§ 33-107 Interagency Green team. There is hereby established within the department an interagency green team to facilitate the use of innovative technologies, design and construction techniques, materials or products that may have significant environmental and sustainability benefits and to assist innovative projects in addressing local regulatory requirements. The interagency green team shall encourage pilots of innovative technologies on city buildings and in other locations in the city.

§ 2. This local law takes effect 120 days after it becomes law.

LS #5910 SS

01/11/19

1. Union of Concerned Scientists “Environmental Impacts of Natural Gas” <https://www.ucsusa.org/clean-energy/coal-and-other-fossil-fuels/environmental-impacts-of-natural-gas> (last accessed April 5, 2019) [↑](#footnote-ref-1)
2. Greenhouse Gas Protocol “Global Warming Potential Values” <https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential->Values%20%28Feb%2016%202016%29\_1.pdf (last accessed April 5, 2019) [↑](#footnote-ref-2)
3. Ken Silverstein “Methane Releases Escalating, Endangering Climate and the Ultimate Health of Oil and Gas Producers” Forbes Magazine. June 21, 2018 <https://www.forbes.com/sites/kensilverstein/2018/06/21/methane-releases-escalating-endangering-climate-and-the-ultimate-health-of-oil-and-gas-producers/#2a29bb0e7b1d> (last accessed April 5, 2019) [↑](#footnote-ref-3)
4. Bryce F. Payne Jr, Robert Ackley. A Proposed Rapid Method For Measuring Area Methane Emissions: An Exploratory Application in Manhattan, New York, USA. European Scientific Journal. November 2015 [↑](#footnote-ref-4)
5. Bryce F. Payne Jr, Robert Ackley. A Proposed Rapid Method For Measuring Area Methane Emissions: An Exploratory Application in Manhattan, New York, USA. European Scientific Journal. November 2015. [↑](#footnote-ref-5)
6. Greenhouse Gas Protocol “Global Warming Potential Values” https://www.ghgprotocol.org/sites/default/files/ghgp/Global-Warming-Potential- [↑](#footnote-ref-6)
7. Ramon A. Alvarez et al. Assessment of methane emissions from the U.S. oil and gas supply chain. Science. 13 Jul 2018: [↑](#footnote-ref-7)
8. Environmental Defense Fund. New Study Finds U.S. Oil and Gas Methane Emissions are 60% Higher Than EPA Reports. <https://www.edf.org/media/new-study-finds-us-oil-and-gas-methane-emissions-are-60-percent-higher-epa-reports-0> (Last accessed 5/29/19) [↑](#footnote-ref-8)
9. DeVynne Farquharson, et al. Beyond Global Warming Potential: A Comparative Application of Climate Impact Metrics for the Life Cycle Assessment of Coal and Natural Gas Based Electricity. Journal of Industrial Ecology. August, 2016. [↑](#footnote-ref-9)
10. Xiaochi Zhou et al.. Estimation of methane emissions from the U.S. ammonia fertilizer industry using a mobile sensing approach. Elem Sci Anth, 2019; 7 (1): 19 DOI: 10.1525/elementa.358 (last accessed 6/7/2019) [↑](#footnote-ref-10)
11. Morgan E. Gallagher et al. Natural Gas Pipeline Replacement Programs Reduce Methane Leaks and Improve Consumer Safety. Environmental Science & Technology Letters. July 2015. <http://biogeosphere.org/Publications/natural-gas-replacement-leak-methane.pdf> (last accessed 6/10/2019) [↑](#footnote-ref-11)
12. Don Hofstrand. Natural Gas and Coal Measurements and Conversions. Iowa State University <https://www.extension.iastate.edu/agdm/wholefarm/html/c6-89.html>(last accessed5/23/, 2019) [↑](#footnote-ref-12)
13. Bryce F. Payne Jr, Robert Ackley. A Proposed Rapid Method For Measuring Area Methane Emissions: An Exploratory Application in Manhattan, New York, USA. European Scientific Journal. November 2015. https://pdfs.semanticscholar.org/b20d/2a0f1f222f3cfd911440aa6e3a786ba424e6.pdf (last accessed 6/10/2019) [↑](#footnote-ref-13)
14. Environmental Defense Fund. Staten Island: Snapshot of natural gas leaks under city streets. <https://www.edf.org/climate/methanemaps/city-snapshots/staten-island> (last accessed, May 23, 2019) [↑](#footnote-ref-14)
15. Morgan E. Gallagher et al. Natural Gas Pipeline Replacement Programs Reduce Methane Leaks and Improver Consumer Safety. Environmental Science & Technology Letters. July 2015. [↑](#footnote-ref-15)
