Addressing the Adverse Effects of Climate Change on Air Quality

New Jersey Clean Air Council
Public Hearing May 2, 2013

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† **NOTE:** In most cases, speakers have either provided their own testimony summary, or have reviewed and approved their testimony summation as written by Clean Air Council staff. For those speakers noted with a '*' symbol after their name in the table of contents, the summary has been written by a Clean Air Council staff member but has not been reviewed by the speaker.

I. EXECUTIVE SUMMARY

New Jersey has recently experienced higher temperatures and changing weather patterns attributed to climate change. Emissions of GHG and other air pollutants are among the major factors driving climate change. The effects of climate change can complicate the State's ability to maintain air quality standards and can lead to adverse health outcomes to all New Jersey residents.

Because of the serious nature of this problem, the CAC chose to concentrate this year's public hearing on the effects of climate change on New Jersey's air quality. Through testimony received at the hearing, the CAC was better able to understand the short and long-term consequences attributable to climate change. This has enabled the Council to identify several areas that need to be addressed to mitigate and adapt to these effects.

In general, the Council sees the need for more directed coordination between NJDEP and other State agencies, such as the BPU, the NJDOH and the NJDOT. This coordination should be extended to local government and academic institutions, as well. This effort is deemed necessary because all of these entities play a major role in developing an effective approach toward adaptive and mitigation strategies.

Moreover, the State, through the NJDEP, needs to continue to comply with the major provisions of the NJ Global Warming Response Act recommendations that call for energy conservation, green initiatives and efforts to reduce vehicle miles traveled (VMT). To deal with the severe storm impacts, the Council believes the State should embark on programs to maintain a resilient electrical grid that will reduce prolonged power outages that will contribute to air quality and public health problems. The Council also concluded that the NJDEP needs to further regulate emission sources, chiefly from transportation (e.g., diesel engines), to significantly reduce the air pollutants responsible for climate change (e.g., black carbon, methane, etc.). Lastly, the Council recognizes the need for public education and outreach in all sectors of the State, in order to prepare the public for its role in preventing and adapting to climate change impacts. Our detailed recommendations are provided below.

II. INTRODUCTION

The New Jersey Clean Air Council (CAC or The Council) is a statutorily created advisory body that provides ongoing input and recommendations to the New Jersey Department of Environmental Protection (NJDEP) on air quality issues. The CAC conducts annual public hearings that highlight the most pressing air quality issues affecting New Jersey. After considering the testimony received at the May 2, 2013 hearing, the CAC has prepared this report with specific recommendations for presentation to the Commissioner of the NJDEP. The NJDEP will make the report available to the public. For 2013, we are pleased to present our report entitled, "Addressing the Adverse Effects of Climate Change on Air Quality".

Because of recent storm-related events that have seriously impacted New Jersey, the Council has elected to address the effects of climate change on air quality within the State. This issue is a long-term challenge for New Jersey, and the CAC believes it will require a significant on-going effort to anticipate, evaluate and prepare for present and future adverse impacts.

Although New Jersey has made great strides in achieving both national and state air quality standards, the effects of a changing climate can potentially reverse some of this progress. We are experiencing higher temperature trends and other changing weather patterns that can complicate the State's ability to maintain air quality standards and protect public health. The potential air quality impacts of climate change include a 2-8 ppb increase in summertime average ground-level ozone, lengthening of the ozone season, exacerbation of ozone levels on already high ozone days, and increases in particle pollution within the State. In addition to changes in ambient levels of chemical air pollutants, climate change is anticipated to increase concentrations of allergenic pollen. These changes in air quality have the potential to adversely affect the respiratory and cardiovascular health of NJ residents. Moreover, certain adaptive responses to climate change can have an adverse impact on air quality. These responses may include distributing power generation to minimize power outages, local reliance on backup electric generators, increased power plant operation in increasingly warmer summer months, and burning and other methods of disposing storm generated waste.

In addition to naturally-occurring phenomena, anthropogenic (of, relating to, or resulting from the influence of human beings on nature) activities release greenhouse gases (GHG) into the atmosphere. Thus, GHG mitigation measures have potential to impact air quality unrelated to climate change, either positively or negatively, depending on how they are implemented. Increased use of alternative fuel vehicles, shifting from coal to natural gas for power generation, and energy conservation can all have air quality benefits that need to be carefully managed.

The air quality impacts cited above can have a wide range of health consequences on all sectors of the State's population. Increases in ozone and other pollutants can cause and aggravate lung and cardiovascular diseases, lead to increased cancer incidence, and increased numbers of premature deaths. Also, changes in temperature, precipitation, and pollution levels can exacerbate pre-existing respiratory conditions such as asthma and allergies, particularly in children and the elderly. Other especially vulnerable populations may include low-income communities, communities of color and the chronically ill. Due to their importance and complexity, the above-cited issues require planning and action at multiple levels of government.

The goal of the 2013 Clean Air Council public hearing was to identify and better understand these critical issues as a basis for recommendations for a comprehensive action plan.

III. OVERVIEW OF WEATHER AND CLIMATE TERMINOLOGY

While environmental effects and adverse health outcomes, resulting from local and area-wide emissions, in relationship to climate change are the focus of this report, it is important that a baseline understanding of weather, climate, climate change, and greenhouse gases is established. Accordingly, an expanded and more detailed primer on climatological terms and issues is presented in an Appendix at the end of this report.

Weather

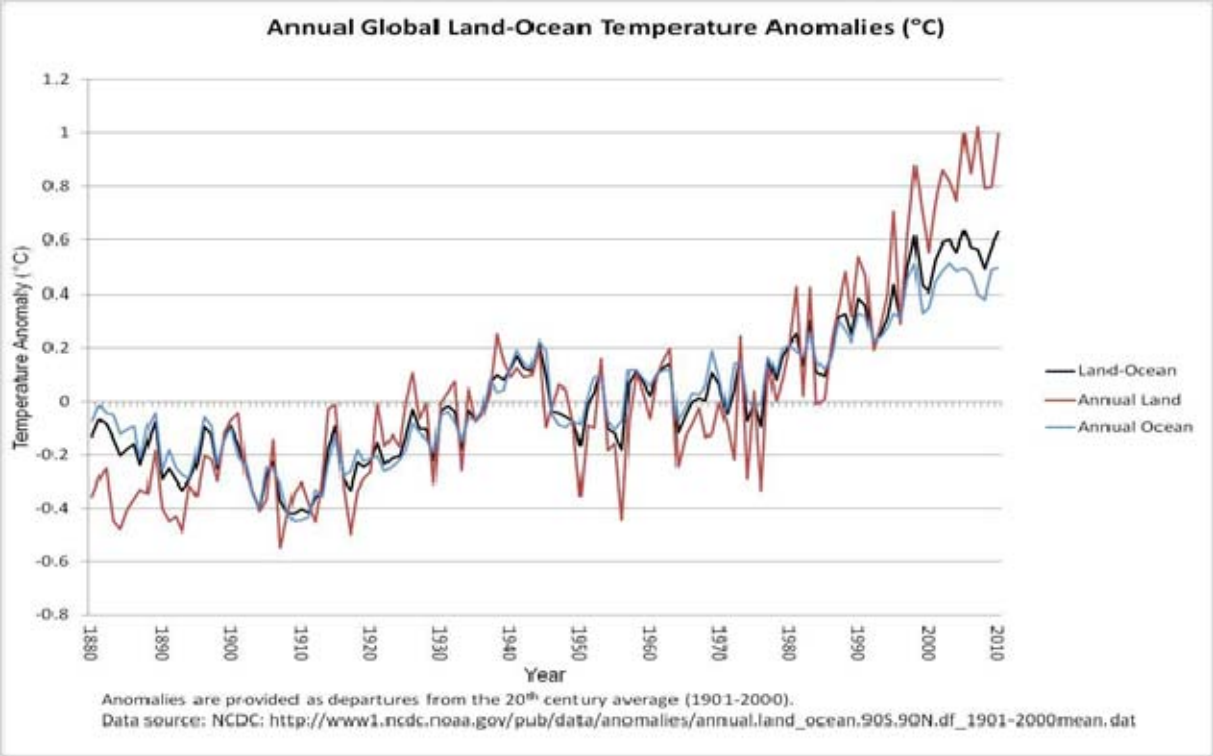
Weather occurs in the troposphere, or the lowest portion of the atmosphere. It is the current, localized condition of atmospheric elements. Common weather factors that affect daily life include wind, clouds, rain, sleet, snow and fog. Weather patterns should not be confused with climactic patterns since the former is of much shorter duration with much variation.

Climate

Climate is an interactive system consisting of the atmosphere, land surface, snow and ice, oceans and other bodies of water, flora and fauna. Climate can be described in terms of the average temperature, humidity, atmospheric pressure, precipitation, wind and other parameters over a period of time, ranging from months to millions of years. Modern climate studies tend to use intervals of 30 years to define climate patterns.

Climate Change

Climate change has occurred naturally throughout history over timescales that vary from decades to hundreds of thousands of years. The figure below provides a graphic representation of the departure of annual global temperature from the 20th century mean over the past 130 years, including mean temperature over both land and ocean, as well as combined land and ocean. Atmospheric temperatures over land increase faster than ocean temperatures due to the greater heat capacity of the ocean and its ability to transfer heat to the atmosphere in the form of evaporative cooling.



Greenhouse Effect

The greenhouse effect is a natural phenomenon that keeps the Earth insulated from the cold temperatures of space. Solar radiation enters the atmosphere and is absorbed and reemitted back from the Earth's surface as infrared energy. The GHGs in the atmosphere prevent some of this heat energy from escaping back into space and reflect it back down to the earth's surface. Since the industrial revolution, emissions of these gases have increased and accumulated in the troposphere. These larger volumes of atmospheric GHGs are trapping more and more heat resulting in an enhanced, adverse greenhouse effect.

