Global Warming Pollutants in New Jersey: Beyond Carbon Dioxide

New Jersey Clean Air Council
Public Hearing April 10, 2019

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This manuscript is dedicated to New Jersey Clean Air Council (CAC) members, both past and present, we have lost this year. There is no doubt that this Council, the citizens of New Jersey and its environment are all stronger, healthier and cleaner as a result of their years of service.

Irwin S. Zonis (1930 - 2019)
(served the CAC, 1969 - 2009)

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I. EXECUTIVE SUMMARY

The New Jersey Clean Air Council (CAC or the "Council"), as an advisory body to the Commissioner of New Jersey Department of Environmental Protection (DEP), has undertaken a public hearing to provide recommendations to the Commissioner to help better understand the extent of emissions of certain global warming pollutants in the State of New Jersey. The following report summarizes the testimony and data received during the CAC's April 10, 2019 public hearing and the Council's recommendations on this important issue. The Council is pleased to present this report in an effort to better understand and appropriately prioritize emissions of higher global warming potential (GWP) gases in New Jersey and supplement the Murphy Administration's goal of further reducing greenhouse gas (GHG) emissions in the State.

Governor Murphy's Administration has undertaken efforts to combat climate change through the regulation of GHG emissions. On April 12, 2019, the DEP adopted the CO_2 Budget Trading rules that will govern New Jersey's reentry into the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among participating states in the region to cap and reduce carbon dioxide emissions from fossil-fueled power plants. While carbon dioxide represents the largest proportion of GHG emissions, there are other GHGs which have a higher GWP than carbon dioxide, such as hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride (SF_6), and methane. Emissions of some of these gases throughout the U.S. have increased steadily since 1990 due to their use as replacements for the widely-used ozone-depleting substances: chlorofluorocarbons and hydrochlorofluorocarbons. Emissions of substitutes for ozone-depleting substances in the U.S., primarily from hydrofluorocarbons, have grown from 0.3 million metric tons in 1990 to 159.1 million metric tons in 2016. Overall, 6,511 million metrics tons of GHG were released in 2016. Ozone-depleting substance substitutes are commonly used in solvents, residential and commercial refrigerants, firefighting agents, aerosol propellants, and semiconductor manufacturing.

The New Jersey Global Warming Response Act (GWRA) of 2007 (N.J.S.A 26:2C-37) requires the State to pursue efforts to reduce GHG emissions to meet the required limits by certain deadlines. These efforts include New Jersey's reentry into RGGI, which is expected to cap and reduce carbon dioxide emissions. Entry into RGGI is not required under the GWRA but is authorized under N.J.S.A. 26:2C-45 et seq. However, the sources and impact of higher GWP GHGs in New Jersey has not been explored in recent years. Before proceeding with policy decisions, there is a need to better understand the significance of their contribution to global warming. The objective of the April 10, 2019 Council hearing and this report is to evaluate the latest information on the emissions of these greenhouse gases, and how those emissions are currently managed.

II. RECOMMENDATIONS

Based upon the testimony received and questions asked at the public hearing, the Council has developed the following recommendations to the DEP to address the use and emissions of several higher global warming potential gases.

General Reduction Actions

The DEP should consider participation in the United States Climate Alliance Short-Lived Climate Pollutant (SLCP) Challenge. The Alliance is working to develop a workplan to comprehensively "address short-lived climate pollutants, including through new and continued actions to improve emissions inventories; quickly identify and address methane leaks and "super emitters;" promote energy efficiency, including in refrigeration and cooling; phasedown the use of HFCs; improve management of organic and agricultural waste streams; and define other targets and measures to rapidly reduce emissions of these potent pollutants" (see: https://www.usclimatealliance.org/slcpchallenge).

Greenhouse Gas Reporting Actions

If the Department determines that additional reporting is necessary to accurately estimate the inventory of climate change pollutants, it should take into consideration not only carbon dioxide (CO_2), methane and other high GWP gases, but should also include other pollutants that may have been excluded from reporting, such as black carbon.

HFC Reduction Actions

1. In the absence of a federal mandate to replace HFCs in air conditioning and refrigeration equipment (as discussed in items 3,4, and 5 below), New Jersey should seek alternatives to transition away from HFC use and develop an accelerated timeline for transition and final implementation;
    a. DEP should update the State's Greenhouse Gas Emissions Inventory targets as part of the strategic plan for 2050 using the most current data available;
2. DEP should work with industry leaders to develop an education program that allows consumers to recognize when it is appropriate to retire or retrofit old equipment using HFCs as refrigerants;
    a. DEP should encourage BPU and the utilities to develop a user-friendly consumer tool to perform cost-benefit calculations related to upgrading and/or replacing current refrigeration and HVAC equipment (e.g., similar to Energy.gov eGallon tool for comparing gas to electric vehicle use);
    b. DEP should encourage the BPU to use the funds from the Societal Benefits Charge to incentivize retirement of old equipment with more energy efficient equipment that uses substitute refrigerants (e.g., BPU Pay for Performance Program, http://www.njcleanenergy.com/commercial-industrial/programs/pay-performance;
3. DEP should support future federal action (legislation or rulemaking) that would establish a national framework for the regulation of HFCs, similar to the Significant New Alternatives Policy (SNAP) rules that were struck down by the U.S. Court of Appeals;

4. In the absence of federal action, New Jersey has the option to adopt the SNAP rules as state regulation. In light of the consensus between industry groups and the environmental community attending the public hearing, DEP should begin a regulatory stakeholder process to implement rules 20 and 21 of the SNAP rules, which were established under Section 612 of the Clean Air Act (42 U.S.C. § 7401), as a backstop to the rescinded federal rules;
5. DEP should encourage EPA to adopt Rule 608, Refrigerant Management Rule, to ensure proper recovery, safe disposal, reclamation, record keeping, and sales restrictions of all refrigerants. If EPA does not reinstate these rules then New Jersey has the option to adopt them as state regulation.

SF_6 Reduction Actions

1. DEP should use the EPA Facility Level Information on Greenhouse Gases Tool (FLIGHT; https://ghgdata.epa.gov/ghgp/main.do#) to obtain detailed emissions by company when developing estimates of SF_6 emission for all updates of New Jersey's Greenhouse Gas Emissions Inventory;
2. DEP should monitor technology and best practices as alternatives are being developed for the replacement of SF_6;
3. DEP should encourage the BPU to work with utilities to continue to update or replace outdated equipment to better contain SF_6.

Methane Reduction Actions

1. DEP should encourage gas public utilities to continue and expand programs identifying, prioritizing, and replacing the largest leak-prone cast iron and unprotected steel pipes throughout the natural gas distribution system and upgrade these pipes to plastic pipes;
2. DEP and BPU should encourage gas utilities to further study the impact of leaks in the gas distribution systems, as the impact of these leaks is still somewhat unknown. The study should include an analysis of leak detection systems to determine whether more effective leak detection and control methods or equipment are available for implementation without unreasonable impacts to ratepayers;
3. DEP should study the impacts of landfill emissions of methane to better quantify these emissions and develop methods to reduce and better manage organic waste, including manure.
    a. Evaluate methane emission capture and monitoring programs at all large landfills throughout the State to determine if the existing system should be expanded;
4. DEP should work closely with natural transmission companies to develop a protocol to minimize methane loss during blowdowns and pigging.

Black Carbon Reduction Actions

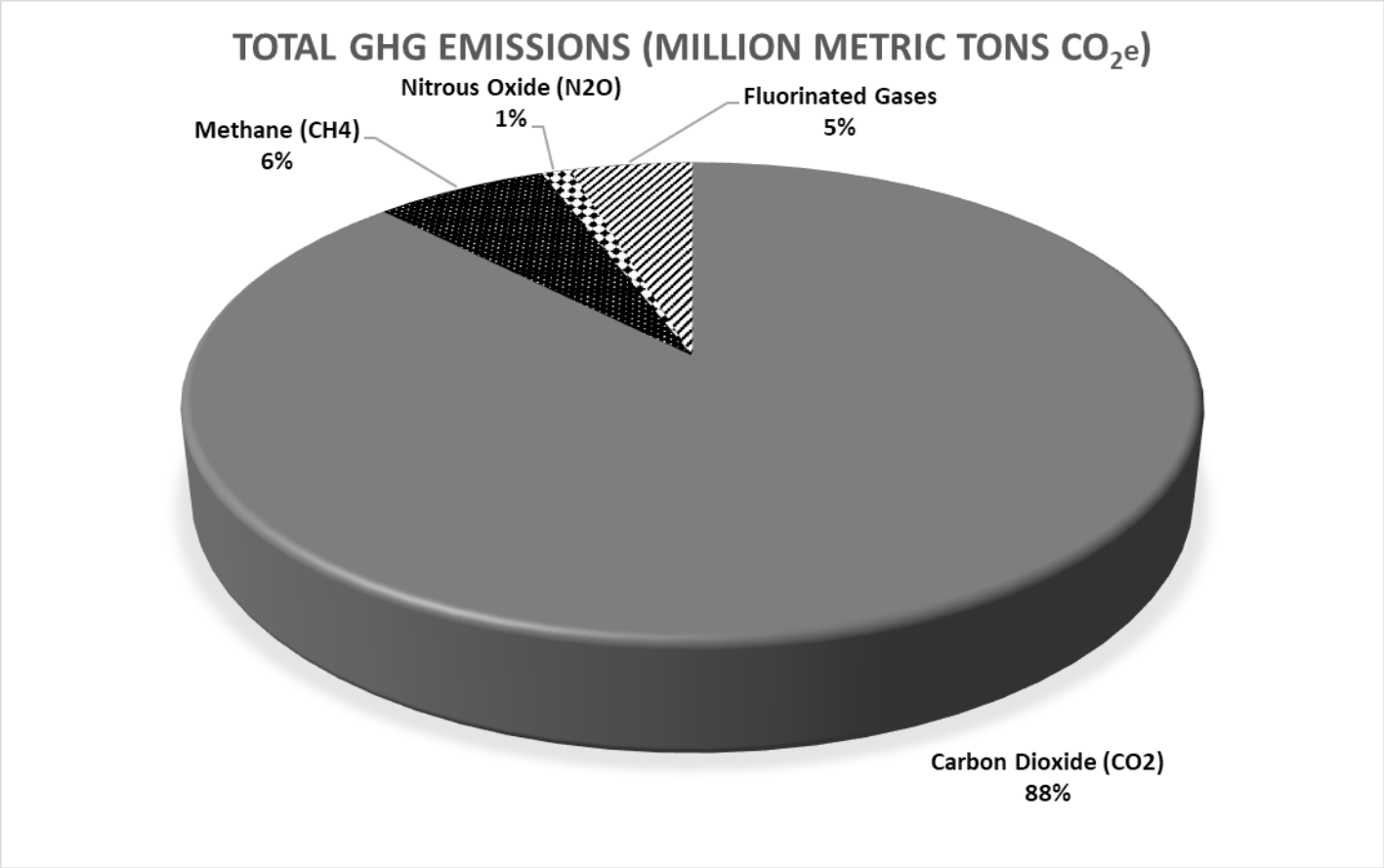
1. Although not a focus of the CAC's public hearing, sufficient concerns were raised by stakeholders that suggest that black carbon's (BC) high GWP should require its inclusion in the GHG inventory for the State;

2. DEP should develop a study to get a better understanding of both anthropogenic (of, relating to, or resulting from the influence of human beings on nature) and natural sources of BC emissions;
3. DEP should consider the recommendations for reducing BC emissions from anthropogenic sources in the NJ CAC 2008 Public Hearing Report entitled, Improving Air Quality at Our Ports and Airports: Setting an Agenda for a Cleaner Future;
4. As part of addressing BC, New Jersey should continue to develop and strengthen the regional framework for transportation pollution reduction strategies through the Transportation and Climate Initiative;
5. Since transportation is a significant source of BC, DEP should consider the recommendations of the CAC regarding zero emission vehicles. The CAC's 2018 report entitled, Zero Emission Vehicles: Clearing the Air, provides a roadmap to accelerating the transition of the transportation and motor vehicle fleet in New Jersey. These recommendations include incentives for purchasing electric vehicles, prioritizing electrification of the public transportation network, and developing publicly available charging stations at strategic locations.

III. Background and Recent Achievements

More than a decade ago, New Jersey recognized that climate change posed a grave risk to the environment and took action to reverse the trends of global warming. The Legislature passed the Global Warming Response Act (GWRA), which had a number of important GHG emissions mandates. Two of the directives set forth in the GWRA were: (1) to reduce the level of GHG emissions in the State to 1990 levels by 2020; and (2) to reduce the level of GHG emissions to 80 percent below 2006 levels by 2050.