16. Jonathan Stempel. Con Edison reaches $153 million settlement over fatal 2014 Harlem blast. Reuters. February 16, 2017. <https://www.reuters.com/article/us-new-york-conedison/con-edison-reaches-153-million-settlement-over-fatal-2014-harlem-blast-idUSKBN15V2Q8> (Last accessed 5/28/2019) [↑](#footnote-ref-16)
17. Natural Gas Fueled Building Explosion and Resulting Fire. Executive Summary. National Transportation Safety Board. <https://www.ntsb.gov/investigations/AccidentReports/Pages/PAR1501.aspx> (Last Accessed 5/28/2019) [↑](#footnote-ref-17)
18. David W. Dunlap. Gas Explosions that Have Rocked New York City. New York Times. October, 4, 2015. (Last accessed 5/28/19). [↑](#footnote-ref-18)
19. Church Explosion Caused by Unlicensed Plumber. Plumbing and Mechanical. June 1, 2000. <https://www.pmmag.com/articles/85210-church-explosion-caused-by-unlicensed-plumber> (Last accessed, 5/28/19) [↑](#footnote-ref-19)
20. Patrick Galey. 415.26 parts per million: CO2 levels hit historic high. Phys.Org. <https://phys.org/news/2019-05-million-co2-historic-high.html> (last accessed 5/30/2019) [↑](#footnote-ref-20)
21. National Aeronautics and Space Administration. Global Climate Change. Graphic: The Relentless Rise of Carbon Dioxide. https://climate.nasa.gov/climate\_resources/24/graphic-the-relentless-rise-of-carbon-dioxide/ (last accessed, 6/10/2019) [↑](#footnote-ref-21)
22. Owen Gaffney and Will Steffen. The Anthropocene equation. The Anthropocene Review. 2017, volume 4. <https://journals.sagepub.com/doi/pdf/10.1177/2053019616688022> (Last accessed 6/5/2019) [↑](#footnote-ref-22)
23. Jay, A., D.R. Reidmiller, et al. 2018: Overview. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume IIII U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71 [↑](#footnote-ref-23)
24. Id. [↑](#footnote-ref-24)
25. Elizaveta P. Petkova et al. Towards More Comprehensive Projections of Urban Heat-Related Mortality: Estimates for New York City under Multiple Population, Adaptation, and Climate Scenarios. Environmental Health Perspectives. January, 2017. <https://ehp.niehs.nih.gov/doi/10.1289/ehp166> (Last accessed, 6/5/2019) [↑](#footnote-ref-25)
26. Kendra Pierre Louis. Mosquitos and Ticks are Going to Eat Us All Alive This Summer. Popular Science Magazine. April 3, 2017. <https://www.popsci.com/winter-warm-mosquitoes-ticks> (last accessed, 6/5/2019) [↑](#footnote-ref-26)
27. Oliver Millman, We are at war: New York’s rat crisis made worse by climate change. The Guardian. December 21, 2018. <https://www.theguardian.com/us-news/2018/dec/21/new-york-rat-crisis-climate-change> (Last accessed 6/5/2019) [↑](#footnote-ref-27)
28. Joel Grover and Amy Corral. Typhus Epidemic Worsens in Los Angeles. February 1, 2019. <https://www.nbclosangeles.com/investigations/Typhus-Epidemic-Worsens-in-Los-Angeles-505166301.html> (last accessed 6/5/2019) [↑](#footnote-ref-28)
29. Sadie J. Ryan et al. Global expansion and redistribution of Aedes-borne virus transmission risk with climate change. PLOS. March 28, 2019. <https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0007213> (last accessed 6/5/2019) [↑](#footnote-ref-29)
30. Jay, A., D.R. Reidmiller, et al. 2018: Overview. In Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment, Volume IIII U.S. Global Change Research Program, Washington, DC, USA, pp. 33–71 [↑](#footnote-ref-30)
31. Id. [↑](#footnote-ref-31)
32. New Study Finds 143,00 New York Homes Worth $98 Billion will be at Risk from Tidal Flooding. <https://www.ucsusa.org/press/2018/new-study-finds-143000-new-york-homes-at-risk-from-tidal-flooding> (last accessed 6/6/2019) [↑](#footnote-ref-32)
33. Dahl, K.A. et al.. Effective inundation of continental United States communities with 21st century sea level rise. Elem Sci Anth, 5, p.37. 2017 DOI: <http://doi.org/10.1525/elementa.234> (last accessed 6/6/2019) [↑](#footnote-ref-33)
34. New Study Finds 143,00 New York Homes Worth $98 Billion will be at Risk from Tidal Flooding. https://www.ucsusa.org/press/2018/new-study-finds-143000-new-york-homes-at-risk-from-tidal-flooding (last accessed 6/6/2019) [↑](#footnote-ref-34)
35. Id. [↑](#footnote-ref-35)
36. Id. [↑](#footnote-ref-36)
37. Id. [↑](#footnote-ref-37)
38. Id. [↑](#footnote-ref-38)