Global Warming

Global warming and cooling have occurred naturally throughout history, usually at a much slower rate of warming than has occurred in the last three decades during which industrial pollutant emissions rose sharply. Both land and ocean temperature measurements independently indicate an atmospheric warming trend since the 1880s, but since 1979, land temperatures have increased approximately twice as fast as ocean temperatures (0.25°C per decade versus 0.13°C per decade). Since the mid-1970s, the average global surface temperature has increased by about 0.56°C. If this trend continues, by the end of the 21st century, average global surface temperature is projected to rise between 1.1°C and 6.4°C. Observed climate-related changes are expected to continue, and are likely to result in new environmental and public health impacts.

IV. RECOMMENDATIONS

The CAC considered all recommendations given at the hearing that focused on air quality issues and climate change affecting New Jersey residents. Given the complexities of source contributions, public understanding of climate change impacts, and the potential environmental and health consequences of severe weather events and climate change, the CAC believes that government, industry, academia, the public, and policy makers need to work together as stakeholders to achieve viable and long-term solutions to the issues outlined below.

As in the past, the Council acknowledges that any successful attempt to mitigate effects from climate change and minimize potential adverse outcomes to both environmental and human health can only be carried out with cooperation from involved stakeholders (listed below with their responsibilities):

i. DEP – identify source(s) of GHG emissions, PM, and other air contaminants; monitor emissions; expand enforcement efforts; educate industry , the public, and the NJ Legislature; increase awareness of community impacts from extreme weather events and climate change; develop and implement appropriate new policies and regulatory changes;
ii. DOH – identify susceptible populations, increase understanding of inter-relationship of environmental impacts from extreme weather events, climate change, and adverse health outcomes; identify specific adverse health outcomes related to air pollution and extreme weather; educate community and health practitioners;
iii. Academic institutions – define and discover relationships between climate change and air pollutants and between pollutants and health; provide technical assistance with modeling and outcomes studies; educate environmental science and public health professionals and the general public;
iv. DOT and other units of State government – promote greenhouse gas emission reduction programs, particularly in the area of transportation; educate and reach out to communities with greatest vulnerability to adverse impacts; fund and coordinate funding for environmental protection programs, tax credits or similar incentives for use of "green technologies";
v. Local government – identify local pollution sources; provide community education and outreach programs to "get the word out" about mitigation and adaptation strategies that can be implemented on an individual basis; develop and implement better land use practices; increase availability of "green" alternatives (e.g., charging stations, natural gas filling stations, etc.);
vi. Industry – conduct an examination of "green" alternatives for vehicles/products/practices including optimizing energy efficiency and conservation;
vii. Community – use "green" alternatives; follow better land use practices; become more involved in extreme weather preparedness and in developing adaptation strategies more tailored to the local/community/neighborhood level;
viii. Environmental Justice/ Environmental organizations – empower communities with organizing and technical assistance; help educate communities, government, and businesses about pollution sources and "green" technologies and helping to develop appropriate public policies.

By working in conjunction with other State agencies and local governments, private industry, community organizations, academic institutions, environmental justice and environmental organizations the NJDEP can ensure that pollution mitigation strategies are readily identified and monitored. In addition to implementation of highly practical mitigation strategies, the State can also be better prepared to deal with extreme weather events and the effect of climate change through implementation of robust adaptive strategies. The costs associated with implementation of both mitigation and adaptive strategies are generally believed to be far less than the costs associated with the response to disasters thereby avoided. Additionally, involvement of the aforementioned stakeholders is critical to address all of the cross-cutting issues faced (e.g., dealing with susceptible and vulnerable populations, public health care infrastructure evaluation and preparedness, assessing capacities and skills needs, communication and outreach) when developing a policy-based response. The specific recommendations are presented below.

1. The NJDEP should work with stakeholders to review and develop a plan to deal with the projected trend of climate change impacts on New Jersey residents. The NJDEP and NJDOH should encourage involvement with existing taskforces examining lower geographic resolution related to air pollution. Mitigation and adaptation plans should be developed to address:

    a. Environmental and public health impacts from extreme heat waves;
    b. Extreme weather events;
    c. Increased air pollution due to increases in ozone, CO_2, particulate matter, etc.

2. The NJDEP, in cooperation with NJDOH, county and local health agencies, needs to develop clear-cut strategies and routinely conduct exercises to be able to quickly respond to several major climate change-related environmental disaster scenarios impacting air quality which include (but are not limited to): extreme precipitation events, heat waves, and storm surges.

3. The NJDEP needs to coordinate with BPU to better target incentives and encourage "green initiatives" and technologies to mitigate already existing and developing environmental impacts from air pollution and climate change. Some of the initiatives may include:

    a. Promoting use of better commercial and residential building insulation;
    b. Utilizing cost effective technology to retrofit State buildings and increase energy efficiency;
    c. Following the relevant "green initiative" provisions of the NJ Energy Master Plan.

4. The NJDEP should adopt the practicable and cost-effective green initiatives detailed in its report entitled "Recommendations Report of December 2009" (Report), prepared in compliance with section 6 of the Global Warming Response Act (GWRA), P.L. 2007, c. 112 (N.J.S.A. 26:2C-37). Further, the NJDEP should designate and facilitate the work of the independent research review panel to review the recommendations and evaluations contained in the Report, as directed by section 9 of the GWRA. The Report sets forth the path for attainment of the 2020 and 2050 GHG emission reductions mandated by the

GWRA, by implementing the measures contained in the New Jersey Energy Master Plan, the New Jersey Low Emission Vehicle (LEV) Program, and the Regional Greenhouse Gas Initiative (RGGI). Since the State opted out of RGGI in 2011, however, it follows that the State must obtain additional reductions elsewhere to meet the statutory GHG emissions reductions mandates.

5. NJDEP should more fully utilize data from the NJDOH Environmental Public Health Tracking (EPHT) portal and CDC's EPHT network to identify historic environmental and health conditions throughout New Jersey and the northeast region of the U.S. Use of these data would give NJDEP more information about environmental and health baselines in New Jersey and allow for easy comparison of these baseline values to current environmental conditions and health outcomes. Collaboration by these agencies to make as much environmental and health data as possible available to the public would also foster:

    a. Educating the public and policy makers on pollutant level and climate change;
    b. Educating secondary school students, college students, and university students through classroom instruction using available datasets as part of the course curriculum (e.g., use in conjunction with programs such as TOXRAP to addresses exposure issues including pollen);
    c. Developing health advisories, alert systems, and community-based health and environmental information services to increase public awareness about environmental issues and impact on health for susceptible populations.

6. As temperatures across the State continue to rise, there is an urgent need for the DEP and all stakeholders to monitor and reduce the levels of ground-level ozone and ozone precursors. Accordingly, New Jersey should continue to focus on regional and local emission reduction strategies.

7. NJDEP should implement the 2015 requirements for stricter controls over "peaker" units use during high ozone periods.

8. While New Jersey is working hard to control in-state pollution and requires industries to use state-of-the-art pollution control equipment, it is estimated that approximately half of pollutants, specifically ozone and ozone precursors, measured in the State come from out-of-state sources. The NJDEP should continue to pursue available remedies including, but not limited to, litigation and petitions to the Federal Government in an effort to lower our monitored ozone levels.

9. In an effort to further reduce air pollution from diesel engines, NJDEP should require use of diesel particulate filters where economically feasible. Since these filters are adaptable to almost all types of machinery, they should be installed on:

    a. Standby or prime power generators;
    b. Construction, excavation, and earth moving vehicles;
    c. Long and short-haul trucks;

d. Near-port marine vessels;
e. Emergency response vehicles.

10. The NJDEP, in conjunction with NJDOH and industry, needs to develop clearer guidance for use of these gas-powered generators. Guidance and regulation would include:

    a. Generator placement when in use;
    b. Gasoline and other fuel container storage guidance (for both commercial and residential properties);
    c. Clear guidance on volume limits for gasoline and other fuels stored in and around homes and businesses.

11. For air quality benefits, the NJDEP, along with the BPU, should promote use of state-of-the-art technologies to develop a more resilient electrical grid throughout the State, as well as on a neighborhood and home level. Some possible solutions may include:

    a. Use of fault-current limiters at key locations throughout New Jersey to absorb current surges that can trip circuit breakers, leading to widespread area blackouts and necessitating use of emergency generators;
    b. Promote utilities' use of smart sensors on transmission lines to provide real-time line condition status and power levels;
    c. Encourage and promote the development of Combined Heat and Power (CHP) to alleviate burdens on the electric grid and reduce the need for and operation of peaking units;
    d. Promote use of more clean energy and renewable energy sources to be used during peak load times;
    e. Consider a phase-in of subterranean power line placement in most storm-vulnerable areas of the State, including coastal communities;
    f. Promote installation and use of smart meters at the time of new home construction and renovation that would allow utilities and residents to monitor power consumption, as well as provide immediate feedback on power status.

12. NJDEP should monitor neighborhood emission impacts in addition to statewide and regional impacts. Key strategies for emission reduction could include:

    a. Eventual phase-out of #4 and #6 heating oil;
    b. Introducing more green and healthy homes initiatives;
    c. Continued support of a cumulative impacts policy that reduces pollution in communities of color, low-income communities, and other communities already overburdened with pollution.

13. The NJDEP, in cooperation with other relevant stakeholders (e.g., NJDOT, BPU), needs to continue to promote (through education, public service announcements, etc.) and expand mass transit in critical areas of the State (e.g., high traffic density areas, $PM_{2.5}$ non-attainment areas, etc.) in order to substantially reduce vehicle miles traveled (VMT), a critical goal for attaining clean air standards. Additionally, NJDEP should promote use of

both electric and natural gas vehicles through economic incentives for drivers, as well as to industries wishing to build rapid electric charging and CNG or LNG refueling stations within the State. Air quality improvement can be accomplished by use of the following strategies:

a. Promote "greening" of short-haul truck fleets, trains, and marine vessels operating near ports;
b. Implementation of additional policies to promote the use of Zero Emission Vehicles (ZEVs) (e.g., income tax or electricity use credit);
c. Adapt uniform building code to require provisions for electric vehicle (EV) charging stations (both residential and at other parking areas);
d. Enacting legislation and/or adopting rules to eliminate any current regulatory uncertainty for public EV charging or alternative fueling stations;
e. Create incentives for the placement of alternative fuel "quick fill" stations at locations where the public spends at least half an hour, such as supermarkets, restaurants, shopping malls, hospitals, parks, rest areas of major highways, and other work places;
f. Expansion of plug-in and shore power technologies at docks, warehouses and distribution centers and exploration of electrified truck stops for independent contractors;
g. Encourage municipalities to consider enacting land use and zoning rules that increase the efficiency of truck travel and minimize impact of diesel emissions on vulnerable populations.