Since the passage of the GWRA, New Jersey has met the 2020 goal for the reduction of statewide GHG emissions to 1990 levels. (See Pacyniak, G., N. Kaufman, J. Bradbury, A. Veysey, H. Macbeth, M. Goetz, M. Kaplan, J. Herb, J. Senick, T. Abrahamian, and K. Zyla, *An Examination of Policy Options for Achieving Greenhouse Gas Emissions Reductions in New Jersey*, Executive Summary, I.D. Discussion (2017)). This achievement was met principally as a result of the State's ongoing efforts to reduce GHG emissions from the power sector. (see: id). New Jersey will have to reduce its GHG emissions by 25.7 million metric tons if it hopes to achieve the 80 percent reduction below 2006 levels by 2050 that is contemplated by the GWRA. The figure below illustrates the GHG contribution for the State.



Although New Jersey has met its interim goal to reduce the level of GHG emissions in the State to 1990 levels by 2020, meeting the 2050 goal has become even more critical for the health and well-being of New Jersey's residents. Beyond efforts to reduce fossil-fuel power plant emissions through its participation in RGGI, New Jersey is also focused on developing and implementing non-carbon-emitting energy sources, such as renewables, and improving and transforming the transportation sector. Last year, the CAC provided recommendations regarding zero emission vehicles. The recommendations to reduce emissions from on and off-road diesel trucks, as well as the remainder of the transportation industry, will go a long way towards the reducing New Jersey's total CO_2 emissions.

Though CO_2 is the most prevalent GHG in New Jersey, there are other GHGs that have a higher GWP. Methane, nitrous oxide, and fluorinated gases all absorb energy more efficiently than CO_2. Thus, while the emissions of these gases may be proportionately lower than the total emissions of CO_2, the ability of these gases to warm the earth's atmosphere at a higher rate suggests that their impact deserves further study and consideration.

According to the U.S. EPA's *Inventory of Greenhouse Gas Emissions and Sinks 1990-2016,* 81 percent of all GHG emissions in the United States are carbon dioxide. The remaining GHG emissions in the United States are comprised of methane (54.8 percent), nitrous oxide (30.8 percent), and fluorinated gases (14.4 percent). Similar to the national framework, New Jersey's

2015 Statewide Greenhouse Gas Emissions Inventory shows that methane emissions in the State accounted for approximately 53 percent of the total non-CO_2 GHG emissions. But in contrast to the national framework, fluorinated gases accounted for approximately 38 percent of the total non-CO_2 GHG emissions in New Jersey. This amount is more than double the national figures. Conversely, the proportion of nitrous oxide emissions in New Jersey were much smaller than the national proportion, at less than 10 percent.

Key findings about fluorinated gases

Fluorinated gases include hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). HFCs and PFCs are commonly used in solvents, residential and commercial refrigerants, firefighting agents, and aerosol propellants. SF_6 is predominantly used as an electrical insulator for medium and high voltage circuit breakers within utility substations.

A. *Hydrofluorocarbons and perfluorocarbons*

HFCs and PFCs are the primary substitutes for ozone-depleting substances (ODS), such as chlorofluorocarbons (CFCs) and hydrochlorofluorocarbons (HCFCs). The ODS are controlled under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer (Montreal Protocol), the international treaty governing the protection of the stratospheric ozone. Under the Montreal Protocol, CFCs have been completely banned from new production and consumption, and HCFCs are currently being phased out of new production and consumption in the United States, with a complete ban beginning January 1, 2020.

Between 1990 and 2016, emissions of substitutes for ODS in the United States grew from 0.3 million metric tons to 159.1 million metric tons. HFCs are synthetic gases that are used in a variety of applications, including refrigeration, air-conditioning, foam blowing, solvents, aerosols, and fire suppression. PFCs are man-made chemicals containing carbon and fluorine that have been used in semiconductor manufacturing, as solvents in the electronics industry, and as refrigerants in specialty refrigeration equipment.

Though HFCs were initially regarded as safe alternatives to ODS, over time the EPA determined that a number of HFCs were unacceptable substitutes to ozone-depleting substances given their high GWP, and other potential health risks. Accordingly, in 2015 and 2016, the EPA issued two regulations, more commonly known as SNAP Rules 20 and 21, that used a phasedown approach to prohibit the use of certain HFCs when a safer alternative had been identified for a particular application.

These regulations were vacated by the D.C. Circuit Court of Appeals in February 2018 and April 2019, respectively. However, by the time of the court's decisions, many of the key players in the industries affected by the phasedown of HFCs were on the road to compliance pursuant to the deadlines set forth in the SNAP Rules. Once the Federal court decision vacating the SNAP Rules became final, several states announced their intention to adopt the Federal regulations (or something similar) at the state level. This was a concern for industry, given the potential for a patchwork of state regulations. The U.S. Climate Alliance, which is a bipartisan coalition of 23 governors, including New Jersey Governor Phil Murphy, committed to upholding the Paris

Agreement, has worked with its member states to develop a model rule based on SNAP Rules 20 and 21. Many of the industries affected by SNAP Rules 20 and 21 have expressed their support for a model rule to provide consistency among states in the absence of Federal rulemaking.

Going forward, HFC emissions are projected to grow by nearly 141 percent between 2005 and 2020 as demands for refrigeration continue to grow and more ozone-depleting substances are replaced. During this same period, emissions of PFCs are projected to remain flat.

B. ***Sulfur hexafluoride***

Sulfur hexafluoride (SF_6) is recognized as an extremely potent GHG, primarily because of its atmospheric lifetime of about 3,200 years, with a GWP of 22,800 years. SF_6, was introduced in the 1950s for use in electrical equipment and is predominantly used as an electrical insulator for medium and high voltage circuit breakers within utility substations. SF_6 has a number of unique qualities that make it an ideal insulator. Widespread use of SF_6 ultimately lead to obsolescence of oil circuit breakers and air-blast circuit breakers.

Though alternative gases are being considered and tested by the transmission and distribution industry, various factors make these alternatives less safe, reliable, and/or cost-effective. For instance, some alternatives do not work at higher voltages or would need special housing units that would require large changes in existing infrastructure. It is unlikely that a suitable alternative substance or a suitable alternative circuit breaker design will be widely available in the next 50 years. Accordingly, the industry is working on improvements to processes and handling in an effort to reduce SF_6 emissions.

Key findings about methane

Methane (CH_4) is the second most prevalent GHG emitted in the United States from human activities. Methane is emitted by natural sources such as wetlands, as well as human activities, such as leakage from natural gas systems and the raising of livestock. Natural processes in soil and chemical reactions in the atmosphere help remove CH_4 from the atmosphere. Methane's lifetime in the atmosphere is much shorter than CO_2, but CH_4 is more efficient at trapping radiation than CO_2. Pound for pound, the comparative impact of CH_4 on climate change is more than 25 times greater than CO_2 over a 100-year period. Globally, over 60 percent of total CH_4 emissions come from human activities. Methane is emitted from industry, agriculture, and waste management activities.

The primary sources of anthropogenic methane emissions are waste management facilities (landfills), leaks from natural gas transmission and distribution, and agriculture (see: Appendices A and B for technical information on NJ landfills and maps of methane emissions from select sources). Natural gas and petroleum systems are the largest source of CH_4 emissions from industry in the United States. Methane is the primary component of natural gas. Some CH_4 is emitted to the atmosphere during the production, processing, storage, transmission, and distribution of natural gas. Agriculturally, domestic livestock such as cattle, buffalo, sheep, goats, and camels produce large amounts of CH_4 as part of their normal digestive process. Manure storage lagoons and

holding tanks also contain and release substantial quantities of methane. Methane is also generated in landfills as municipal waste decomposes and in the treatment of wastewater. Landfills are the third largest source of CH_4 emissions in the United States. Methane (CH_4) emissions in the United States decreased by 6 percent between 1990 and 2014. During this time period, emissions increased from sources associated with agricultural activities, while emissions decreased from sources associated with the exploration and production of natural gas and petroleum products.

The production, processing, storage, transmission and distribution of natural gas and oil are estimated to account for 31 percent of the total methane emissions in the United States. That percentage is almost double the amount of emissions from landfills, which are estimated to make up 16 percent of the total methane emissions in the United States. It should be noted that the EPA acknowledges that its estimates are subject to a great deal of uncertainty as a result of many factors, including but not limited to imperfect data sources and methodologies.

In contrast to the national profile, New Jersey's estimated percentage of total methane emissions from landfills differs significantly. According to New Jersey's statewide emissions inventory, landfills emit approximately 68 percent of the State's total methane emissions while natural gas transmission and distribution systems account for approximately 30 percent of the total.

A. Landfills

Currently, the EPA requires new and modified landfills designed to hold 2.5 million megagrams (2.755 million tons) and 2.5 million cubic meters (3.27 million cubic yards) or more of waste over their lifetime, which could emit 50 megagrams or more non-methane organic compounds annually, to install and operate a gas collection and control system (see: https://www.epa.gov/lmop/frequent-questions-about-landfill-gas). In August 2016, the EPA finalized a rule that retained the design capacity threshold of 2.5 million megagrams and 2.5 million cubic meters but reduced the non-methane organic compounds emission threshold for the installation and removal of a gas collection and control system from 50 megagrams or more per year to 34 megagrams or more per year. The rule applies to landfills that commenced construction, reconstruction, or modification after July 17, 2014. (see: "Standards of Performance for Municipal Solid Waste Landfills; Final Rule," 81 Fed. Reg. 59332, 59333-34 (August 29, 2016)). However, since finalizing the rules, the EPA has not taken the necessary steps to implement these provisions, and the rules remain the subject of on-going litigation.

Methane emissions from smaller landfills are not regulated by the EPA. In New Jersey, only 15 landfills are authorized to accept waste pursuant to valid, state-issued permits. Air permits are required for landfills only if the facility operates a gas collection system or if the facility is classified as a Title V facility because it meets a certain threshold of emissions for a given air contaminant. Landfills with methane emissions equal to, or greater than, 100 tons per year are classified as Title V facilities pursuant to N.J.A.C. 7:27-22. DEP estimates that New Jersey has approximately 800 or more non-operating landfills. Per information from the US Energy Information Administration (EIA), there are currently 11 NJ facilities that have landfill gas (LFG) collection systems for electricity generation.

B. Natural gas Transmission and Distribution

Methane emissions from natural gas transmission and distribution line leaks account for approximately 30 percent of the remaining statewide methane emissions in New Jersey. It is acknowledged by the EPA that leak estimates using existing leak detection methods are much lower than when using new technologies. A 2018 peer-reviewed analysis found emissions to be 60 percent higher than the USEPA's official estimate, suggesting that the real numbers are much larger and underscoring the urgency in addressing these sources. (Alvarez et al. 2018. Assessment of methane emissions from the U.S. Oil and Gas Supply Chain. Science, July 13, 2018, issue 6398, pp. 186-188, DOI:10.1126/science.aar7204.) While the EPA has a reporting requirement for methane emissions, a facility is only required to comply with the requirement if it emits at least 25,000 metric tons of CO_2 equivalent per year. Neither the EPA nor the State requires distribution facilities to identify distribution system leaks and ensure that they are repaired and/or replace in a timely manner.

New Jersey's largest utilities have taken voluntary steps to reduce methane emissions, particularly by engaging in programs to replace aging cast iron and unprotected steel mains. However, replacement is a long term and costly exercise. There is some question as to whether leak detection methods and equipment could be better utilized to address leaks earlier, particularly as it pertains to the gas distribution system. There is still a great deal of work to be done to replace the aging cast iron and unprotected steel gas mains that pose the greatest risk to New Jersey's residents and the environment.

Key findings about black carbon

Over the last decade, black carbon (BC) has emerged as a major contributor to global climate change, perhaps second only to CO_2. BC particles, a component of particulate matter, or soot, that comes from the burning of fossil fuels and plant materials, has a strong warming effect both in the atmosphere, and when it lands on snow, ice caps and glaciers, where it absorbs the sun's heat, reduces reflectivity and causes widespread and faster melting. BC is produced both naturally and by human activities as a result of the incomplete combustion of fossil fuels, biofuels, and biomass. The primary source of BC throughout New Jersey and the surrounding region is emissions from diesel engines and slightly less from wood burning fireplaces and forest fires. Black carbon remains in the atmosphere for only a few weeks, so reducing source emissions locally would immediately contribute to the reduction in the rate of local and regional warming effects.