14. NJDEP should consider developing climate change mitigation strategies that achieve significant emission reductions in co-pollutants (such as black carbon), as well as in GHGs. This may be achieved in part by:

a. Reducing emissions of particulate matter, particulate matter precursors and hazardous air pollutants, especially in communities of color, low-income communities and communities already overburdened with air pollution;
b. NJDEP should help institutions calculate and mitigate their particulate matter footprint as well as their carbon footprint;
c. NJDEP should consider intensifying its efforts to reduce emissions of diesel particulate matter, a major contributor to climate-forcing black carbon, as a climate change mitigation policy and a climate change mitigation co-pollutant policy;
d. NJDEP should expeditiously move forward in compliance with the process and timelines set forth in Executive Order 60 (April 20, 2011). Upon completion of the pilot program, NJDEP should timely initiate the stakeholder process to determine whether it is appropriate to continue or expand the diesel emission reduction requirement that non-road diesel powered equipment used in publicly-funded State construction contracts have appropriate retrofit technology and, consistent with this determination, timely make the appropriate recommendation to the Governor.

15. NJDEP should incorporate discussions of issues related to climate change during EJ meetings and activities.

16. The NJDEP should encourage having a representative of the NJDOT, and other appropriate agencies not currently represented, attend meetings of the CAC on an as-needed basis for consultation and input of issues related to their purview.

17. Acknowledging that transportation is the major source responsible for GHG and other pollutants leading to climate change and adverse health, the NJDEP should continue to regularly meet with and intensify its relationship with the NJDOT to monitor all highway and public transit projects to explore means of reducing VMT.

18. State, county and local government should seriously consider replacing government vehicles scheduled for replacement with clean vehicles.

V. SUMMARY OF TESTIMONY

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

Dr. Anthony J. Broccoli
Professor, Department of Environmental Sciences
Rutgers University

To open the Public Hearing, Dr. Broccoli gave a presentation on the fundamentals of climate change. The combustion of fossil fuels is currently emitting about 9 billion tons of carbon into the atmosphere each year. This number gets closer to 10 billion when you include the effects of deforestation. Roughly half of the carbon dioxide remains in the atmosphere, while much of the remainder goes into the ocean and causes ocean acidification.

Increasing carbon dioxide heats the earth and as a result, global temperatures have risen between eight-tenths of a degree and one degree Celsius during the past century. This increase in temperature also has other impacts on the climate system, including changes in sea level.

We have understood this with increasing amounts of awareness since the 1890's, when Svante Arrhenius, a Nobel Prize winning chemist, wrote a paper that speculated that carbon dioxide from fossil fuel burning could influence the temperature of the earth, and he even made some rudimentary calculations to try to arrive at an estimate of how much the temperature would change. In the 1960s, we entered the modern era of studying this problem with the introduction of climate models. Our knowledge has increased as a result of different lines of evidence, basic physics, observations, and also numerical model.

The basic physics of carbon dioxide and climate is that if an object receives energy in the form of visible light, as the earth does from the sun, it heats up. The warmer an object is, the more energy it emits in the form of infrared light. This is the earth's cooling mechanism that balances the heating from the sun's visible light. Carbon dioxide and water vapor are greenhouse gases.

They make it more difficult for infrared energy to escape to space, so the more greenhouse gases we have in the atmosphere, the warmer we would expect the planet to be.

We are approaching a milestone in terms of the amount of carbon dioxide in the atmosphere. We have a roughly 55-year record of carbon dioxide from the Mauna Loa Observatory in Hawaii. It's now measured in other places as well, and it shows a substantial rise from 315 parts per million in the 1950's to approaching 400 parts per million today. As mentioned earlier, temperature has also increased. Temperatures rose gradually in the early part of the 20th Century, leveled off from the 1940s through the 1960s, and then began a more rapid rise around 1970. Various lines of analysis have suggested that the majority of the warming that we have seen, particularly in the late 20th Century, is the result of the human emission of carbon dioxide into the atmosphere.

Some specific impacts of climate change go beyond just global temperature to the ability to impact public health. There are specific examples of things that may be important for public health, including floods and droughts, which ironically can occur in the same places as a result of climate change. The main reason is because of the increase in the strength of the hydrologic cycle. In regards to extreme precipitation levels, the baseline for the 20th Century is about 11 percent of the United States being affected by these extremes during the course of each year. In the last 40 years or so, we've seen that rise, so that many years in the last decade have seen almost a doubling of the area affected by heavy precipitation extremes.

In addition, in the case of heavy precipitation events, by the middle of the century, a 20-year event would be expected to have a return period from around 10 to 12 years and by the end of the century, anywhere from 7 to maybe 9 years. The expected trend towards more frequent heavy precipitation events will continue with all of the ancillary implications for flooding and for public health.

Changes in dry spells and droughts will also become more frequent, because of increased evaporation. There will be more frequent heat waves in summer. For New Jersey, by the middle of the century, 70 percent of the summers will be warmer than what is currently the warmest summer on record. By the end of the 21st Century, 90 percent of the summers will be warmer than what is currently the warmest summer on record. This presumes a scenario of emissions that reflects more or less business as usual, with continued reliance on fossil fuel combustion as the main source of energy globally.

There is a strong connection between temperature and ozone. Data shows that the warmer the temperature, the higher the ozone concentrations. This relationship also reflects the fact that higher temperatures often lead to more stagnant conditions with reduced circulation. The warmer temperatures also tend to occur when there is more sunlight to induce the photochemical reactions that produce ozone.

Projecting into the future, changes in ground level ozone are highly dependent on the emissions scenario. Under a high emissions scenario, where the climate becomes a great deal warmer and there are more modest reductions in the impact of ozone precursors, ozone concentrations would be expected to increase throughout most of the United States. Under a lower emissions scenario,

we have two counteracting effects. The temperature is still rising, but it's not rising as rapidly. The emission of ozone precursors is decreasing. And so in that case, the net effect is a slight reduction in ozone concentrations over much of the country. This highlights the role of the future path of emissions in affecting ground level ozone concentrations. The key here is that climate change is controlled by collectively what global society does in terms of future emissions.

Climate change will result in a number of impacts that have the potential to affect human health: greater hydrologic variability, more heat waves and their impact on air quality, and rising seas. A portfolio of options to reduce the amount of carbon dioxide we produce includes energy efficiency, alternative sources of energy, carbon capture and sequestration, that is, continuing to burn fossil fuels but extracting carbon dioxide from the waste stream and either burying it deep in the ground or deep in the ocean sediments so that it doesn't have the ability to affect the climate. There are many different things that in combination can help mitigate this issue.

Jeanne Herb
Associate Director, Department of Environmental Sciences
Rutgers University

Jeanne Herb gave an overview of the New Jersey Climate Adaptation Alliance. Studies at Rutgers are focusing on a set of sectors here in New Jersey that have been identified as particularly pressing, economically important, and vulnerable. These sectors include public health and society, the natural environment, coastal communities, New Jersey's rich agricultural economy, the built infrastructure, including energy and telecommunications, and also impacts from water resources.

A big focus of the work that Rutgers is doing in regard to the different impacts to climate change is on the vulnerable populations here in New Jersey. A number of stakeholders from particularly vulnerable populations are now recognizing that climate impacts are important to them, and they are willing to participate in discussions about climate change. As a result of the experiences that occurred during Hurricane Sandy, Rutgers is seeing a special impact on populations dealing with the elderly, urban and poor communities, and in particular, people who need access to public transit and public housing.

Adaptation and preparedness for climate changes, as well as mitigation, are particularly important. Adaptation is viewed as putting systems in place to be prepared for the impacts of climate, as well as being able to respond to those impacts when they happen. Mitigation is reducing levels of greenhouse gas emissions that cause global climate change, including carbon. The New Jersey Climate Adaptation Alliance is the most focused on the world of preparedness and adaptation.

A November 2011 Conference facilitated by Rutgers University and supported by Public Service Electric and Gas (PSE&G) entitled "Preparing New Jersey for Climate Change" led to the formation of a network of policymakers – public and private sector practitioners, academics, NGOs, and business leaders – to build climate change capacity in New Jersey. The idea was to

create a network of networks to talk about climate adaptation, accepting the fact that climate in New Jersey is changing and that the impacts are critical to our population, our economy, and our way of life. It created strong partnerships to work within existing delivery systems, who agree that climate change is an issue that affects various sectors of the state, and working together is a critical way to move forward. As a result, we have groups who do work regarding the environment, or conservation communities, or the business community, or public health, who are coming together to talk about how to move forward with preparedness and adaptation here in New Jersey.

The New Jersey Climate Adaptation Alliance is a network of networks with an Advisory Committee. The Alliance's work plan goals are to develop recommendations for action, assess vulnerability and preparedness options for targeted business sectors, conduct communications and education, and facilitate demonstration and other projects. The group is also policy-forming based on science, with a public policy process that includes sector-specific climate impact data and leading processes moving to stakeholder engagement, sector specific workshops, and ultimately the finalizing of policy recommendations.

Dr. Annmarie Carlton
Assistant Professor of Atmospheric Chemistry, Department of Environmental Sciences
Rutgers University

Dr. Carlton's presentation to the Clean Air Council was entitled "Climate Change Impacts in New Jersey: Opportunities for Preparedness and Improved Prediction of Peak Air Quality Events". This presentation focused on efforts to address air quality emissions from peaking units and the electric generation sector.

Power plant emissions affect air quality through a variety of pathways. Nitrogen oxide emissions contribute to the formation of ozone. In addition, sulfur dioxide emissions turn into sulfate particles, and there are also mercury emissions, VOC emissions, and air toxic emissions, all of which can cause adverse health effects. This chemistry is modeled with a photochemical transport model called CMAQ.