Control technologies that reduce BC include retrofitting diesel vehicles with filters to capture BC emissions, fuel switching (e.g., from diesel to natural gas in buses), and replacement of inefficient wood burning stoves with cleaner alternatives. A more comprehensive discussion of diesel emission reduction strategies and cleaner fuel alternatives can be found in previous Clean Air Council recommendations (see: NJ CAC 2008 Public Hearing Report, NJ CAC 2012 Public Hearing Report, NJ CAC 2018 Public Hearing Report).

IV. SUMMARY OF TESTIMONY

(Note: Summaries are listed in order of speaker testimony.)

Debbie Mans
Deputy Commissioner, DEP
Welcome and Opening Remarks

The focus of the Clean Air Council hearing is timely in view of the importance of and attention currently being given to the issue of climate change. The Department is taking a holistic approach to climate change by evaluating the efforts that will be necessary to address both mitigation and resilience. While New Jersey has taken some steps to mitigate climate change, like rejoining RGGI and participating in the Transportation Climate Initiative, the Department knows that these steps alone will not be enough to reach the Global Warming Response Act's goal to reduce greenhouse gas emissions to 80 percent below 2006 levels by 2050. Therefore, today's hearing on highly warming gases is an important piece of the puzzle. We look forward to the Clean Air Council's report and recommendations and believe it will assist the Department in identifying and prioritizing additional actions the Department can take to meet the 2050 greenhouse gas emissions limit.

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Kristin Igusky
Senior Associate, U.S. Climate Alliance
Reducing Short-Lived Climate Pollutants: Protecting Our Health, Food, and Climate

The impacts of climate change are apparent in U.S. Climate Alliance states and all around the world. The recent IPCC 1.5 degree report[1] has made it clear that the global response to climate change must be comprehensive and urgent, and it must include immediate efforts to slash emissions of short-lived climate pollutants (SLCPs) by 2030, as a complement to continued reductions of carbon dioxide (CO_2). Short-lived climate pollutants include methane, hydrofluorocarbons (HFCs), and black carbon (soot). Many are harmful air pollutants and potent climate forcers with a much shorter lifetime in the atmosphere than CO_2. Fortunately, the solutions to the SCLP challenge exist today, are cost-effective, and deliver substantial health and agricultural benefits for local communities and the planet.

Until recently, a growing and effective regulatory framework was in place to help reduce SLCP emissions nationally. Many of these rules have been rescinded or delayed, leading to significant uncertainty in the regulatory landscape affecting businesses and emissions in the U.S. Given this uncertainty and inaction at the federal level, the U.S. Climate Alliance is stepping up to lead on SLCPs. On June 1, 2018, we issued the SLCP Challenge, committing to comprehensively address

[1] IPCC, 2018: Summary for Policymakers. In: *Global Warming of 1.5°C. An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty* [Masson-Delmotte, V., P. Zhai, H.-O. Pörtner, D. Roberts, J. Skea, P.R. Shukla, A. Pirani, W. Moufouma-Okia, C. Péan, R. Pidcock, S. Connors, J.B.R. Matthews, Y. Chen, X. Zhou, M.I. Gomis, E. Lonnoy, Maycock, M. Tignor, and T. Waterfield (eds.)]. World Meteorological Organization, Geneva, Switzerland, 32 pp. https://www.ipcc.ch/sr15/

SLCP emissions as a critical component of meeting the goals of the Paris Agreement, and calling on the world to do so as well. At September's Global Climate Action Summit, we released a roadmap that takes that commitment from SLCP Challenge to Action.[2] It outlines a menu of options states will consider as we pursue an ambitious set of goals that have the potential to reduce SLCP emissions in the U.S. Climate Alliance as a whole by 40-50 percent below current levels by 2030. Alliance states are now focused on implementation, with inventories and backstopping EPA's SNAP rollbacks at the forefront. Moving forward, we will continue to:

- Improve state-level emissions inventories,
- Provide technical assistance,
- Develop model regulations and incentives,
- Expand partnerships, and
- Report on progress annually.

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Francis Steitz
Director Division of Air Quality, DEP
New Jersey Non-CO_2 GHG Emissions: Brief Status Overview

This brief report presents data available to the New Jersey Department of Environmental Protection (DEP) on emissions from *Non-CO_2 Greenhouse Gases (GHG)*. These gases include methane (CH_4), nitrous oxide (N_2O), and fluorinated gases such as the hydrofluorocarbons (HFCs). Also included is a short discussion on "black carbon" comprising fine particles and aerosols that contribute to global warming.

To place the New Jersey data in context, we start with a comparison of the global and U.S. national outlooks with respect to the non-CO_2 GHGs. Globally, these gases contributed to 14 percent of the total GHG emissions. Nationally, the non-CO_2 gases constitute 19 percent of total GHG emissions in 2016. Of the global non- CO_2 gases, methane emissions dominate with 66.5 percent share. In the U.S., methane is also the main non-CO_2 GHG emitted.

For New Jersey, the non-CO_2 gases constitute 12.3 percent of total GHG emissions. Of these gases, methane was 53.3 percent of the non-CO_2 GHG emissions, followed by fluorinated gases at 37.8 percent and nitrous oxide at 8.9 percent in 2015. The sources of methane emissions in the State are: waste management (landfills), waste water treatment, agriculture, natural gas transmission and distribution, and stationary combustion. The primary sources are adequately covered in the GHG inventory but there is a need for improved natural gas leak detection and estimation methods. Natural emissions from wetlands and other natural sources (approximately 30 percent of global CH_4 budget) are not encompassed by current inventory.

With respect to fluorinated gases, there is no direct data from in-state facilities. The estimates are derived from national estimates using population and state electricity consumption (for SF_6) as

[2] U.S. Climate Alliance, *From SLCP Challenge to Action: A roadmap for reducing short-lived climate pollutants to meet the goals of the Paris Agreement,* September 2018, https://www.usclimatealliance.org/slcp-challenge-to-action

scaling factor. The State's direct access to production, import and export data as well as the complexity of the U.S. Environmental Protection Agency (USEPA) model for estimating fluorinated gas emissions are key areas of concern.

In terms of nitrous oxide emissions, there is currently no direct reporting in the DEP emissions statement database program. These emissions are mainly from agricultural activities. The U.S. Department of Agriculture (USDA) data sufficiently covers the State situation. Some emissions generated in fossil fuel combustion are indirectly estimated.

Black carbon (particles and aerosols) that remains in the atmosphere for a short period is now recognized as also contributing to global warming. Black carbon data could possibly be extracted from air emission inventories. There is significant distillate fuel use in the State but it should be noted that global warming potential (GWP) for biomass black carbon is 50 percent higher than the GWP for distillate black carbon. We have identified potential sources of black carbon in New Jersey.

Attached are the data and data sources supporting this presentation (Appendix C). Also attached (Appendix A) is a note with total tonnage data of major landfills in the State.

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Allison Maginot[1]
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Vice President of Regulatory Affairs, Air Conditioning, Heating, and Refrigeration Institute
AHRI Climate-Motivated Refrigerant Transition

[1]Hydrofluorocarbons (HFCs) are a refrigerant utilized in refrigeration and air conditioning equipment, as well as other applications. As a major source of greenhouse gas emissions around the world, many countries have started to regulate the phase down of HFCs on varying timelines. The HVACR industry has long been supportive of international and national efforts to phase down the use of HFCs, including policies that promote environmental stewardship while meeting societal needs in an energy efficient, safe, and cost-effective manner. The safe use of low global warming potential alternative refrigerants is achievable but requires evaluation and upgrades to the entire supply chain, as well as codes and standards revisions.

[2]Chair Valeri, Vice Chair Weston, and members of the New Jersey Clean Air Council. My name is Helen Walter-Terrinoni and I am Vice President of Regulatory Affairs for the Air-Conditioning, Heating, and Refrigeration Institute (AHRI). Thank you for allowing me to share our experience with efforts to reduce greenhouse gas emissions from hydrofluorocarbons (HFCs).

AHRI represents more than 300 manufacturers of air-conditioning, heating and commercial refrigeration equipment. It is an internationally recognized advocate for the HVACR industry and certifies the performance of many of the products manufactured by its members. In North America,

the annual output of the HVACR industry is worth more than $20 billion. In the United States alone, AHRI members employ approximately 130,000 people, and support another 800,000 dealers, contractors, and technicians nationwide.

AHRI has been actively engaged at the international, federal, and state levels with rulemakings and legislation related to the reduction of HFC emissions from stationary air-conditioning and refrigeration systems. As an association, we have organized our members and facilitated information sharing with all of the states that have announced an intent to regulate HFC emissions. It is our goal that through providing technical feedback and industry expertise we can help states, including New Jersey, in the adoption and implementation of laws and regulations that are feasible and reduce greenhouse gases while also helping American businesses retain their positions as global leaders in air conditioning and refrigerant technologies.

With these same objectives in mind, AHRI advocated for the development of the Kigali HFC Amendment to the Montreal Protocol to phasedown high global warming potential (GWP) HFCs. Furthermore, AHRI supports pragmatic, predictable, and cost-effective measures like the adoption of the rules promulgated by the Environmental Protection Agency (EPA) to control the use of high GWP HFCs in specific end uses [Significant New Alternative Policy or SNAP Rules 20 and 21] with some specific exceptions as we detailed in our presentation on April 10, 2019.

HFCs were introduced as refrigerants, and in other uses, with the intent of safely meeting critical societal needs (e.g., food preservation, fire suppression, and delivery of medicines) which must continue to be met without increasing risk, minimizing the cost impact to consumers and maximizing environmental benefits. It is also important that the phasedown of HFCs allow adequate time for manufacturers, distributors, and contractors to prepare for a safe and efficient transition to lower-GWP technologies.

AHRI also supports leak reduction measures and the use of reclaimed refrigerants which incentivizes proper capture and disposal of used refrigerants, an important component of the overall strategy to reduce emissions. AHRI would also like to emphasize that our members have a strong preference for technology neutrality when determining which refrigerants might have the smallest carbon footprint in the context of energy efficiency.

Thank you for the opportunity to continue the conversation between New Jersey and AHRI. We believe that AHRI can continue to provide helpful recommendations that are technically feasible, allow for market certainty, benefit consumers and the industries that serve them, while still positively impacting the environment.

AHRI looks forward to continuing to work with you as partners in supporting and achieving the phasedown of high global warming HFCs.

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David Doniger
Senior Strategic Director, Natural Resources Defense Council Climate and Clean Energy Program
Regulating HFCs: An Opportunity for Climate Protection in New Jersey

New Jersey should join other climate leadership states in replacing HFCs – highly potent greenhouse gases mostly used in air conditioning, refrigeration, foams, and aerosols – in key uses where there are safer alternatives. Shifting from HFCs to safer alternatives is a key part of strategies to curb dangerous climate change. Under its current management, the federal Environmental Protection Agency has moved to repeal its national limits on HFC emissions, primarily its so-called "SNAP" regulations. So, action on HFCs now rests in state hands. New Jersey can join other states that have begun regulating HFCs based on those SNAP regulations, which allowed appropriate lead-time for switching to safer alternatives in new products and retrofits of existing equipment. Scaling based on population, if New Jersey implements the SNAP rules, it will reduce HFCs by the equivalent of approximately 800 thousand tons of carbon dioxide in 2020, 1.9 million tons in 2025, and 3 million tons in 2030. The recommended state SNAP rules reflect several minor modifications to the federal timetable negotiated between industry and environmental groups and enjoy broad support.

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Dennis Hart[1]
Executive Director, New Jersey Chemistry Council and,
Allison Skidd[2]
Marketing Manager, The Chemours Company
The Role of HFO Technology in Achieving Climate Goals While Meeting Industry Needs

[1]Industry in New Jersey is producing a number of products that can help lower carbon, refrigerant and other emissions in order to assist states and companies to meet Greenhouse Gas reduction goals. Government policymakers should encourage and incentivize the use of these new products and work with industry on identifying additional new products to meet environmental needs.

[2]Hydrofluoroolefin (HFO) chemistry can reduce GWP environmental impact more than 99 percent compared with previous-generation hydrochlorofluorocarbon (HFC) refrigerants. It is a major leap forward in sustainable cooling technology. Demand is being driven by new regulations in the United States, Europe, Japan, and other countries where stricter environmental standards, such as Europe's F-gas regulations and the EPA's SNAP delisting program, are phasing out older, less sustainable refrigerants.