Federal regulations do not require electric generating units with less than 25 megawatt capacity to control their emissions or even to report them. These "peaking units" only turn on a few days out of the year on high electricity demand days, which typically occur in July and August. Peaking units are typically older, dirtier, less-regulated, and located in highly populated urban areas. Peaking unit use and peak air quality events will likely increase with a warming climate, and high electricity demand days are most likely to have poor air quality because hot, high solar intensity days lead to conditions ripe for robust photochemistry. Emissions from peaking units on these days will create additional pollution and poor air quality.

The hypothesis is that a CMAQ underestimation of peak air quality events is caused, in part, by under-represented electric generating unit sector emissions. The goal is to quantify peaking unit impact on air quality and make the case for regulation.

PJM is the electrical reliability network that New Jersey is a part of. Data shows that PJM power generation directly negatively impacts air quality in New Jersey. For example, there was a blackout in 2003, just prior to which a high pressure stagnation system was building and building. Levels of $PM_{2.5}$ were increasing steadily leading up to the blackout. When the blackout occurred, air quality in New Jersey dramatically improved. The high stagnation continued, and nothing was being blown away, but still air quality improved. As soon as the lights came back on, the $PM_{2.5}$ mass concentration measured in New Jersey shot up again. Data shows that the pattern and $PM_{2.5}$ mass was predominantly sue to sulfate, which is produced mainly from the electric generating unit sector. Other data collected during heat waves shows similar results.

The conclusions of the Rutgers studies are that they demonstrated a clear relationship between peak power generation and measured air quality in New Jersey, and that coupling an energy trading model (because day traders buy, trade, and sell the electricity from peaking units) with a photochemical model can better represent peak air quality events.

The hope for future directions is to determine cost effective regulation of peaking units for effective air quality management in New Jersey and to design effective control strategies to deal with this problem. An economic analysis of different air quality scenarios is planned. For example, we can calculate economic benefits or dis-benefits associated with different air quality scenarios. With peaking units or without peaking units, you can directly estimate the cost associated with those emissions. There are also plans to do air quality modeling of the different New Jersey energy master plan scenarios.

Dr. George DiFerdinando, M.D., MPH
Adjunct Professor, Department of Epidemiology
UMDNJ-SPH

Dr. DiFerdinando presented a topic entitled "Public Health Preparedness Today: Climate Change and Public Health". Some of the issues surrounding climate and health include allergies, infectious disease, asthma, drinking water impairment, heat stress, red tides, and extreme weather. A sub-issue is extreme weather and lack of power.

Traditional management of public health includes assessment, policy development, and assurance. Public health actions for climate change adds an additional layer of management tasks, including tracking diseases and trends related to climate change, studying and predicting links between climate change and health, and communicating effectively on climate change, among many other things. Aspects that connect climate change to health outcomes worldwide include changing patterns of disease and mortality, food, water and sanitation, shelter and human settlements, extreme events, and population and migration. Even though we don't have gigantic population shifts, as happened after the 2004 tsunami, we're still seeing migration or change in living patterns every day on the shore.

There are 11 categories of health consequences from the National Institute of Environmental Health and Safety. Some of these, including asthma, respiratory allergies, airway diseases, and

mental health and stress-related disorders can be a direct result of atmospheric issues and air pollution. Crosscutting issues and key challenges expand the area to include public health and the impact on susceptible, vulnerable, and displaced populations. People with autoimmune illnesses or other similar reasons may be more susceptible to climate effects on their health.

In the Northeast, extreme heat and declining air quality are likely to pose increasing problems for human health, especially in urban areas. The decrease in air quality during a heat-related event can be substantial in regard to morbidity and mortality, particularly to those among the elderly population who may already have existing cardiovascular or coronary artery disease.

There has also been a 67% increase in very heavy precipitation from 1958 to 2007. These changes will alter the insect vectors as well as the humidity inside homes, both of which will have a direct impact on people's exposure to things like cockroach dander or external allergens that will likely increase either the incidence of asthma or cause exacerbations in people's asthma.

The direct exposures to climate change are to the weather itself, including the heat and cold, while the indirect exposures include changes in vector ecology and food yields, as well as social and economic distribution. There are many dimensions of climate change vulnerability, at both the community and individual level. There are some who wait until health conditions are exacerbated because they have less means of accessing health care.

Climate change has an impact on respiratory risk factors. Increased temperatures, carbon dioxide, and precipitation can cause earlier flower blooming and increased mold growth, which lead to increased allergens and possibly to increased development of allergies. Increases in regional ambient concentrations of ozone, fine particles, and dust are caused by increased temperatures and certain air emissions, leading to ozone production and airborne fine particulate matter. This type of air pollution can lead to asthma, chronic obstructive pulmonary disease, and coronary vascular disease.

Triggers for adverse respiratory responses can be climatic, such as meteorological events, rainfall patterns, and temperature anomalies. Vehicle emission levels, land use patterns, variables in the built environment, and distance from roadways all contribute as well. The most vulnerable individuals to these triggers are children, pregnant women, the elderly, persons of low socio-economic status, persons living or working near high traffic urban centers, and persons with pre-existing medical conditions.

Wild cards for climate change and respiratory health include an increased incidence of wildfires, and airborne dust carrying infectious diseases. Precipitation hyper-variability causes both drought (which leads to dust and particulate matter) and rainfall (which leads to mold and microbial pollution).

What if climate change is a big hoax and we create a better world for nothing? In any case, it is always important and appropriate to focus on people’s access to good care for climate impacts.

Clifford Weisel
Professor
Environmental and Occupation Health Sciences Institute

The US is highly dependent on electrical power for day to day living. Over the last several years several storms have resulted in widespread power failures in multiple communities in NJ that have lasted for days to weeks. Hurricane Sandy resulted in more than 2.7 million people in NJ and 8.1 million overall to be without electrical power for an extended time period when the temperature was below 50°F. Home owners and businesses have purchased and, during power outages, used gasoline, propane and gas generators to provide electrical power. The trend is for additional people to use electrical generators in future episodes when there are power failures. Generator operation results in emissions of carbon monoxide (CO) which has been responsible for 1888 cases of CO poisoning with 75 fatalities nationwide between 1991-2009, and nine reported deaths during Hurricane Sandy. As generator use becomes more widespread, it is likely that there will be localized increases of ambient air CO levels. Other potential health and safety problems with generator use is the need to transport gasoline to operate the generator, uncontrolled gasoline vapor emissions, safety hazards associated with handling the gasoline and, if the generator and gasoline containers with residual gasoline are stored in a garage attached to a home, indoor air quality issues.
Manufacturers and governmental agencies (e.g., NJ Department of Consumer Affairs, Center for Disease Control and Prevention (CDC)) indicate to never use a generator inside a home, garage, basement, crawlspace or any partially enclosed area because of CO emissions. The safe use of generators also requires that they be placed a safe distance from the user's and neighbor's home, though the recommended distance varies. CDC recommends that a generator be placed at least 25 feet from any door or window. Manufacturers instruction specify much shorter distance or to use common sense. How different individuals obtained information on what to do during Hurricane Sandy was highly variable and included relatives, neighbors, television, radio, newspapers, governmental web sites, manufacturer information sheets, social media, community centers, towns and municipalities. Entities in NJ need to consider how best to get warnings out to the public to protect their safety before, during, and immediately after storms that could result in power failures.

The storage of gasoline generators and gasoline storage containers is an issue. If they are stored in a home or a structure attached to a home, such as a garage, the gasoline can evaporate into the air. That air then penetrates the residences resulting in exposure to gasoline derived volatile organic compounds that include benzene, toluene, n-hexane, all of which can have adverse health effects. Storage of these items external to the home is recommended.

The contribution of additional generator use to air pollution at a community level is unknown and emission standards for generators do not exist. New multimedia/social media messages need to be developed for communicating health and safety issues to communities before and after storms that can cause power failures. Guidelines and education for safe use of generators should be developed.

Stephanie Greenwood
Sustainability Officer
City of Newark

Stephanie Greenwood gave a presentation on the city of Newark's Sustainability Action Plan. Newark's air quality is seriously impacted by its land use. In addition to having a concentration of stationary and mobile sources, Newark is coastal and vulnerable to extreme weather events that come with climate change. In addition, Newark is seventy percent paved with only a fifteen percent tree canopy coverage. There are also equity issues in terms of income and racial characteristics. To try to respond to some of these challenges, an action plan has been developed to try to put Newark on track to have a healthier and more vibrant urban environment. All of the actions committed to in this plan exist within a policy framework that focuses on public health, quality of life, and economic strength in the local economy.

The air quality actions in this plan include the following: convene an air quality task force, reduce diesel pollution from trucks, develop and implement a cumulative impact ordinance, strengthen partnerships and advocacy work on major emissions sources, phase out No. 4 and No. 6 heating oil, and roll out the "Green and Healthy Homes Initiative" that focuses on indoor air quality. Other elements in the plan that integrate air quality into them include energy generation, materials management and recycling, and storm water and community greening.

Ms. Greenwood's recommendations to the Clean Air Council include focusing on large-scale energy efficiency retrofits, accelerating work on cumulative impact rules in coordination with impacted municipalities and environmental justice advocates, and providing additional technical assistance to municipalities on waste reduction and re-use based manufacturing. In addition, there should be investment in projects that reduce diesel pollution near vulnerable populations. These could include facilitation of the next steps on the electric truck stop at the Port, providing additional enforcement assistance for truck route and anti-idling rules, increasing attention to local air quality monitoring, especially for particulate matter, and designating technical staff to work closely with municipalities such as Newark on local air quality mitigation efforts.

Dr. Nicky Sheats, Esq, Ph.D.
Thomas Edison State College

Dr. Sheats' presentation focused on environmental justice, climate change, Hurricane Sandy, and co-pollutants. Cumulative impacts occur when multiple pollutants are emitted by multiple sources that are located in, or affect, the same community. A screening tool has shown that in New Jersey, cumulative impacts increase as the number of people of color in a neighborhood increases and income level decreases. These are the same communities that will most likely have disproportionate impacts and be the most vulnerable to climate change. These are the communities that need to be especially protected from the detrimental impacts of climate change.

When re-building in such a community after a storm or weather event such as Hurricane Sandy, it should be taken into consideration if the facility will release emissions, how much pollution is already in the community, and what are the demographics of the community. If building a

facility will perpetuate or exacerbate the existing relationship in New Jersey between race, income and cumulative impacts then the facility should not be constructed before the amount of existing pollution is reduced. There should be adaptation policies in place that will make these communities more resilient to the impacts of climate change. We also need to make sure that climate change mitigation policies will yield equal benefits to these communities, and we need to make sure mitigation policies do not actually harm these communities. Thirdly, these communities are especially susceptible to the detrimental impacts of storm surge. Even when the flood recedes, there is still worry about contamination left behind.

A cumulative impacts policy should include identification of environmental justice and overburdened communities, no net increase in pollution due to new permits, a net decrease in pollution upon permit renewal, and incentives for fresh food, open space, non-polluting industry, energy efficiency, and renewable energy. There are also several environmental justice climate change policy recommendations. These include developing and emphasizing strategies that reduce emissions of fine particulate matter and its gaseous precursors (these are called greenhouse gas co-pollutants) along with emissions of greenhouse gases. Co-pollutant policy yields public health "co-benefits". Such a policy should quantify the co-pollutant reductions of a climate change policy. A particulate matter footprint should be developed, with strategies that are going to reduce carbon dioxide emissions and also particulate matter emissions. Diesel particulate matter emissions should also be reduced since this would help fight climate change and yield b public health benefits.

As stated above, climate change policies should be developed that reduce emissions of both greenhouse gases and greenhouse gas co-pollutants. However, climate change policy that is only intended to reduce emissions of greenhouse gases will also probably result in the "accidental" reduction of co-pollutants. This occurs because often sources of pollution will emit greenhouse gases and other air pollutants simultaneously. This unintentional reduction of co-pollutants will benefit the communities located near the polluting facilities. For this reason we need to ensure that even under current climate change policy, which does not intentionally address co-pollutants, reductions of greenhouse gas emissions occur in and near communities that have high levels of cumulative impacts.

Dr. Leonard Bielory, M.D
Rutgers University/RWJ University Hospital

Dr. Bielory's presentation was on air quality and pollen, and its impact on allergic and airway disease. In regard to climate change, there is a straightforward effect of heat stress and heat mortality, along with more complex effects such as infectious and allergic disease and asthma. Secondary and more complex pathways are brought on or exacerbated by climate change, and these include population migration and human conflict arising from food or water scarcity. Special populations, such as environmental justice areas, and geographic regions are already experiencing a high burden of public health problems and resource scarcity.

Climate change is not just one variable or dimension, it is multiple. We also have the natural cycle which includes pollen and the allergens. Over the years, people are becoming more

allergic. Stinging insects are migrating north, and with warmer temperatures and more rain, certain plant allergens are growing taller and the biomass is increasing, and this is due to the increases in carbon dioxide and other greenhouse gases.

There is an increased length in ragweed pollen season in North America and people are being exposed more. The longer you are exposed to an allergen, the more multiple allergies occur. You do not become allergic until you live around the allergen for a while; that is the normal immune system response. When we get to the frequency of exposure and increased allergy sensitization, it becomes a burden on human health. The NJDEP is tasked with finding out how to improve the quality of life, the air quality impact on health that will have an impact in this domain. There is also an economic burden involving health care providers, health care facilities, and production. There needs to be a balance.

There is also a dose of allergen exposure, as we have determined through pollen production modeling at Rutgers University funded by a grant by EPA. In 2020, pollen production will probably be about 20 to 30 percent higher. Peak volume, start date, peak day, and annual production were all assessed variables. Most pollen exposure models have done just temperature, and are very limited. The US EPA Grant permitted an experiment incorporating multiple variables at the same time such as increased temperatures and CO_2. This year they've actually included last year's storm precipitation totals which demonstrated that the precipitation from Super Storm Sandy lead to the highest levels of tree pollen seen in the past 25 years. The plants need the right temperature and the right duration of sunlight in order to generate the best time for pollen release (plant reproduction). The increase in duration found in the studies in the Midwest with ragweed correlated with frost-free days. When there's frost, ragweed stops. Mold spores are dispersed, but ragweed pollination stops leading to increased allergic and asthmatic symptoms

There is a clear need to address the source of the greenhouse gases affecting the climate on a long term basis that would include some greenhouse gas mitigation strategies with health benefits include increasing active transport, such as bicycling and walking, use public transport, eat fresh locally-grown organic food, and energy efficiency, such as turning off at the power source when not in use, use energy-efficient lighting and appliances, optimizing insulation, and using “green cars”.

Wayne Wittman
PSEG

Mr. Wittman’s presentation was on Electric (EV) and Natural Gas (NGV) Alternative Fueled Vehicles (AFV). In 2010 PSEG started an internal AFV evaluation team to review the technology of EV’s and NGV’s, impacts to the electric distribution system, potential business cases for EV charging infrastructure and NGV fueling stations, project the sales of EV’s and NGV’s, potential reduction in air emissions for switching from fossil fueled vehicles to AFV’s, participate in public outreach, and enhance PSEG employees knowledge of AFV’s.

Starting off with an overview on EV's first, EV's fall into two categories, plug-in hybrid electric vehicles (PHEV) like the Chevrolet Volt and an all battery electric vehicle (BEV) like the Nissan Leaf. With a plug-in hybrid EV such as the Chevrolet Volt you have gasoline as a secondary source of fuel for the vehicle. With the Nissan Leaf all of the motive power comes from the electricity stored in the batteries.

Electricity makes a great fuel. It's a cleaner fuel than gasoline for carbon output per mile traveled and also less expensive than gasoline on a mile to mile comparison. Assuming gasoline costs of $3.50 per gallon and electricity costs of $0.18 per kilowatt-hour (kWh), the average fuel costs of a conventional car is $0.117 per mile versus $0.056 per mile for a PHEV and $0.061 for a BEV. With regard to greenhouse gases, the annual carbon footprint of a convention car is approximately 3.7 short tons whereas; PHEVs and BEVs have a carbon footprint in the range of 2.1 to 2.3 short tons. And as we retire older generation, especially older coal generation and we start bringing in wind and other renewables, this is actually going to be cleaner for the environment to fuel EV's with electricity. In the end EV owners will be motivated both environmentally and economically to maximize electric usage for the vehicles.

EV sales have been on the rise, with the United States now having the largest fleet of electric vehicles in the world on the road numbering about 90,000. As of this presentation the four leading sellers of electric vehicles right now in the United States in cumulative sales are the Nissan Leaf, General Motors Chevrolet Volt, Toyota Plug in Prius, and Tesla Model S. With respect to how many EV's are estimated to be in New Jersey; from our own intelligence that we have probably approximately 4,000 EV's on the roads right now. From an EV adoption curve developed with help from the Electric Power Research Institute (EPRI), New Jersey is following the median adoption line which is currently tracking at 70,000 EV's by 2020.

Charging an EV will essentially take place under three different voltage levels; 120V (Level 1) and 240V (Level 2) and DC fast chargers. It is estimated that Level 2 charging will be the predominate technology employed in the next few years.

Where are we going to locate the charging equipment? The bulk of the charging equipment for EV's will either take place at one's home or workplace; with destination charging following. One of the problems with EV charging here in the northeast is that we're a little bit lean with public EV charging sites. The reason for this was simple; do you put the EV public charging equipment in before the cars come or wait until they come? With all of the major auto manufactures selling EV's in New Jersey and the northeast, this may be less of an issue in the future.

Where will EV charging occur and how will it affect the Electric Distribution System. The AFV Team put together a 2020 projection of where people will be charging their EV's in the future and how they'll be charging. Right now most of the charging is at home with little workplace charging. As EV sales increase we'll see more workplace charging because people will want to drive as much as they can on electricity. With respect to impacts to the electric grid; if EV charging is staggered during off peak hours (10AM – 5AM) for home charging and low peak hours (8AM-12PM) for workplace charging then there should be little to no impact to the electric grid here in New Jersey.

Moving to NGV's; there have been big strides in the area of NGV's, especially in the large heavy duty NGV's. It is currently estimated that there are over 100,000 NGV's on the roads today in the US. The majority of these vehicles are heavy duty trucks for fleet applications. Regarding light duty passenger cars, Honda is the only car company in the United States that sells a factory produced NGV.

Compressed natural gas is predominantly the major gas that's being used in these vehicles. Liquid natural gas systems are being installed at key locations in the US for long haul trucking. Natural gas is a less expensive fuel especially when compared diesel or gasoline fuel (40-60% less depending on the cost of diesel or gasoline).
NGV refueling stations are generally classed into three different categories; time-fill, fast-fill or combination stations (fast and time-fill). New Jersey is on the move with the installation of new NGV fueling stations for larger fleet applications at key locations in the state. One of these locations is near Atlantic City and when Hurricane Sandy hit, this NGV refueling station was the not affected which enabled a fleet of natural gas jitneys to aid the people affected in the area when conventional fuels were not available.

A few final takeaways; all the major OEMs are making and selling EV's. Electricity is a clean and efficient fuel. The majority of charging for EV's will occur at home. EV's are reliable, easy to operate and fun to drive. Large NGV's are a perfect match for fleet applications. NGV's are less expensive to operate over conventional fossil fueled vehicles. The rich natural gas delivery system here in New Jersey gives us a fuel diversity mix not seen in too many places elsewhere in the US. Education and outreach by key stakeholders are critical in making New Jersey a model state here where AFV technology really takes off.

Bob Martin
Commissioner
New Jersey Department of Environmental Protection

Introduction

Commissioner Martin began his testimony by thanking the Clean Air Council (CAC) for holding the hearing, investigating timely air pollution control issues each year, and providing useful feedback and recommendations to the air program throughout the year and especially in the CAC Annual Public Hearing Report. The CAC has picked another timely topic this year, focusing on how long-term average temperature increases and short-term extreme weather events affect air pollution. Commissioner Martin reiterated that the DEP establishes policy based on data and facts, which are based on sound science, and not ideology or politics.

Specific Requests of CAC

New Jersey has three key air quality concerns that may be affected by both long-term and short-term climate changes: fine particles, ozone, and air toxics. The DEP is looking for specific input from the CAC in these areas.