HFO-1234yf was developed in 2010 to replace HFC-134a and meet the needs of the European Union MAC Directive and other global regulations for mobile air conditioning. HFO-1234yf, marketed by Chemours as Opteon™ YF, offers a favorable safety and environmental profile and compatibility with existing air conditioning technology. Chemours offers a broad range of sustainable alternatives for stationary air conditioning and refrigeration applications. All of them share the advantages of HFO-based refrigerants: low toxicity, nonflammability or mild flammability, and zero ozone-depletion potential.

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Billy Lao
General Manager, DILO Company, Inc. DILO Direct, Representing National Electrical Manufacturers Association (NEMA) Electric Transmission and Distribution SF_6 Coalition
SF_6 Gas Handling and Regulations

DILO is recommending that if the State of NJ wishes to enact any type of GHG reporting, it should line itself with the requirements of the EPA. This allows for consistent reporting and will be in line with what users are required to provide today.
These reporting factors may include a minimum nameplate threshold, using the mass balance equation and reporting the annual emissions with a target that is in line with the EPA.
It is further recommended that the regulatory representatives familiarize themselves further with SF_6 gas filled equipment, understand why SF_6 gas is used, and understand how the SF_6 gas handling is done to ensure zero emissions during handling.

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Noah Tai
Regional Vice-President Mitsubishi Electric Power Products, Inc.
Mitsubishi Electric, Non-SF_6 Switchgear Roadmap

Circuit breaker technology has evolved over the past 70 years. SF_6 circuit breaker has emerged as the optimum technology for load and fault current interruption, replacing oil and air technologies, for high voltage applications. Vacuum circuit breakers have replaced oil and air technologies for low voltage applications. Due to SF_6's global warming effect, the industry has embarked on finding alternatives to SF_6 technology. There are two broad categories of alternatives to SF_6; substitute gases and vacuum. Both of these face many technical challenges. As for substitute gases, lower dielectric withstand, potential instability, higher boiling point, etc. may result in larger footprint, higher operating pressure, more frequent use of heaters, and perhaps periodic gas replacement. Vacuum technology has the challenge of heat dissipation as well as potential need to operate with multiple gaps in series at higher voltages. The implication is that non-SF_6 equipment will likely have a larger footprint, higher maintenance, and lower performance. Mitsubishi Electric Power Products, Inc. (MEPPI) is seeking a practical and economic solution based on vacuum technology to transition out of SF_6. This is not a universal approach as others are pursuing solutions based on alternative gases. It may be that a total life cycle analysis may ultimately show that continued use of SF_6 (or alternative fluorinated gases) will be the best choice for high voltage (above 170 kV 63kA) AC transmission system. SF_6 will still be around for another 50 years. The industry needs a smooth transition to non-SF_6 alternatives that are affordable and reliable. Regulation, cost, technical feasibility, reliability will likely determine the pace of adoption of alternative technologies. Recommendation: Monitor domestic and international GHG mitigation activities; consult with local utilities on technology development and implementation challenges; maintain contact with Federal and State environmental agencies; and engender policy conducive to adoption of non-SF_6 technologies.

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Kim Scarborough
Environmental Policy Manager, Air, Public Service Electric and Gas
SF_6 and Methane

PSE&G has recognized for several decades that climate change is a real phenomenon that impacts our Planet. Inclusion of climate change in our business plans has been a part of the PSE&G culture since 1990. PSE&G recognizes that there is no simple or short-term solution to address both mitigation and adaptation of global climate change. As new challenges arise, we have adapted our business plans to develop cost-effective solutions meet these challenges.

Activities to reduce our greenhouse gas footprint include replacement of cast iron and unprotected steel natural gas distribution pipelines under PSE&G's Gas System Modernization Program (GSMP). The first GSMP was approved by the New Jersey Board of Public Utilities (NJBPU) in November 2015. The program was designed to replace up to 510 miles of cast iron and unprotected steel mains and related service lines over a three-year period. PSE&G collaborated with the Environmental Defense Fund to conduct a study on methane emissions in grids that were selected for the program. The study included a survey of 30 one-square-mile grids in PSE&G's service territory using a Google Street View car outfitted with methane sensors. The collaboration resulted in a sub-prioritization that takes into account leak history. PSE&G was able to reduce methane emissions more quickly by replacing significantly fewer miles of gas lines than would have been necessary to achieve the same emissions reductions without the survey data.

The NJBPU approved the extension of the GSMP in May 2018 (GSMP II). GSMP II is designed to replace up to 875 miles of cast iron and unprotected steel mains and related service lines over a five-year period. PSE&G agreed to retain a third-party vendor to conduct and complete a methane leak survey of approximately 280 miles of utilization pressure case iron mains and associated services. PSE&G will use the same sub-prioritization for grids of similar hazard as used in GSMP.

PSE&G currently reports fugitive methane emissions from our natural gas distribution system to the United States Environmental Protection Agency (USEPA) under the Greenhouse Gas Mandatory Reporting Program Subpart W. In addition, PSE&G reports emissions of sulfur hexafluoride (SF_6) under the Greenhouse Gas Mandatory Reporting Program, Subpart DD.
Reporting of emissions required the company to take a deep look into our SF_6 management process. PSE&G established a Lean Six Sigma Team to require all projects to go through Materials Management in order to minimize inventory. The significant reduction in 2017 was due to the retirement and replacement of older equipment with hermetically-sealed pressure equipment.

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Jayana Shah
Managing Director of Gas Supply, New Jersey Natural Gas
Reliable, Affordable, Clean

New Jersey Natural Gas has a long and extensive record of leading on emission reduction issues – and we believe our company's efforts are consistent with where the industry has moved to on this issue. In 2007, NJNG committed to achieve a 20 percent reduction in our own emissions by

2020. That includes our pipeline operations, as well as reductions made to our other business operations, including fleet, building and travel footprints. NJNG achieved those reductions 5 years ahead of schedule, which has allowed us to continue taking the initiative in methane reduction and management.

Reducing and managing greenhouse gas emission is a priority for the natural gas industry. Putting a clear focus on methane emission reduction and management is also a priority, as well as driving energy efficiency that incents customers to use less energy.

New Jersey Natural Gas believes there are sensible practices that the industry should adopt when it comes to methane emissions disclosure and reduction:

- Be transparent and report on the methane emissions from their operations;
- Identify the voluntary commitment program that fits their business and adopt its targets, such as the EPA Natural Gas Methane Challenge or ONE Future; and,
- Give priority to system improvements and investments that reap environmental benefits and help control methane emissions.

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N. Jonathan Peress
Senior Director, Energy Market Policy, Environmental Defense Fund
Utility Use of Advanced Leak detection to Maximize Cost Effective Methane Reductions

New Jersey natural gas utilities have opportunities to cost effectively reduce methane, a potent climate forcing pollutant when leaked from gas distribution systems. Each methane molecule traps 84 times more heat than does CO_2. Local natural gas distribution utilities (LDCs) are responsible for 40 percent of methane emissions in New Jersey (based on EPA GHG inventory), and based on EDF's extensive leak survey data, we estimate that 79 percent of the LDC emissions are from distribution infrastructure, amounting to 32 percent of the NJ methane emissions inventory. New Jersey utilities also have among the highest mileages of leak prone distribution mains in the US (with more vintage cast iron pipe than any other state). If New Jersey utilities were to utilize commercially available and cost-effective Advanced Leak Detection (ALD) methods to find and abate the 20 percent largest non-hazardous leaks, we estimate that LDC methane emissions would be decreased by more than 50 percent statewide. A recent report filed by PSE&G with the BPU concludes that methane mapping (i.e., ALD) "can be used to maximize methane emissions reductions and/or maximize remediation of the maximum number of belowground leaks through changes to construction priorities based on these methane maps and associated data." See, Picarro Emissions Quantification Results Final Report in Support of the Methane Leak Surveying Report for the PSE&G GSMP II Program, (December 18, 2018, filed with the BPU March 1, 2019). EDF recommends that the LDCs in New Jersey should be required to use ALD to find leaks and prioritize leak abatement efforts based on the relative size of leaks within each respective distribution system (after consideration of safety).

Potential cost savings by employing advanced leak detection technology can be found through:

- Capturing gas through identification and remediation of high-volume leaks

- Reducing risk through replacement of pipe segments with high leak density (leaks per mile)
- Reducing risk through auditing a walking survey
- Responding to fewer odor calls
- More quickly locating hard-to-find leaks
- Conducting rapid post-emergency survey
- Finding leaks during post-construction quality control
- Real-time source attribution, if using methane/ethane sampling
- Verifying quality of a system prior to asset acquisition

The following example demonstrates how to estimate potential savings for Elizabethtown Gas Company from employing advanced leak detection technology and leak quantification to prioritize grids for replacement. In 2017, the Company's Natural Gas Deliveries reported on EIA Form 176 were approximately 48.4 billion cubic feet. https://www.eia.gov/naturalgas/ngqs/#?year1=2017&year2=2017&company=Name. Mean while, the Company's reported "Losses from Leaks Volume" represented about 2.2 percent of Natural Gas Deliveries. However, the method of estimating losses from leaks is not clearly defined by the EIA, nor is the method of estimation reported by operators. For the sake of being conservative, we assume that the Company's rate of losses from leaks is 1.1 percent. At a citygate price of $4.27 per thousand cubic feet (EIA estimate for New Jersey in 2017, http://www.eia.gov/dnav/ng/ng_pri_sum_dcu_snj_a.htm), the value of that lost gas was nearly $2.3 million. Therefore, if advanced leak detection technology and leak quantification could be used to prioritize replacements for the pipes representing the top 25 percent of losses from leaks, the Company could save over $500,000 in only the first year those leaks are stopped. This may represent a conservative estimate of savings if the Company's actual leak rate is closer to 2 percent.

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Krishnan Ramamurthy
Director Bureau of Air Quality, Pennsylvania Department of Environmental Protection
Pennsylvania's Strategies to regulate Methane Emissions from Oil and Natural Gas Sources

The Pennsylvania Department of Environmental Protection has been a leader in addressing methane emissions from the oil and natural gas industry. Since 2013, Pennsylvania was the first to programmatically require a robust leak detection and repair (LDAR) program at unconventional natural gas well sites, midstream compressor stations, and processing plants with a methane-specific leak definition. LDAR was one facet of the methane emissions reduction requirements that allow Pennsylvania to be the second largest producer of natural gas with estimated methane losses of approximately 0.13 percent of production according to published studies and DEP data. Pennsylvania will continue to lead with Governor Tom Wolf's Methane Reduction Strategy nearing fulfillment with a rulemaking in progress for existing sources. Governor Wolf also recently issued Executive Order addressing Climate Change and promoting energy conservation and sustainable governance providing specific greenhouse gas (GHG) emissions targets of 26 percent reduction of 2005 GHG emissions by 2025 and 80 percent reduction of 2005 GHG emissions by 2050.

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Scott M. Conklin
President and Environmental Consultant, Sea Girt Environmental
New Jersey Wastewater Collection and Treatment Systems: How Methane is Produced, Beneficially Reused, and Controlled

The DEP and USEPA regulated wastewater industry plays a key role in protecting the public health and preserving the environment for current and future generations. This is accomplished in a cost-effective manner for utility rate payers by licensed and skilled professionals who ensure that safe and clean water is recycled back into the natural ecosystem. In the wastewater collection system and treatment plant, the industry may use physical, chemical or biological processes to treat the wastewater and residual biosolids. Methane is a byproduct of the anerobic biological degradation process used for stabilization and volume reduction of the wastewater biosolids. When feasible, the industry beneficially reuses the Methane for fuel in boilers, micro turbines or engines to create heat and electricity. Methane not consumed in such a manner is destroyed in flares. To aid with current and future Methane related projects, NJ needs to continue supporting the Environmental Infrastructure Financing Program, the Clean Energy Program, and the Energy Resilience Bank.

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Mike Van Brunt, P.E.,
Senior Director, Sustainability, Covanta
Role of Sustainable Waste Management in Reducing Methane Emissions

The waste management sector is the 3rd largest source of anthropogenic methane emissions globally and in the United States. Emissions of methane from the sector are driven by the anaerobic decomposition of biodegradable materials in landfills. Landfill operators collect much of the methane that is generated and, in many cases, use the collected methane to generate electricity or to supply renewable natural gas. However, landfills are imperfect systems that will require care and maintenance for 100 years or more. A more effective approach is to divert biodegradable materials, the source of the methane, from landfills to higher and better uses, including reuse, recycling, and energy recovery. The European Union has adopted this strategy, and many countries in Europe have achieved significant levels of diversion, including up to 65 percent recycling rates. Adopting this approach in New Jersey alone could achieve annual lifecycle GHG savings of 3.3 million tons of CO_2-e, the same GHG savings as pulling 640,000 cars off the road for a year.