For instance, New Jersey has made tremendous progress and now achieves the health standards for fine particles. How can we avoid backsliding, especially during extreme weather events, and increase the margin of clean air?

Ozone is our major air quality challenge today. How can we make more progress and attain the health standards as temperatures rise?

The major air toxic issue in New Jersey is particle emissions from diesel engines. Reducing emissions from diesel engines has been and continues to be one of New Jersey's top priorities. How can we maintain progress to further reduce diesel emissions?

There are also more specific diesel issues on which Commissioner Martin would like feedback. How can air pollution be minimized from the use of emergency generators, both diesel and gasoline, during power outages? How can the need to use emergency generators be avoided by having a more storm-resilient electric grid?

Commissioner Martin is especially interested in the CAC's recommendations on what measures are practical and effective to reduce both long-term and short-term air pollution. For short-term extreme weather events, like Superstorm Sandy, how can building resiliency into our energy, industrial, housing, and environmental infrastructure also help address air pollution? For long-term climate change, how can we extend the progress we have already made with our Energy Master Plan and air pollution control strategies?

Air Pollution Control Highlights

Air pollution control is a continuing challenge in New Jersey because of our population density, high traffic levels, and our location downwind of states that emit major amounts of air pollution. These are challenges that we are meeting or making significant progress to solve. Commissioner Martin summarized some of those efforts to provide perspective for the CAC's deliberations, focusing specifically on power plants and diesel engines.

Power Plants

New Jersey has made remarkable progress in the last 10 years and leads the nation with effective air pollution control requirements on all types of power plants – coal, heavy oil, gas, and diesel. In 2012, power plants in New Jersey were among the cleanest in the Eastern United States. Based on the average emission rate for fossil fuel fired power plants, New Jersey has less than half the nitrogen oxide emission rate of Pennsylvania and New York, and if nuclear power is included, our emission rate would be even lower.

Sulfur dioxide emissions from New Jersey power plants have declined by over 95%, and nitrogen oxides have declined by over 85% in the last 10 years. This is because New Jersey coal units have either installed modern air pollution controls or stopped burning coal. Old gas- and oil-fired units are also being replaced, shut down, or equipped with modern air pollution control for nitrogen oxides.

To comply with New Jersey's High Energy Demand Day rule to reduce nitrogen oxide emissions on high ozone days, over 100 old oil- and gas-fired peak power units (peakers), totaling over 3,000 megawatts, are planned to be shut down by May 1, 2015. At the same time, importation of electricity from out-of-state power plants has decreased.

Complementing our air quality strategies, the Governor's 2011 Energy Master Plan (EMP) set forth policies that promote the shut-down of older, inefficient plants, replacing them with new, cleaner sources of energy. The EMP further strengthens our air quality goals by eliminating coal as a new source of power.

The EMP's goals are to drive down the cost of energy for all customers, promote a diverse portfolio of new, clean, in-State generation, reward energy efficiency and energy conservation and reduce peak demand, capitalize on emerging technologies for transportation and power plants, and maintain support for the renewable energy portfolio standard at 22.5%.

Greenhouse gas emissions in the power sector have also been decreasing. Factors in reductions include changes to the fuel mix, driven by the strong renewable portfolio standard, retirement of older inefficient boilers, reliance on newer combined cycle natural gas-fired power plants, and end-use energy efficiency programs.

The last poorly controlled coal-fired unit in New Jersey is at the BL England Power plant in Cape May. An air pollution permit was issued in March to convert it from coal and oil to natural gas, using high efficiency combined cycle technology.

New Jersey continues to pursue out-of-state power plants that significantly impact New Jersey air quality and do not meet New Jersey emission standards. In January, the Portland power plant across the river in Pennsylvania reduced maximum sulfur dioxide emissions by over 60% as a result of New Jersey petitioning EPA to address health standard violations in our state. The two coal units at that plant are scheduled to shut down before 2015, which will finally eliminate the health exceedances caused by this power plant. New Jersey is active in fighting other out-of-state power plant cases as well.

Diesel Engines

New Jersey is also a national leader in the reduction of emissions from diesel engines used on vehicles and stationary sources. This is critical since diesel emissions pose a greater cancer risk than any other air pollutant in New Jersey.

Our program to reduce toxic particulate emissions from public vehicles is being successfully implemented, with 10,000 vehicles retrofitted to date and 6,000 more expected in the next two years. In addition, pursuant to Governor Christie's Executive Order #60, we are in the midst of a pilot program to reduce emissions from privately owned construction vehicles at state Department of Transportation construction sites. Over 60 vehicles have been retrofitted already, and 60 more are undergoing a technical feasibility analysis. The goal is to have 175 completed by the Summer of 2014. This pilot will inform our future direction for further control of diesel engines.

Using a variety of funding sources, we have voluntarily reduced emissions from a multitude of other sources, including locomotives, cargo-handling equipment, and construction equipment. In cooperation with the DEP, the Port Authority of New York and New Jersey has implemented a clean air plan that reduces particulate emissions from diesel engines associated with Port operations, including cranes, cargo carriers, trucks, and ships.

New Jersey has stringent nitrogen oxide limits for stationary diesels used to generate electricity. New Jersey does not allow uncontrolled emergency diesels to be used for peak power or demand side management. We also continue requirements for annual inspection of diesel vehicles so that they are well maintained and their emissions are as low as possible.

Summary

In summary, the DEP is making substantial progress to reduce air pollution. Ozone remains a challenge, and we are working with other states to develop more effective air pollution control strategies to attain the ozone standard.

We will also continue to take legal action on out-of-state air pollution that adversely affects New Jersey's air quality.

Reducing air toxics emissions, especially from diesel engines, will continue to be a priority.

Maintaining our progress for cleaner air may become more difficult as temperatures rise and extreme weather events increase because of climate change. Superstorm Sandy has created tremendous incentive to build resiliency into New Jersey to better withstand future storms and sea level rise.

Commissioner Martin looks forward to the CAC's feedback on the science of climate change and their recommendations on how to attain and maintain clean air.

Ali Mirzakhalili, PE
Director of Air Quality
State of Delaware

This presentation was on the air quality impact of diesel generators used in electricity markets' demand response programs. Electric markets are managed by independent system operators. The summer peak for electricity demand is expected to grow. Demand response (DR) is a decreasing of electronic demands. This is usually done through monetary incentives offered by utilities or the independent system operator to reduce the electrical load they serve. Some DR programs address general load reduction throughout the year, while others target reductions during peak demand periods. Many traditionally target energy efficiency, and the beneficial effect on air emissions that comes along with it, so it's demand response that is generally thought of positively.

Diesel generators enter the market as a behind the meter power source. This generation type is not always obvious or clean. The climate change considerations of this type of power source are

that the CO_2 emission rate per megawatt of generation for diesel generators are roughly twice that of a modern combined cycle electric generating unit, and diesel generators compare even less favorably with renewable sources of generation and fuel cells.

A Delaware case study was used to assess the air quality impacts of emergency generators used in DR. The study looked at the emissions inventory of diesel generators in Delaware, the impacts of emergency generation on the national ambient air quality standards, and the impacts on cancer/non-cancer risk.

There were several conclusions derived from the results of the study. Permitted generators alone have the potential to cause adverse health effects. Nitrogen dioxide emissions have the potential to violate the EPA-established hourly nitrogen dioxide national ambient air quality standards particularly in areas close to the sources. CALGRID modeling demonstrated that nitrogen dioxide impacts are significant. Diesel PM, benzene, and formaldehyde can potentially cause additional cancer risks in poor neighborhoods, which is an environmental justice concern. The same air toxics, in addition to toluene and xylene, have the potential to cause additional non-cancer. And finally, inclusion of unpermitted diesel generators is likely to show further adverse health impacts.

Leo Cortizo
Business Development Manager Trucking
Clean Energy Fuels

Mr. Cortizo's presentation was about the benefits of using Natural Gas as opposed to diesel as a transportation fuel. Natural gas is cleaner, domestic and cheaper. It offers companies the ability to have a predicable fuel expense budget thereby decreasing the instability caused by foreign oil price fluctuations. The Department of Energy estimates moderate price increases out to the year 2020 for Natural Gas. In addition, there is at least a 150 year supply discovered and growing.

Natural gas is roughly 25% cleaner wheels to well than diesel. It is also renewable in that methane is created in landfills and animal waste. It can also be produced by adding cellulose material and enzymes to digesters and capturing the resulting methane gas. This captured gas is given special consideration by the EPA.

Natural gas is extremely safe. Natural gas is lighter than air and when it escapes it dissipates into the atmosphere. In its liquefied form it boils off when released and dissipates as well. Liquefied Natural Gas is also lighter than water so it won't contaminate water supplies like gas or diesel if spilled. Natural gas has an ignition temperature of between 1,000 and 1,100 degrees, higher than gasoline or diesel. A 5-10% gas to air mixture is required to ignite it so it won't burn in an open air environment.

Compressed natural gas is pipeline gas that is compress to 4,500 psi and then stored in cylinders for dispensing at 3,600 psi. Liquefied Natural Gas is a cryogenic fuel. The gas is cooled to -260 and stored as a liquid. It is stored and transported much like diesel or gasoline. The difference

being all the storage is above ground. The tankers as well as storage vessels are basically large thermos' that hold the gas and keep it extremely cold.

I was asked to speak about LNG (Liquefied Natural Gas) so that is what I shall do. New Jersey has some of the densest trucking lanes in the nation. It is the gateway to the Northeast. LNG is a simple way to immediately impact the air quality of the state. Clean Energy builds cookie cutter stations. What that does is it allows for ease of build and rigorous safety standards. We can also add vaporizers in areas where there are no pipelines so we can offer both types of fuel to our customers. Validation for the NatGas model is that Shell, as well as Blu LNG have announced plans to build national networks as well. This is not a science experiment; it is a wave sweeping the nation. Clean Energy is committed to building the American Natural Gas Highway which is a network of 150 stations nationwide. It will allow trucks to travel across the country and the four corners of the U.S. So far 93 stations have been completed and the remainder will be finished by the end of 2013.