Characterize landfill diversion as infrastructure
Energy-from-Waste (EfW), recycling, anaerobic digestion, and composting facilities represent critical infrastructure to help meet the ongoing waste needs of the state in a more carbon efficient manner. The maintenance and continued operation of existing infrastructure is a cost-effective means of preventing an increased demand on landfills and greater GHG emissions. The Warren County EfW facility, for example, ceased operations largely due to low power pricing and relatively cheap landfill availability.

Recognize value of CH_4 avoidance

The social cost of carbon (SCC) provides a meaningful way of recognizing the economic value of GHG's *not* emitted, including methane. This value could be used to set appropriate positive financial support mechanisms for diversion of organic matter from landfills and their continued operation. Financial support mechanisms could include carbon offsets under RGGI, low-interest or no-interest infrastructure loans and bonds, or a methane emission reduction credit (MERC) administered under the state's RPS for those technologies that generate or save electricity or fuels from diverted organics.

Remove roadblocks to CH_4 avoidance

Much of the EfW infrastructure that can avoid landfill methane is owned by, or operated on behalf of, municipalities. These municipalities are typically responsible for providing numerous other services as well, including water treatment, wastewater treatment, and emergency services, all of which need reliable sources of energy. Other critical infrastructure may also be located in these communities, including hospitals, nursing homes, and other facilities that serve a public good. Creating virtual and/or actual microgrids in these communities can help provide resiliency in the event of broader electrical grid outages, increase the value of electricity sold by EfW and AD facilities, and reduce the cost of electricity to critical infrastructure. As an overall minor parentage of the load base, the financial impact to utilities would be minor, while helping to ensure the reliability of local electrical supplies.

Use 20-year GWP for methane

The importance of dealing with SLCPs, like methane, is in part, masked by our over-reliance on the 100-year global warming potential (GWP) as a system of equating emissions to a comparable amount of carbon dioxide (CO_2). For years, climate scientists have been calling for separate regulation of climate pollutants like methane owing to their potency and other differences relative to CO_2.[i],[ii],[iii] There is growing recognition that the 100-yr GWP does not accurately capture the climate impacts of short-lived climate pollutants, including methane. The choice of the 100-yr timeframe commonly used for GWPs is somewhat arbitrary and doesn't have a basis in science. According to the IPCC's 5th Assessment Report:

> "There is no scientific argument for selecting 100 years compared with other choices. The choice of time horizon is a value judgment because it depends on the relative weight assigned to effects at different times."[iv]

In response, California uses a 20-year GWP in its *Short-Lived Climate Pollutant Reduction Strategy:*

> "The use of GWPs with a time horizon of 20 years better captures the importance of the SLCPs and gives a better perspective on the speed at which SLCP emission controls will impact the atmosphere relative to CO_2 emission controls."[v]

In its *Policy and Action Standard*, the WRI GHG Protocol recommends the use of 20-year GWPs in looking at the significant effects of policies or actions designed to reduce emissions of short-lived climate pollutants:

"Twenty-year GWP values may be used to focus on short-term climate drivers, and should be used if the policy or action accessed is specifically designed to reduce emissions of short-lived greenhouse gases, such as methane."[vi]

Calculate future methane burden from waste landfilled

Traditional inventory approaches estimate GHG emissions from landfills by year. While this is helpful from an annual emissions inventory perspective, it is intrinsically backwards looking, as it reflects policies and waste that was deposited in landfills years ago. Conversely, the positive impacts of policy changes made today to increase recycling rates or diversion of biodegradable materials from landfills are seen only gradually, undermining recognition of their impact.

Presenting the future burden of methane in the year in which waste is landfilled rectifies this problem. This approach, adopted by ICLEI in its Local Government Operations Protocol, aligns the policy action with the emissions signal, allowing for clear recognition of the value of landfill organics diversion. From a scientific perspective, this approach is no different than using a 100-year averaging period for GWPs. A GWP effectively estimates future climate impact over a specific time period, recognizing that once the methane is released, its impact on the atmosphere will occur and can be calculated. Similarly, once biodegradable waste is placed into a landfill, its future climate impact will also occur, and can be calculated.

[i] Jackson, S., (2009), Parallel Pursuit of Near-Term and Long-Term Climate Mitigation, *Science*, **326:** 526-527 http://science.sciencemag.org/content/326/5952/526.ull

[ii] Weaver, A., (2011), Toward the Second Commitment Period of the Kyoto Protocol, *Science*, **332**: 795-796 http://science.sciencemag.org/content/332/6031/795.full

[iii] See p2 of UNEP, WMO, (2011), Integrated Assessment of Black Carbon and Tropospheric Ozone: Summary for Decision Makers. https://wedocs.unep.org/rest/bitstreams/12809/retrieve

[iv] See p711-712 of IPCC WGI Fifth Assessment Report, Chapter 8: Anthropogenic and Natural Radiative Forcing.

[v] CARB (2016) Proposed Short-Lived Climate Pollutant Reduction Strategy https://www.arb.ca.gov/cc/shortlived/meetings/04112016/proposedstrategy.pdf

[vi] See p64 of WRI GHG Protocol (2014) Policy and Action Standard: An accounting and reporting standard for estimating the greenhouse gas effects of policies and actions. http://www.ghgprotocol.org/policy-and-action-standard

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V. PUBLIC COMMENTS

William O'Sullivan

1. Black Carbon and USCA - USCA confirmed that action on short lived climate pollutants is important. Measures to reduce black carbon should be included. That is consistent with DEPs ongoing efforts to minimize fine $PM_{2.5}$ emissions, especially from diesels, to reduce air toxics and improve visibility. NJ's continued participation in the USCA should be encouraged.

2. Landfills - DEP pointed to landfills (68 percent) and natural gas transmission (30 percent) as the major sources of methane emissions in NJ, with methane being the major (over 50 percent) non-CO_2 warming pollutant emitted in NJ. The hearing had detailed testimony on methane from

gas transmission, but little testimony on landfills. Given the significance of landfill methane, the CAC should seek more information. DEP air and waste staff have extensive experience regulating landfill emissions and should be able to provide useful information. In my experience, how much landfill gas escapes the collection system is the biggest uncertainty. A likely CAC recommendation is for the DEP to require best available methane measurement periodically from all active and recently closed landfills, and a lesser level of measurement from landfills closed within a defined timeframe, in the range of 20 to 40 years. Efforts to reduce landfill methane emissions are also beneficial for control of H_2S, odor, VOCs, and HAPs emitted from landfills. Landfills have greatly improved over the last 30 years but remain a significant challenge for better environmental protection in all media, including air. Covanta provided convincing testimony that waste to energy incineration results in lower methane emissions than average USA landfills. While NJ landfills are much better than average USA landfills, I believe the Covanta conclusion on higher landfill methane emissions for MSW disposal is also true in NJ, but not to the extent in the estimates provided.

3. HFC leaks- AHRI, NRDC, Chemours, and NJ Chemistry Council all recommended adopting state level SNAP (significant new alternatives policy) regulations to address the slowdown in federal regulation and maintain industry momentum to develop alternatives to HFCs for air conditioning, refrigeration, and other uses. California has already adopted SNAP rules and several other USCA states are following. NJ should be a strong supporter of SNAP rules and a leader amongst the USCA states. I agree with the NRDC characterization of the sources of HFCs as "area" sources, and that detailed inventories are not required to make progress. Timeliness is more important than precision for this rulemaking. DEP should also develop expertise in this area in order to be more active in evaluation of progress and potential future regulation development.

4. SF_6 leaks - efforts to minimize leakage from circuit breakers should be encouraged and required. The current less than 1 percent annual leakage goal by 2020 seems high when compared to the Mitsubishi 0.1 percent specification for new equipment. Given the long timeframe for development of alternatives, such as Mitsubishi vacuum breaker program, and the extraordinary high global warming potential of SF_6, replacement of equipment with 1 percent annual leaks should be mandated, with a goal for the new equipment being less than 0.1 percent annual leakage. PSE&G reported much lower leakage in 2017 due to replaced equipment. The percent leakage rate in 2018 should be requested. There should be a long-term goal of zero leakage of SF_6. DEP should charge its technical staff with keeping up on industry developments on SF_6 alternatives. Continuation and possible improvement of reporting should be required. This is a good example of where reporting and public disclosure drives emissions lower. Also, as testified by DILO, properly reclaiming used SF_6 from leaking in use and removed breakers is important. Regulation on reclaiming SF_6 may be appropriate.

5. Gas transmission leaks – PSE&G, NJ Natural Gas, and EDF all testified on the ongoing significant efforts to find leaks and replace leaking gas pipes. As the 2nd highest known source of non-CO_2 warming pollutants, it is important that leak detection and repair (LDAR) progress continue and improve. Multiple benefits include GHG reduction, economics, and safety. PSE&G reported over a 10 percent reduction in methane emissions from distribution mains over 6 years and about a 30 percent reduction from distribution services (connections to customers) over 6 years. That is significant progress, but a major leakage problem remains, and timely correction is

needed. NJ Natural gas provided different metrics (leaks per mile) so comparing progress was not possible with the data provided. DEP should consult with BPU to obtain comparable information on the progress of all NJ gas delivery companies to find and reduce leaks. Is there annual reporting, and is it understandable by the public and useful for the DEP and BPU? The CAC could also seek additional information from the gas companies directly. The EDF testified that the traditional industry methods under estimate methane emissions, and that there are advanced leak detection (ALD) methods to find and better measure the amount of leakage. PSEG has been a leader in demonstrating ALD. The EDF recommended that ALD be required to better inventory leaks and methane emissions and that abatement of "environmentally significant non-hazardous leaks (by leak flow volume)" be mandated. These appear to be reasonable recommendations. The CAC should further explore what is an "environmentally significant non-hazardous leak". That could be a declining amount as the larger leaks are timely addressed. DEP should develop expertise in methane LDAR to determine what are feasible and reasonable goals/requirements for minimizing gas leaks in NJ.

6. Wastewater - Testimony indicated that a properly operated wastewater treatment facility is not a major source of methane emissions. Efforts to control H_2S and other odorous compounds also control methane emissions. The NJ public has demanded odor control, and DEP has been a strong regulator of odors from wastewater treatment, which has had the added benefit of low methane emissions.

7. Oil and Gas production - While NJ has no oil or gas wells, its neighbor state Pennsylvania has over 100,000 wells and significant emissions of methane and other pollutants from leaks and processing equipment. Penn has required leak detection and repair (LDAR) from certain new gas and oil equipment and is attempting require LDR for existing equipment. NJ does have gas pipelines, pig stations, and pumping stations, and should explore methane emission potential and LDAR for these facilities. DEP should monitor and support Penn (and other states) efforts to reduce emissions from its extensive gas and oil production operations. In addition to reducing GHG, LDAR would reduce volatile organic compound (VOC) emissions which are precursors to ozone. The transport of ozone from Penn and other upwind states exacerbates the ozone public health problem in NJ. DEP should continue its participation and leadership in OTC and MARAMA to encourage other states to reduce air pollution that is carried by the wind into NJ. Increased involvement in ECOS, which is an organization of state environmental commissioners is also appropriate. It was good to hear that the DEP Commissioner was at an ECOS meeting.

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Thomas R. Churchelow

My name is Tom Churchelow and I am the Senior Director of Government and Public Affairs for the New Jersey Utilities Association (NJUA). NJUA is the statewide trade association for investor-owned utilities that provide essential water, wastewater, electric, natural gas, and telecommunications services 24 hours a day, 365 days a year. I writing to you on behalf of the NJUA natural gas members[3] to discuss the steps our members have taken to successfully reduce methane emissions in their systems and ways that the Department can support continuation of those efforts.