Every truck manufacturer now has a natural gas offering. The OEM's have embraced the technology. Until this year we had a 9 liter and 15 liter engine available. The 9 liter was too small for most trucking firms and the 15 liter too large. In addition, the 15 liter uses diesel as a primer so it required all the diesel emission equipment a regular diesel tractor would. The new 12 liter is in the sweet spot for most trucking companies running over the road or regionally. It requires no special emissions and uses a catalytic converter much like your cars. Much like the 9 liter was the correct engine for the refuse industry and we saw a hockey stick growth pattern in sales we believe the 12 liter is the right tractor engine and we expect to see the same hockey stick growth pattern. America can become energy independent through the use of our resources. Converting the 35 billion gallon a year goods transportation industry would go a long way to making that independence a reality.

Michael Krauthamer
Director
NRG Energy

eVgo is the developer and operator of the nation's largest network of direct current fast-chargers for battery-electric vehicles. eVgo currently operates an ecosystem comprised of more than three dozen fast-chargers in Houston and the Dallas-Fort Worth metroplex, and we are in the process of building a comparably-sized network in the Washington, D.C., Metropolitan area, as well as at least 200 fast-chargers and infrastructure for at least 10,000 lower-voltage chargers across California. All in all, eVgo is committed to investing approximately $150 million of private capital in electric vehicle charging.

NRG is cognizant of the importance of electric vehicles not contributing to higher peak loads. We believe the combination of technology and attractive electricity prices can encourage most electric vehicle charging to be conducted during off-peak times, thereby minimizing or obviating the need for new generation to serve electric vehicles.

Although electric vehicle service providers operate in an environment which appears similar a regulated industry, but in fact it is very different. For example, electric vehicle service providers do not sell electricity; rather, eVgo and most others offer access to one or more charging stations. The risks and costs associated with electric vehicle infrastructure are best borne by the private sector, which will be motivated to expend the resources and capital needed to provide needed access, and a critical factor in companies such as eVgo doing business in various jurisdictions is the regulatory environment. The New Jersey market will be more appealing if electric vehicle service providers know with certainty that (1) they will not be regulated as utilities by the Board of Public Utilities and (2) utilities are not permitted to offer electric vehicle charging services.

Based on our experience in other jurisdictions, NRG believes the following guiding principles should govern policymakers' decision-making process as it relates to electric vehicle charging services:

- Private investors should develop electric vehicle charging equipment.
- Electric vehicle charging service providers are not electricity suppliers, and should not be regulated as such.
- Given the nature of electric vehicle charging equipment, it is not necessary that economic regulators, nor electric distribution companies, permit, install, maintain or inspect such equipment.
- There is no need for regulated utilities to offer special time-of-use rates to EV customers.
- The competitive retail market will provide the products and services that allow customers to realize the full benefits of their electric vehicles.

The best way for the State to promote efficient usage of the distribution system, as well as smart energy consumption in general, is to enable a robust competitive retail market in which competitive electric generation suppliers offer innovative rates, programs, rebates, metering, and communications. In this way, customers will be able to select the best service provider to meet their needs and the market will evolve in manner that is directed by customer demand.

One way in which NRG promotes the efficient use of energy is to encourage the use of timer technologies built into many electric vehicles so that, even when a vehicle is plugged in during the day, the vehicle does not begin charging until off-peak hours (unless overridden by the driver). Additionally, when feasible, eVgo specifically motivates customers to charge their vehicles during off-peak hours by offering, in return for a low flat monthly fee, to pay the entire cost of charging a vehicle at home, even if that cost exceeds the monthly fee. The condition on this offer is that eVgo will only pay for charging at home to the extent the charging is done during off-peak hours.

Since, as stated above, electric vehicle infrastructure is best enabled by private investment, if utilities are permitted to own ratepayer subsidized charging infrastructure, private sector investment and innovation in the electric vehicle charging sector will languish. In addition to the direct potential of a ratepayer subsidy, indirect subsidies such as a cost of capital based upon regulated service and other aspects of being a regulated utility will likely result in only one service provider and one business model in each market. Investment in innovative equipment

and the development of creative business models will slow and EV adoption potential may not be reached.

Other helpful efforts include initiatives to inform the public about electricity markets in general, and electric vehicles in particular. eVgo's market research indicates that, after learning about eVgo and the many convenient subscription charging plans that are available, more than twice as many new-car buyers would consider buying an electric vehicle.

Drs. Tammy Thompson and Noelle Selin (via teleconference)
Massachusetts Institute of Technology (MIT)

Michelle Manion (present at public hearing)
Climate and Energy Program Manager
NESCAUM

Ms. Manion's presentation addressed the air quality impacts of three carbon policies, implemented at the national and regional levels. Ms. Manion co-presented with Drs. Tammy Thompson and Noelle Eckley Selin, both scientists at MIT.

With funding from US EPA's STAR grant program, a state-of-the-science modeling framework was developed to evaluate changes in air quality and human health of policies aimed to reduce greenhouse gas emissions. The current challenge is for states and regions to identify the best strategies to meet targets for "traditional" air pollutants while also making progress on relatively new goals for GHG emissions and greater use of renewable energy, all at lowest possible cost. "Synergistic" strategies can reduce overall costs, while other strategies may introduce unintended trade-offs.

The following three policy scenarios were applied to the US as a whole (National Policy), and to the Northeast states (Regional Policy): 1) Clean Energy Standard; 2) a limit (or cap) on GHG emissions from the transportation sector; and 3) an economy-wide cap-and-trade program. Total carbon reduction in all three regional scenarios is constant and designed to match the carbon reduction that occurs in the Northeast states as a result of the National Cap and Trade Scenario.

Modeling results showed that for CO_2 emissions, regional policies by definition lead to smaller national CO_2 reductions, emissions of all species decrease in all national policies, and some emissions show increases in areas outside of capped regions in regional policies. When looking at the Clean Energy Standard, benefits are more widespread in a National Policy with areas of ozone dis-benefit in a Regional Policy. In a transportation scenario, benefits are more widespread in a National Policy, with areas of PM and ozone disbenefit in a Regional Policy, and under a cap and trade scenario, benefits are more widespread in a National Policy, with areas of ozone dis-benefit in a Regional Policy.

Policy implications are that a policy covering all sectors (cap and trade) provides the most favorable benefit-to-cost ratio. There is no increase in CO_2 emissions outside of the capped region, and it pays for itself – human health benefits are larger than policy costs in all scenarios.

Regional CES and transportation policies appear less cost-effective and result in smaller National carbon reductions. Human health benefits in the Northeast are similar for all regional policies, but some health dis-benefits occur in areas not capped.

Russ Furnari
Environmental Policy Manager
PSEG

Mr. Furnari's Testimony was on the topic of generation mix in New Jersey. The presentation addressed both an overview of international and United States generation mix and comparison to the New Jersey mix. The presentation highlighted some of the differences of where New Jersey is and what that means from an air quality perspective.

The first slide included a view of the world at night. The photo demonstrates just how small of an area of the world actually uses most of the power.

Designation of generation type is dependent on technology and/or fuel type. Generation from a steam turbine can be powered using a number of different fuels. Nuclear fueled steam technology is referred to as base load generation, it's always there and the only time it's really not in service is when it's out for refueling outages which have become very small periods of time, generally about three weeks after an 18-month period of run time. Base load nuclear fuel generation is important player in the generation mix in New Jersey.

Fossil fueled steam plants can range from base load to load following generation. One of the major differences you'll note from the slide is that for nuclear fuel there are no emissions. Fossil fuel use results in high levels of emissions although current technologies have helped to control them and significantly reduce their impacts, especially in NJ. However, emission control technologies are an added cost. Nuclear has a high capital and requires a long lead time to build as compared to fossil fuel units. A relatively newer technology combined cycle incorporates the use of combustion turbine technology supplemented by steam turbines that derive their power through the use of a Heat Recovery Steam Generator (HRSG). Combined Cycle units can be base load or load following. This technology has much higher efficiencies and lower emissions while also being relatively inexpensive compared to the cost of nuclear. Combined Cycle units primarily run on natural gas, which is lowest cost fuel at the current time.
The next category is what the industry refers to as gas or combustion turbines which make up the primary source of peaking units. They depend mostly on natural gas as a fuel source, but they do have the capability to operate on light oil (kerosene or jet fuel). The advantage of this technology as peaking units is they can be put into and out of service quickly. They are much less efficient and have higher emissions than the other technologies.

Renewables are another category of power generation. There are a variety of different technologies, such as solar, wind and geothermal; but they have lower capacity factors. Particularly here in New Jersey even though there has been a significant investment into solar. They generate power intermittently, have high capital costs and in many cases are very location dependent. Most of New Jersey's investment has been in solar technology that has taken

advantage of the existence of a high availability of direct users with roof surface and brownfields. With respect to wind, there are particular areas in the country where we have a high wind capacity and other places where you can't really build it at all. This limits the utility of this technology and both wind and solar are limited by power storage technology.

Hydro power is another renewable category. New Jersey does not rely on hydro power generation other than a small pump storage facility. Hydro power produces no emissions, however it requires a high capital investment, needs a major water source and it also leads to a significant landscape alteration to create that water source. Many people will remember that back in the sixties and seventies there was a project plan that would have provided a significant amount of generation for this region. This project was the Tock's Island dam and reservoir. This project would have provided thousands of MW's of generation, but it meant damming the entire Delaware River and after facing major opposition was abandoned.

The following economic, policy and political decisions have impacted the generation mix in the United States over time.