By way of background I would like to note that the New Jersey Board of Public Utilities (BPU) is statutorily mandated to ensure that utilities under its jurisdiction[4] provide "safe, adequate and proper" service.[5] As such, the BPU can adopt regulations, issue orders, and hold public hearings regarding any aspect of service carried out by New Jersey's natural gas companies. In particular, the BPU, pursuant to N.J.S.A. 48:10-1, has general jurisdiction over natural gas pipeline utilities, and is authorized to "prescribe reasonable rules and regulations for the safe construction, operation and maintenance by natural gas pipeline utilities of pipelines within or through the State of New Jersey."[6]

NJUA's natural gas member companies are subject to a comprehensive and extensive regulatory regime governing natural gas facility operations and safety requirements.[7] In addition to compliance with those requirements and making safety a top priority, our companies have also made it a priority to proactively work to reduce methane emissions. To start, significant reductions are being achieved by NJUA's natural gas members through annual capital construction and by the implementation of accelerated infrastructure replacement programs. The programs involve replacement of cast iron, wrought iron, bare steel, and unprotected coated steel distribution pressure mains. Collectively, the companies have invested billions of dollars in New Jersey's natural gas distribution infrastructure through these programs since 2010.[8] The accelerated infrastructure replacement programs were initiated by the companies and approved by the BPU in response to the State's call for the BPU and New Jersey's investor-owned energy utilities to aid in economic recovery; subsequently programs were added to address resiliency and reliability.[9] Since then, each company has created hundreds of good paying jobs through these programs.[10]

[3] The NJUA member natural gas distribution companies include Public Service Electric & Gas Company, New Jersey Natural Gas, South Jersey Gas, and Elizabethtown Gas.

[4] See N.J.S.A.48:2-13

[5] N.J.S.A.48:2-23

[6] N.J.S.A. 48:10-5.

[7] See attachment – "Summary of NJ Natural Gas Safety Statutes and Regulations**"**

[8] See I/M/O the Proceeding for Infrastructure Investment and a Cost Recovery Mechanism for All Gas and Electric Utilities, BPU Docket Nos. EO09010049 and GO09010054 and examples of associated orders: South Jersey Gas – Docket No. G0O09010051 (April 2009), PSE&G – Docket No. EO11020088, Elizabethtown Gas – Docket No. GO09010053 (April 2009), New Jersey Natural Gas – Docket Nos. EO09010049, GO09010052, and GR07110889 (April 2009), and Atlantic City Electric Docket Nos. EO09010049, and GO09010054.

[9] See, for example, BPU Docket Nos. EO09010049, GO09010052, and GR07110889, regarding New Jersey Natural's investment program, citing the State's request of New Jersey's investor-owned energy utilities to accelerate capital investments and efficiency programs as a means to support economic development and job growth. The State requested that the utilities provide company-specific program proposals.

[10] State law requires that employees who work on public utility construction projects must be the paid prevailing wage for their craft or trade. See N.J.S.A.34:13B-2.1

While the impetus for State support of the programs was economic, there are tangible environmental benefits. A peer-reviewed study[11] led by researchers from Stanford University revealed that U.S. cities with programs calling for the replacement of aging natural gas pipeline have 90 percent fewer leaks per mile than cities without such programs. Likewise, here in New Jersey, we have tangible evidence that these programs significantly reduce emissions as demonstrated by the company estimates state below:

PSE&G

PSE&G estimates GHG reduction associated with cast iron and unprotected steel pipe replacement using the current EPA Greenhouse Gas Reporting Program: Subpart W – Petroleum and Natural Gas Systems methodology (EPA Subpart W). At the completion of the first three years of the Gas System Modernization Program (GSMP I)[12], PSE&G estimates a ***cumulative reduction of 70,500 tons of CO_2 equivalent annually*** based on the replacement of:

- 356 miles of cast iron
- 84 miles of unprotected steel main
- 34,000 unprotected steel services
- 113 district regulators abandoned

At the completion of the five-year Phase II extension of the GSMP, PSE&G ***estimates an additional cumulative reduction of 155,000 tons of CO_2 equivalent annually*** based on the replacement of:

- 755 miles of cast iron
- 175 miles of unprotected steel main
- 80,000 unprotected steel services
- 224 district regulators abandoned

South Jersey Gas

South Jersey Gas ***estimates a cumulative reduction of 63,708 tons of CO_2 equivalent annually*** based on the following replacements from 2010-2017:

- 170 miles of cast iron main
- 565 miles of bare steel main
- 33,221 steel services
- 45 district regulators retired

Elizabethtown Gas

[11] http://www.platts.com/latest-news/natural-gas/houston/study-calls-for-us-natural-gas-pipeline-replacement-21167598 citing *Environ. Sci. Technol. Lett.*, **2015**, *2* (10), pp 286–291, Publication Date (Web): September 9, 2015

[12] The replacement work was prioritized based on methane emissions data from the Environmental Defense Fund.[12]

Elizabethtown Gas estimates ***a cumulative reduction of 34,455 tons of CO_2 equivalent annually*** based on the following replacements from 2010-2017:

- 286 miles of cast iron main
- 6,631 steel services
- 6.558 copper services
- 12 district regulators retired

New Jersey Natural Gas

New Jersey Natural Gas estimates a cumulative ***reduction of 61,907 tons of CO_2 equivalent annually*** based on the following replacements from 2010-2017:

- 148 miles of cast iron main
- 515 miles of steel main
- 36,906 steel services

Also, the companies' replacement programs involve upgrading systems to elevated pressures which supports use of modern high efficiency natural gas appliances and encourages development of emerging technologies.

Significant investment in aging utility infrastructure is critical to ensuring the economic and environmental well-being of our state.[13] Now our members are further empowered to maximize the benefits of that investment by proposing five-year infrastructure improvement programs. That is because the Board of Public Utilities recently adopted new rules at N.J.A.C. 14:3-2A[14] which allows utilities to file for an infrastructure program "for a period of five years or less"[15] and allows that the utility may file its subsequent base rate case "not later than five years after the Board's approval…"[16] It requires the filing of five-year capital expenditure budgets and actual capital expenditures for the prior five-year period.[17] This was accomplished with recognition of the benefits associated with longer-term, five-year infrastructure programs. As the NJUA noted in our comments during the stakeholder process associated with these rules, by encouraging utility

[13]According to a 2010 Rutgers study, the work itself has a significant economic benefit as the benefits in earned income for workers, tax revenue and gross state product are enormous and clearly a major economic driver for New Jersey. The study posited that every $1 million spent on natural gas infrastructure in New Jersey results in the creation of 10.2 jobs, $573,807 in income, $27,709 in state tax revenues, $33,635 in local tax revenues, and $766,727 in gross state product.[13] As this study was based upon older assumptions about average earnings per job, and the like, the projects noted above could produce even greater benefit per million invested. The benefits in earned income for workers, tax revenue and gross state product are significant enormous and clearly a major economic driver for New Jersey, available at http://ceeep.rutgers.edu/wp-content/uploads/2013/11/2010NJNG_Economic_Impact_Report.pdf. Figures include direct, indirect, and induced amounts.

[14] BPU Docket Number AX1750469

[15] NJAC 14:3-2A.4(a)

[16] NJAC 14:3-2A.6(f)

[17] NJAC 14:3-2A.5(b)

proposals for BPU authorization of investment programs of five years for utility hardening, modernization and improvement programs, the BPU would be supporting more efficient, longer-term utility capital planning and a regulatory process that will benefit utility customers. Utilities will likely be able to engage contractors for longer periods of time, purchase necessary components in larger quantities, and maximize the efficiency of infrastructure planning, engineering, and construction. We would assert that, the larger the program, the greater the total benefit that will accrue as a result of the efficiencies inherent in five-year programs. It follows that greater efficiencies and longer-term, streamlined planning will lead to reduced emissions. Our companies plan to implement those efficiencies through implementation of longer-term infrastructure investment programs. With that, we respectfully urge the Department to support these critical investments as they are proposed for BPU approval.

The Methane Challenge Program

In addition to critical infrastructure investments, NJUA member companies have committed to reducing methane emissions through participation in the Natural Gas STAR Methane Program. The Program was founded by the U.S. Environmental Protection Agency, in collaboration with natural gas and oil companies and provides a framework for Partner companies to implement methane reducing technologies and practices and document their voluntary emission reduction activities. By joining the Program, Partners commit to 1) evaluate their methane emission reduction opportunities, 2) implement methane reduction projects where feasible, and 3) annually report methane emission reduction actions to the EPA. New Jersey Natural Gas, South Jersey Gas, and PSE&G have all made commitments under the Program as demonstrated below.

Partner	Partner Join Date	Segment	Commitment	Rate/Intensity Target	Start Date	Commitment Achievement Year
South Jersey Gas	3/25/2016	Distribution	Mains – Cast Iron and unprotected steel	5.0%		
South Jersey Gas	3/25/2016	Distribution	Services – Cast Iron and Unprotected Steel		1/1/2016	2020
PSE&G	3/25/2016	Distribution	Mains – Cast Iron & Unprotected Steel	1.5%		2021
PSE&G	3/25/2016	Distribution	Services – Cast Iron & Unprotected Steel		4/1/2016	2021
New Jersey Natural Gas	9/13/2018	Distribution	Mains – Cast Iron & Unprotected Steel	95%	10/1/2018	2021
New Jersey Natural Gas	9/13/2018	Distribution	Services – Cast Iron & Unprotected Steel		10/1/2018	2021

Full report available at: https://www.epa.gov/natural-gas-star-program/methane-challenge-partner-commitments

New Jersey's natural gas companies will continue to partner with the EPA to reduce methane emissions and to seek BPU approval to make investments in their infrastructure. The NJUA and its natural gas members greatly appreciate any support you can provide in that effort. Thank you for taking the time to consider NJUA's comments. If you have any questions or would like to further discuss this matter, please do not hesitate to contact me at (609) 392-1000.

Respectfully,
Thomas R. Churchelow, Esq.
New Jersey Utilities Association

Attachment to Written Comments of NJUA
Submitted for New Jersey Clean Air Council 2019 Annual Hearing

Summary of NJ Natural Gas Safety Statutes and Regulations

The BPU's leak inspection, repair, and reporting standards, as well as natural gas company procedures were established in accordance with federal requirements. Each gas leak is categorized as Grade 1, 2, or 3 based on the associated level of risk[18] and all leaks are classified with criteria established in accordance with the Pipeline Safety Regulations of the United States Department of Transportation, Pipeline and Hazardous Materials Safety Administration (PHMSA), set forth at 49 CFR 190, 191, 192, 193, 198 and 199. In addition, the BPU has promulgated regulations that exceed federal requirements. BPU regulations, codified at N.J.A.C.14:7 et seq., set forth extensive requirements governing the construction, operation, and maintenance of transmission and distribution pipelines for the transportation of natural gas by intrastate natural gas pipeline operators within the State of New Jersey and generally applies to natural gas pipelines used in both distribution and transmission of natural gas. To aid in its enforcement of these rules, the BPU has the authority to levy significant civil penalties for violation of any law, rule, regulation, or order relating to natural gas pipeline safety. These penalties are set by statute and were increased just

[18] **Grade 1**: A leak that presents an immediate or probable hazard to persons or property, and requires immediate repair or continuous action until the conditions are no longer hazardous. Shall be promptly repaired, if not repaired immediately upon detection. Example: broken line. **Grade 2**: A leak that is recognized as being non-hazardous at the time of detection, but requires scheduled repair based on probable future hazard. Shall be monitored and reevaluated at least once every six months until cleared with no further signs of leak. Example: 10% gas in air above main line. **Grade 3**: A leak that is non-hazardous at the time of detection and can be reasonably expected to remain non-hazardous. Shall be monitored and reevaluated during the next scheduled leak survey, or within 15 months of the date reported, whichever occurs first, until the leak is regarded or cleared with no further signs of leak.

this year: up to $200,000 for each day that the violation persists, and up to $2,000,000 for any related series of violations.[19]

In addition to adherence to BPU-specific oversight, natural gas pipeline operator compliance with State and federal pipeline safety regulations is monitored through a comprehensive inspection and enforcement program. The program is comprised of field inspections of operations, maintenance, and construction activities; programmatic inspections of operator procedures, processes, and records; incident investigations and corrective actions; and through direct dialogue with pipeline operator management. In New Jersey, The BPU's Bureau of Pipeline Safety works in partnership with the federal Pipeline and Hazardous Materials Safety Administration (PHMSA) to assure that pipeline operators are meeting requirements for safe, reliable, and environmentally sound operation of their facilities. Violation data is collected and reported annually as part of the State's annual pipeline safety program certification or agreement to PHMSA.

The federal government has also instituted standards which directly pertain to the operation of the in-state natural gas distribution system. Specifically, the Pipeline Safety Improvement Act (PSIA) of 2002 established regulations for Integrity Management of Transmission Pipelines followed by the Pipeline Inspection, Protection, Enforcement and Safety Act (PIPES) of 2006 required the U.S. Department of Transportation (DOT) to establish a regulation prescribing standards for integrity management programs for distribution pipeline operators. In 2009, PHMSA published the final rule establishing integrity management requirements for gas distribution pipeline systems. The regulation requires operators, such as natural gas distribution companies to develop, write, and implement a distribution integrity management program.[20]

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VI. APPENDICIES

Appendix A: *Tonnage Received by New Jersey Landfills*

2015 Tonnage	2016 Tonnage	2017 Tonnage	2018 Tonnage
3,758,681	3,499,984	3,809,073	4,053,266

[19] See P.L.2007, c.118, amending N.J.S.A.48:2-86, N.J.S.A.48:3-99, and N.J.S.A.48:10-11 which govern, respectively, underground facilities protection, distribution facilities operations, and intra- and interstate transmission facilities operations. See also, N.J.A.C.14:7-2.7.

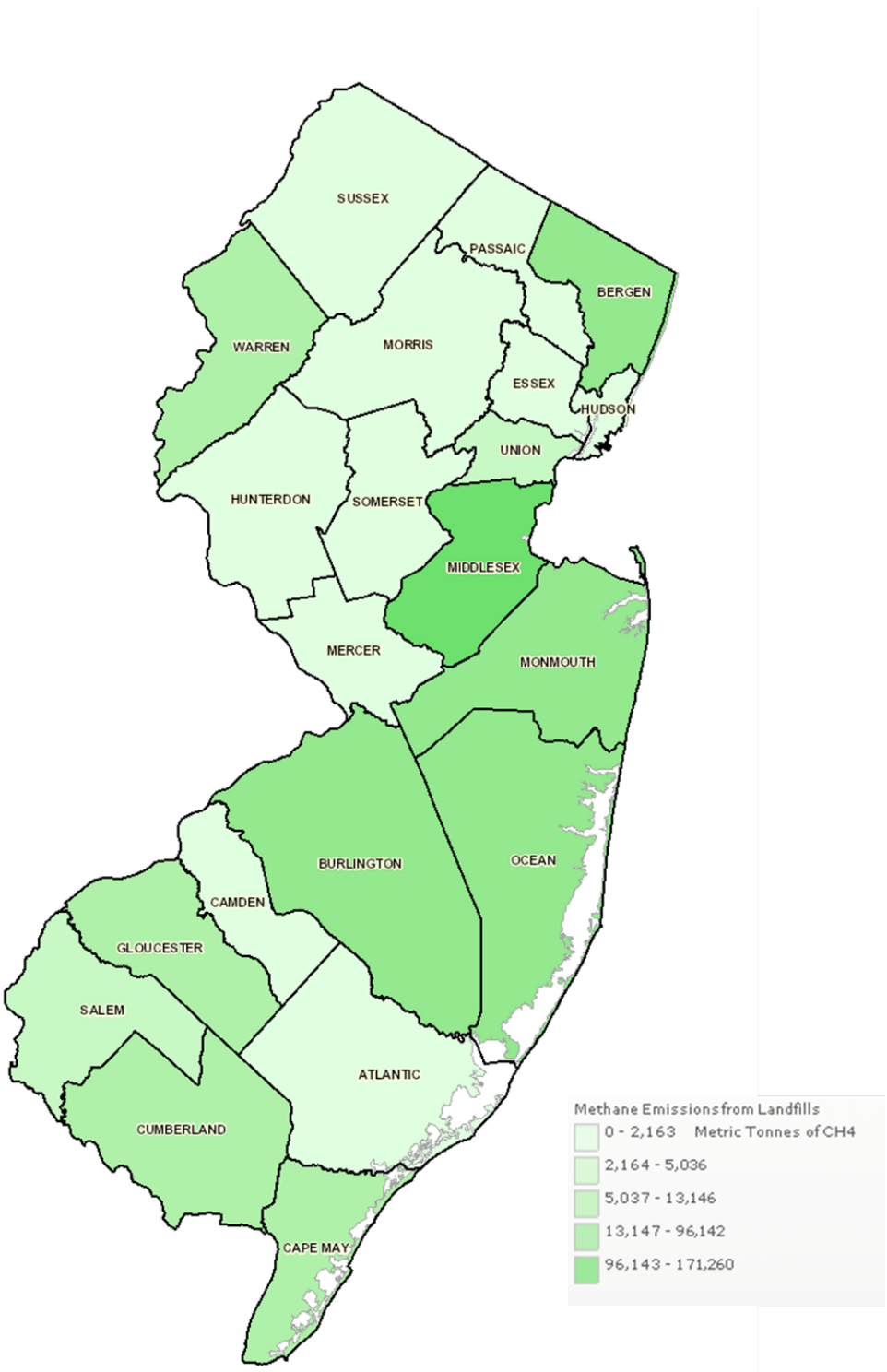
[20] The program is to contain the following elements: i. Knowledge, ii. Identify Threats, iii. Evaluate and Rank Risks, iv. Identify and Implement Measures to Address Risks, v. Measure Performance, Monitor Results, and Evaluate Effectiveness, and vi. Periodically Evaluate and Improve Program.

Notes:

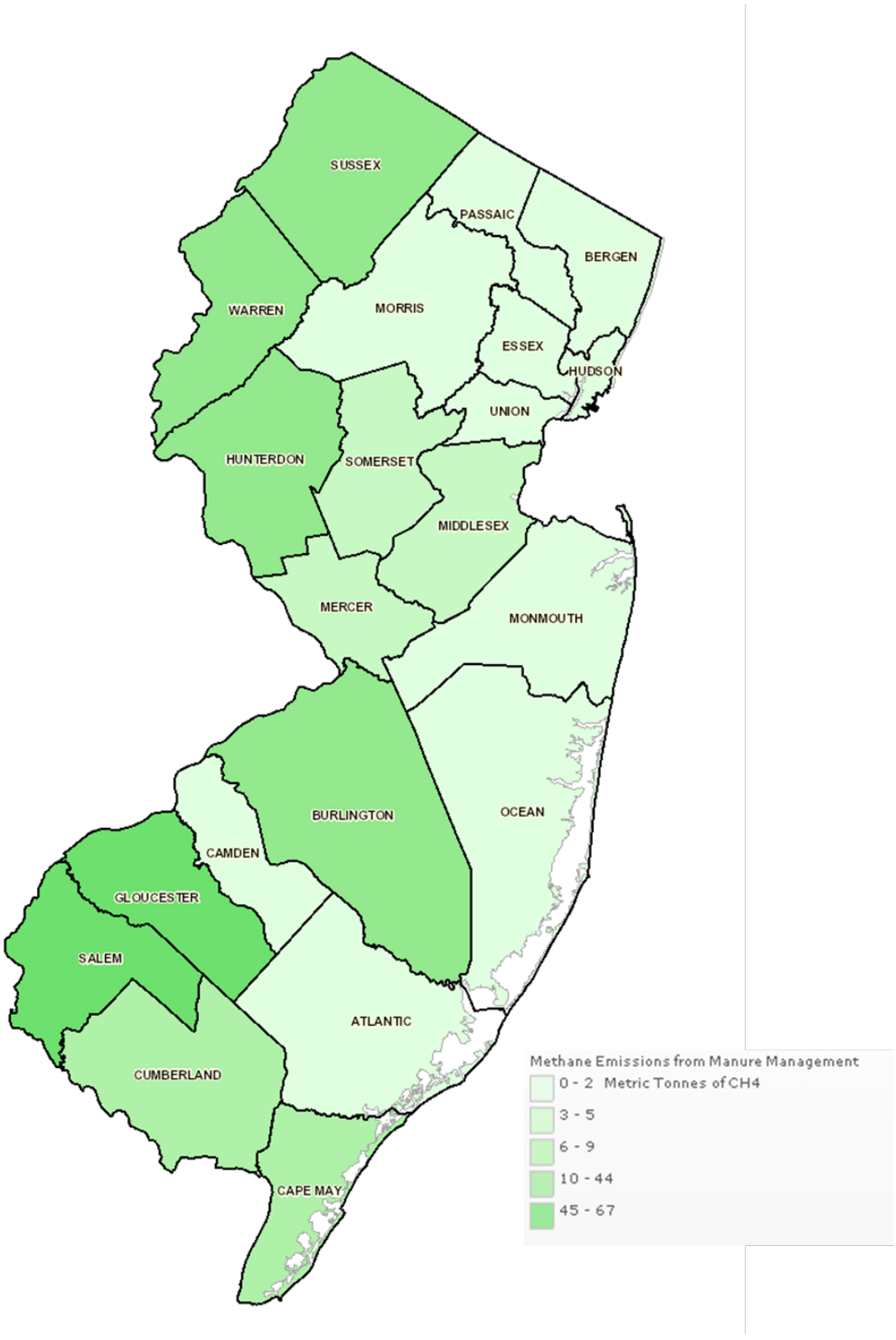
- DEP has a list of 800+ known or suspected landfills in NJ.
- The tonnage in the above table are from 14 major landfills authorized to operate. There is also a landfill in Roxbury Township that technically has approval to dispose of on-site generated waste. However, the company has not used the landfill in a long time, hence the lack of data for that site in 2017. All the 800+ other landfills are no longer authorized to accept waste.
- Tonnage is in short tons.

Appendix B: *Landfill Status and Maps of Select Methane Emissions*

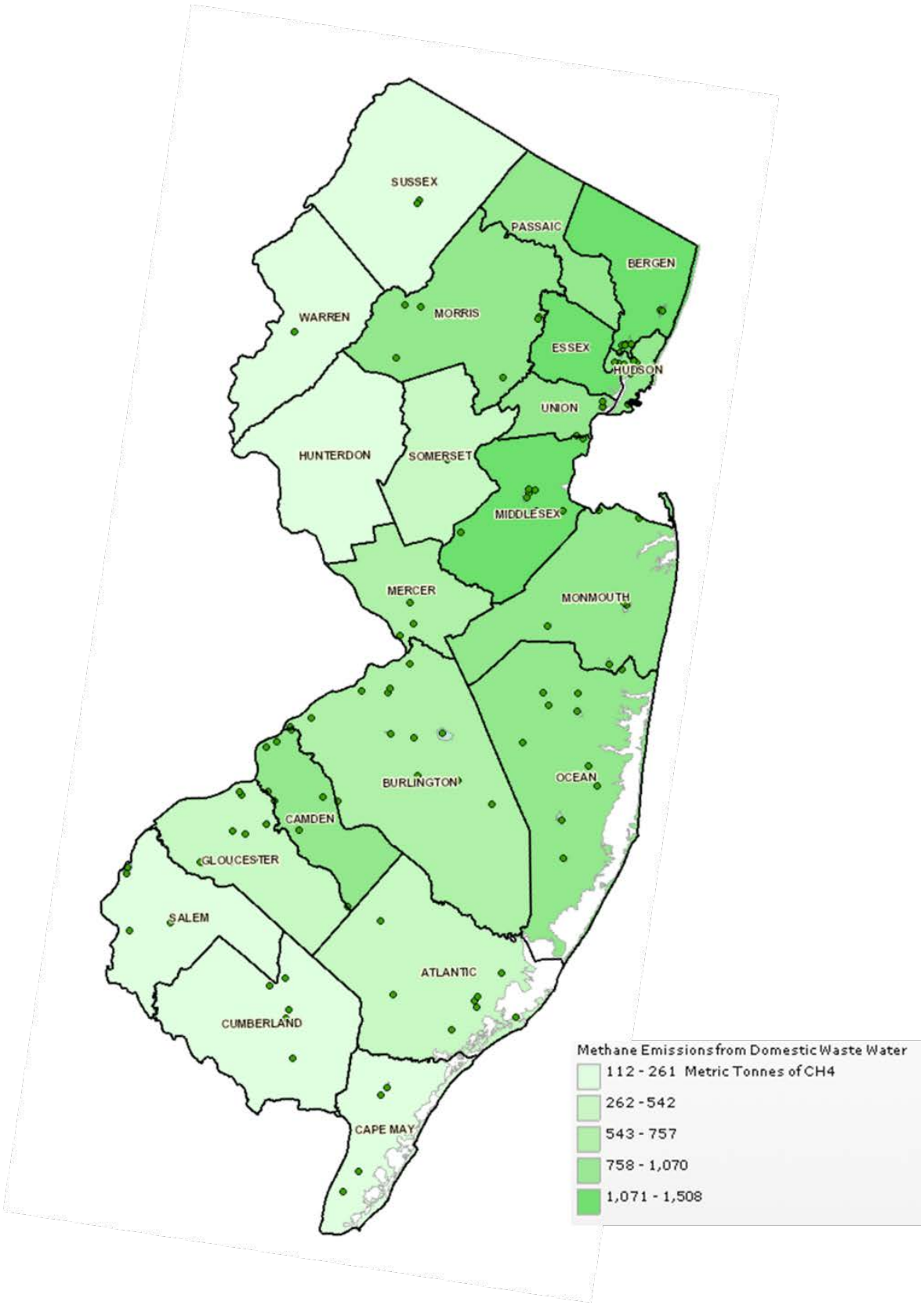
	Total Known	Landfill Owner				Waste Accepted			Status as of December 2014		
County	**# Landfill Sites**	**Government**	**Industrial**	**Private**	**Unknown**	**Commercial**	**On-Site Gen.**	**Unknown**	**Open**	**Properly Closed**	**Excavated**
Atlantic County	49	29	2	17	1	21	22	6	1	9	2
Bergen County	51	16	9	15	11	13	14	24	0	4	1
Burlington County	58	31	7	20	0	12	36	10	1	12	3
Camden County	49	22	6	21	0	16	16	17	1	1	0
Cape May County	24	10	2	12	0	8	14	2	1	1	0
Cumberland County	38	28	3	6	1	5	22	11	1	11	0
Essex County	41	12	7	12	10	9	8	24	0	4	1
Gloucester County	46	21	10	14	1	9	25	12	1	8	0
Hudson County	37	13	5	12	7	7	10	20	1	5	0
Hunterdon County	12	4	5	1	2	1	6	5	0	1	0
Mercer County	34	12	8	14	0	4	24	6	0	2	2
Middlesex County	97	17	32	37	11	22	39	36	1	16	1
Monmouth County	56	24	3	29	0	18	23	15	2	9	3
Morris County	46	13	6	16	11	8	15	23	1	4	0
Ocean County	46	27	3	16	0	10	27	9	1	6	2
Passaic County	18	8	5	2	3	1	7	10	0	0	2
Salem County	25	12	6	6	1	4	19	2	2	5	1
Somerset County	35	17	8	6	4	3	14	18	0	4	2
Sussex County	30	14	3	8	5	7	9	14	1	4	0
Union County	30	7	9	5	9	5	11	14	0	4	1
Warren County	31	10	10	7	4	4	16	11	1	6	0
Total	**853**	**347**	**149**	**276**	**81**	**187**	**377**	**289**	**16**	**116**	**21**



Map 1 - CH_4 from Landfills



Map 2 - CH_4 from Manure Mgmt.



Map 3 - CH_4 from Wastewater

Appendix C: *Technical Support Note (Tabular Data for Charts)*

1. Global

GHG	***Total GHG Emissions (Billion Metric Tons CO_2e)***	***Non-CO_2 GHG (Billion Metric Tons CO_2e)***
CO_2 (Carbon Dioxide)	37.2	
CH_4 (Methane)	7.8	7.8
N_2O (Nitrous Oxide)	2.9	2.9
F-Gases (Fluorinated Gases)	0.98	0.98
Total	49.0	11.7

Source: IPCC (2014) based on global emissions from 2010. Details about the sources included in these estimates can be found in the *Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*.

2. U.S. Federal

GHG	***Total GHG Emissions (Billion Metric Tons CO_2e)***	***Non-CO_2 GHG (Billion Metric Tons CO_2e)***
CO_2 (Carbon Dioxide)	5.3109	
CH_4 (Methane)	0.6574	0.6574
N_2O (Nitrous Oxide)	0.3695	0.3695
F-Gases (Fluorinated Gases)	0.1734	0.1734
Total	6.5113	1.2003

Source: U.S. Environmental Protection Agency (2018): *Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990-2016.* EPA 430-R-18-003

3. New Jersey State

GHG	***Total GHG Emissions (Million Metric Tons CO_2e)***	***Non-CO_2 GHG (Million Metric Tons CO_2e)***
CO_2 (Carbon Dioxide)	95.5	
CH_4 (Methane)	7.2	7.2
N_2O (Nitrous Oxide)	1.2	1.2
F-Gases (Fluorinated Gases)	5.1	5.1
Total	109.0	13.5

Source: New Jersey Department of Environmental Protection (2017): *2015 Statewide Greenhouse Gas Emissions Inventory.*

4. New Jersey Estimated Shares of Methane Emission Sources

Emission Source	***Estimated Share (Million Metric Tons CO_2e)***
Waste Management (landfills)	4.925
Waste Water Treatment	0.010
Agriculture	0.085
Natural Gas Transmission and Distribution	2.217
Stationary Combustion	0.014

Source: New Jersey Department of Environmental Protection (2017): *2015 Statewide Greenhouse Gas Emissions Inventory.*

5. New Jersey Fluorinated Gases Estimated End-Use Shares, 2015

Major End Use Emission Source	***Estimated Share (Million Metric Tons CO_2e)***
Refrigeration	1.459
Air Conditioning (AC)	0.937
Mobile Refrigeration/Air Conditioning	1.442
Electric Transmission/Distribution Insulation	0.100
Other minor uses* (Foams, Solvents, Aerosols)- *not included in chart	0.515

Source**:** California Air Resources Board (2018): *Current and Projected Emission Inventory and Methodology of HFC-Gases, Black Carbon, and Methane in California and Other U.S. Climate Alliance States*. Draft Final.

6. New Jersey Estimated* Shares of Nitrous Oxide Emission Sources, 2015

Emission Source	***Estimated Share (Million Metric Tons CO_2e)***
Animal Manure Management	0.01
Agricultural Soils Management	0.25
Solid Waste Management (Landfills)	0.20
Agriculture	0.20
Waste Water Treatment	0.20
Mobile Combustion	0.49
Stationary Combustion	0.07

Source: New Jersey Department of Environmental Protection (2017): *2015 Statewide Greenhouse Gas Emissions Inventory.*

*Estimated using U.S. EPA *State Greenhouse Gas (GHG) Inventory Tool* https://www.epa.gov/statelocalenergy/state-inventory-and-projection-tool

VII. LIST OF ACRONYMS

AC	-	Alternating Current
AD	-	Anaerobic Digestion
AHRI	-	Air-Conditioning, Heating, and Refrigeration Institute
ALD	-	Advanced Leak Detection
BC	-	Black Carbon
BPU	-	(NJ) Board of Public Utilities
CFC	-	Chlorofluorocarbon
CH_4	-	Methane
CO_2	-	Carbon Dioxide
CO_2-e	-	Carbon Dioxide Equivalents
DOT	-	(U.S.) Department of Transportation
ECOS	-	Environmental Council of the States
EDF	-	Environmental Defense Fund
EfW	-	Energy from Waste
EIA	-	(U.S.) Energy Information Administration
EPA	-	(U.S.) Environmental Protection Agency
GHG	-	Greenhouse Gas
GSMP	-	Gas System Modernization Program
GWP	-	Global Warming Potential
GWRA	-	Global Warming Response Act
GWSFA	-	Global Warming Solutions Fund Act
H_2S	-	Hydrogen Sulfide

HAP	-	Hazardous Air Pollutant
HCFC	-	Hydrochlorofluorocarbons
HFC	-	Hydrofluorocarbon
HFO	-	Hydrofluoro olefin
HVACR	-	Heating Ventilation Air Conditioning and Refrigeration
ICLEI	-	International Council for Local Environmental Initiatives
IPCC	-	Intergovernmental Panel on Climate Change
kA	-	Kiloamp
kV	-	Kilovolt
LDAR	-	Leak Detection and Repair
LDC	-	Local Natural Gas Distribution Utility
MARAMA	-	Mid-Atlantic Regional Air Management Association
MERC	-	Methane Emission Reduction Credit
MSW	-	Municipal Solid Waste
N_2O	-	Nitrous Oxide
NEMA	-	National Electrical Manufacturers Association
NJAC	-	New Jersey Administrative Code
NJNG	-	New Jersey Natural Gas
NJSA	-	New Jersey Statutes Annotated
NJUA	-	New Jersey Utilities Association
NRDC	-	Natural Resources Defense Council
ODS	-	Ozone-depleting Substances
OTC	-	Ozone Transport Commission
PFC	-	Perfluorinated Compound

PHMSA	-	Pipeline and Hazardous Materials Safety Administration
PIPES	-	Pipeline Inspection, Protection, Enforcement and Safety Act
$PM_{2.5}$	-	Particulate Matter (2.5 microns in diameter)
PSE&G	-	Public Service Electric and Gas
RGGI	-	Regional Greenhouse Gas Initiative
RPS	-	Renewable Portfolio Standard
SCC	-	Societal Cost of Carbon
SF_6	-	Sulfur Hexafluoride
SLCP	-	Short-lived Climate Pollutants
SNAP	-	Significant New Alternatives Policy
USCA	-	U.S. Climate Alliance
VOC	-	Volatile Organic Compound
WRI	-	World Resources Institute

VIII. HISTORY OF THE CLEAN AIR COUNCIL

2018 Zero Emission Vehicles: Clearing the Air

2017 What Can Be Learned from Low Cost Air Quality Monitors: Best Uses and the Current State of Technology

2016 The Clean Power Plan: Impact on New Jersey (not released)

2015 Air Pollution Knows No Bounds: Reducing Smog Regionally

2014 Reducing Air Emissions Through Alternative Transportation Strategies

2013 Addressing the Adverse Effects of Climate Change on Air Quality

2012 Transportation and Small Sources of Air Pollution: Challenges and Opportunities to Achieve Healthier Air Quality in New Jersey

2011 The Cumulative Health Impacts of Toxic Air Pollutants on Sensitive subpopulations and the General Public

2010 Vision for the Next Decade: Air Quality and Pollution Control in New Jersey

2009 Electricity Generation Alternatives for New Jersey's Future: What is the Right Mix for Improving Air Quality and Reducing Climate Change?

2008 Improving Air Quality at Our Ports & Airports—Setting an Agenda for a Cleaner Future

2007 Improving Air Quality through Energy Efficiency and Conservation: The Power of Government Policy and an Educated Public

2006 Indoor Air Quality

2005 Air Pollution—Effects on Public Health, Health Care Costs, and Health Insurance Costs

2004 Fine Particulate Matter in the Atmosphere
- Health Impacts in NJ
- Need for Control Measures

2003 Moving Transportation in the Right Direction

2002 Innovative Solutions for Clean Air

2001 Air Quality Needs Beyond 2000

2000 Air Toxics in New Jersey

1999 The Impact of Electric Utility Deregulation on New Jersey's Environment

1998 CLEAN AIR Complying with the Clean Air Act: Status, Problems, Impacts, and Strategies

1997 Particulate Matter: The proposed Standard and How it May Affect NJ

1996 Clearing the Air Communicating with the Public

1995 Strategies for Meeting Clean Air Goals

1994 Air Pollution in NJ: State Appropriations vs. Fees & Fines

1993 Enhanced Automobile Inspection and Maintenance Procedures

1992 Impact on the Public of the New Clean Air Act Requirements

1991 Air Pollution Emergencies

1990 Trucks, Buses, and Cars: Emissions and Inspections

1989 Risk Assessment - The Future of Environmental Quality

1988 The Waste Crisis, Disposal Without Air Pollution

1987 Ozone: New Jersey's Health Dilemma

1986 Indoor Air Pollution

1985 Fifteen Years of Air Pollution Control in NJ: Unanswered Questions

1984 The Effects of Resource Recovery on Air Quality

1983 The Effects of Acid Rain in NJ

1981 How Can NJ Stimulate Car and Van Pooling to Improve Air Quality

1980 (October) Ride Sharing, Car– and Van-Pooling

1979 What Are the Roles of Municipal, County, and Regional Agencies in the New Jersey Air Pollution Program?

1978 How Can NJ meet its Energy Needs While Attaining and Maintaining Air Quality Standards?

1977 How Can NJ Grow While Attaining and Maintaining Air Quality Standards?

1976 Should NJ Change its Air Pollution Regulations?

1974 Photochemical Oxidants

1973 Clean Air and Transportation Alternatives to the Automobile and Will the Environmental Impact Statement Serve to Improve Air Quality in NJ?

1972 The Environmental Impact on Air Pollution: The Relationship between Air Quality, Public Health, and Economic Growth in NJ

1971 How Citizens of NJ Can Fight Air Pollution Most Effectively with Recommendations for Action

1970 Status of Air Pollution from Mobile Sources with Recommendations for Further Action

1969 Status of Air Pollution Control in NJ, with Recommendations for Further Actions

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