1. Resource availability; coal is abundant and available, so it led to a significant amount of coal development in the United States and around the world.
2. The oil embargo in the '70s generally shifted a lot of generation at that time to coal. It was quicker to build than some of the nuclear plants that were already in development, and some of the existing plants that were dual fuel switched and burned coal and then many never went back to oil.
3. Three-Mile Island, slowed and then ended a lot of the nuclear developments, as discussed further later and depicted in the other slides, the level of nuclear generation has kind of remained fairly flat.
4. Clean Air Act and its amendments have had a significant role in emissions reductions and impacted the type of development and cost of generation.
5. Kyoto protocol focused attention on climate change and the need to reduce CO_2.
6. Natural gas pricing, you can see the swing here from $14 to $2 and I don't know what it is today, but there have been times when it's been under $2. Initially part of the reason for the high costs were the hurricanes in the gulf coast where a lot of production was and then the opposite is true because of shale gas. So we come full cycle and resource availability again is driving a lot of the economics.
7. Economic recession, that drives down demand and with the lower demand you get into a different situation where generation growth slows. This in turn impacts what type of generation may be built because you're looking at smaller growth increments.
8. Renewable portfolio standards are driving the growth of this category and they will increase, particularly at least at this point in the northeast and California although other areas in the country are expected to follow this path.
9. Greenhouse gas being declared a pollutant is the most recent policy decision that is going to affect power generation decisions as we go forward. It is unclear at this time what specific path this will take nationally.

The generation mix in the United States has changed over the years. In 2012, generation shifted from coal to natural gas. Internationally, the generation mix is similar to the U.S. However, there are more nuclear plants in the US overall versus other countries.

The generation mix for New Jersey is quite different from the U.S. Nuclear power is the primary fuel source of electricity in NJ.

While the US is still the largest nuclear country, the fastest growing is China. I would imagine in 10 or 20 years they may be up there with us. I expect that China will pass us if things don't change regarding the way nuclear is developing in the US. Our units, most of them are in the range of 30 to 35 years old. Slide #9 shows the range of US nuclear generation by age.

The original design for a nuclear plant was to operate it for 40 years. Advances in technology and maintenance practices have provided an opportunity to extend the useful life of these facilities. As a result, the majority of the U.S. plants have been relicensed and have added an extra 20 years so they'll be around for 60 years. However, there have been recent economic developments occurring where some of these plants are shutting down because there are other forms of generation that are more cost effective. Nuclear generation is also running into other issues linked to the inability to operate as base load units in face of fluctuations related wind generation in the Midwest. Finally, there are some plants that are still capable of running that are being targeted for decommissioning much sooner than they would have due to regulatory impacts.

Electricity demand in NJ currently outpaces the electricity supply from NJ generation sources. The gap has closed in recent years because total generation in the state has gone up overall. Demand actually in the last couple of years now that we're coming out of the recession is going up again. As a result the level of imported generation remains significant.

In NJ, natural gas generation is in balance somewhat with coal, which has resulted in a decrease in CO_2 emissions while the overall generation output is increased.

Nuclear power is roughly only a quarter of the generation that installed for PSEG, however it produces most of the power that the state uses.

There are significant changes in the generation mix in New Jersey in the future, both new developments and retirements. The most significant one from the standpoint of air quality is the retirement of Oyster Creek Nuclear Power Plant. Currently, PSEG is involved in an early site permit for a new nuclear plant down in Salem County. The process is ongoing, but it's a long process that will take approximately 13 years. That timetable could get extended if the necessary funding is not available.

The advancement of new smaller “modular” nuclear units offers an opportunity that could alter the nuclear development scenario. Due to a slightly different design these units can take advantage of different construction approach facilitated by the fact that they can be built off-site. As a result construction time would be reduced and they placed into operation incrementally so you can offset demand needs more effectively.

In conclusion there are several questions I would pose from the information presented in this paper. Is fuel diversity important? PSEG continues to support this perspective. Effective management of a generation portfolio focuses on many issues but economics plans a strong role. Being able to draw on different sources depending upon where the cost is provides flexibility and reduces the risk inherent when choses are narrowed.

Right now you have more natural gas and the price of natural gas is low, so it's supplying the majority of newly developed generation. One development that could drive the pricing structure of natural gas is will it became an international commodity? History has shown us what happened with oil as an international commodity, specifically how the price fluctuated and ultimately rose higher as those in control manipulated the market. Maintaining flexible options is one of the drivers that led PSEG to invest in emissions controls for its coal plants.

Then there is the question regarding whether or not there is going to be a price on carbon? Changing that input would further affect the price of coal that may push the industry into a different direction. If that price was to increasing dramatically, then another fuel may become the fuel choice for the future or a different generation technology could become more cost effective.

PSEG believes that having a national energy strategy is important to managing future air quality issues. Some of the topics that will need to be part of that strategy are:

1. Predictable environmental regulation;
2. Defining a role for nuclear that supports development of new nuclear because it is the low carbon and zero emission choice;
3. Defining the role for fossil fuels both coal and natural gas;
4. A long term plan to address emissions from other sectors such as transportation.

Joe Eldridge, MPH
New Jersey Department of Health

Mr. Eldridge's presentation was on the Department of Health's (DOH's) environmental health activities during Hurricane Sandy recovery. Mold has been a big issue for DOH, more particularly so because of Superstorm Sandy. Because there is no licensing program within the state, the DOH has published a new brochure which gives the consumer and homeowner ways of dealing with the issue.

The DOH is also doing things with occupational health surveillance. This includes looking at hospital data to determine if there have been any upticks in some of the diseases that we would expect to be related to a storm. In the very beginning there was an increase in things like carbon monoxide poisoning, injuries, and death. There was also concern about a "Sandy cough", but the data are not supporting that.

The big issue is the large amount of demolitions. Most of the activity surrounding it has been centered on cleaning up, getting big piles of debris together, off of people's properties, out of

town, and disposed of properly. Now they are bringing individual homes down. The DOH has developed a demolition guidance document in cooperation with other agencies. It is very comprehensive as far as making a road map for towns to follow when these homes and businesses are coming down. It includes perimeter monitoring on certain jobs; asbestos is a concern and overall dust is a nuisance. There is such a large amount of damage and devastation that this is going to be a long-term process.
There has been a lot of work that has happened up to this point with the cleanup and addressing some of the needs. Now the DOH is going to be involved in a tremendous amount of outreach. They are working with local health department, providing free training through public health at UMDNJ for homeowners, volunteers, and also code officials and local health officials, specifically for mold and mold cleanup. There are 8 courses for each: 8 for the homeowner and volunteer groups, and 8 for the code and local health officials. There's also an organization that's handing out supplies to people, going through the local health departments for cleaning up of mold. It's a big issue, and although it's not the central issue, it seems to get the most press.

Bob Kelly
Clean Air and Sustainability Division
USEPA Region 2

Climate Change Science
A useful graph of global temperature change:
http://www.columbia.edu/~mhs119/Temperature/T_moreFigs/
(And see Dr. Broccoli's presentation)

Not an EPA slide...but useful for keeping the science straight:
http://englishventured4theso.blogspot.com/2012/11/know-basics-about-global-warming-here-so.html

Formation of Particulate Matter by emissions of: Direct particulate matter, Nitrogen Oxides, Sulfur Oxides.
Makes white haze (sulfates) and brown haze (nitrates and NO_2)
Changes in climate -> increase sulfates and nitrate concentrations, decrease visibility and increase health effects.
Health effects include premature death, lung disease.
Watch the visibility camera at Newark, NJ, pointing toward lower Manhattan.
http://www.hazecam.net/camsite.aspx?site=newark

Ozone is highly reactive: Nitrogen oxides, split by sunlight, make O_3. Volatile organic compounds prevent the O_3 and NO from recombining, O_3 increases.
Ozone's high reactivity inflames the lungs, inducing asthma attacks; and damages vegetation.
Temperature and ozone are correlated; temperature is really a surrogate for sunny skies, winds favoring urban plumes, corridor transport, regional transport.

Projections of future temperature trends:
1) The higher carbon emissions scenario when new and more resource-efficient technologies are not introduced until late in the century, leads to atmospheric CO_2 concentrations reach 940 parts per million (ppm) by 2100—more than triple pre-industrial levels.
2) A lower-emissions scenario: a much faster shift to less fossil fuel-intensive industries and more resource-efficient technologies. CO_2 emissions to peak around mid-century then decline to less than our present-day emissions rates by the end of the century. Atmospheric CO_2 concentrations reach 550 ppm by 2100—about double pre-industrial levels.
Science, Impacts, and Solutions. Synthesis report of the Northeast Climate Impacts Assessment (NECIA). Cambridge, MA: Union of Concerned Scientists (UCS).

Hotter summers will lead to more nitrogen dioxide , more particulate emissions , increased use of distributed power ('clean' diesel and not so clean peaking units), lead to more ozone from increased evaporation of VOCs (solvents, gasoline), and more fossil fuels burned, which leads to more warming, increased temperatures, more ozone, and the cycle continues.

Challenges to Adaptation, Post-Sandy: Windstorms destroy trees, structures, need to dispose of dead trees and ruined structures.
Landfill? Methane increases. Burning? Carbon increases.
Health problems from increased generator use, PM, O_3, CO.
Heavier rainfalls → erosion → loss of soil, unstabilized land.
More windstorms → easier to lose more trees, structures.
Also, non-native pests find favorable climate and susceptible hosts -> mulching may spread them, burning releases carbons, and back to the original question: Landfill? Burn? Or what?
Increases in violent weather and rainfall in more intense bursts work against gains made from tree planting and carbon sequestration

Break the cycle:

- Reduce Carbon Emissions (of course)
- Make new and distributed power renewable, non-carbon power
- Improve power distribution, storage
- Impact of climate change pushes against air quality improvements and warming is 'locked in' for years after emissions.
- While climate change-related *change* is small *over a 6 – 10 yr. State Planning cycle*
- Longer planning cycles in states' energy and transportation planning that can be part of solution.
- Has additional benefits – creating a better world
  http://mediagallery.usatoday.com/Editorial-Cartoons/G373,S81137

Steven Jenks, Ph.D.
Environmental Engineer
New Jersey Department of Environmental Protection

Dr. Steven Jenks gave a presentation entitled "2009 Update to New Jersey's Statewide Greenhouse Gas Inventory". Understanding the sources of greenhouse gases is important to

making informed decisions on policies for the reduction of emissions. New Jersey's first greenhouse gas (GHG) inventory was finalized in November 2008 and included a 1990 baseline estimate, estimated emissions for 2004, and a projection out to 2020. Since then there have been three updates that included estimated GHG emissions from 2005 to 2009. The latest update was finalized in November 2012, and includes the most recent GHG emissions estimate for 2009. The next iteration of this report will include years 2010 and 2011.

In general, the methodology used in developing our inventory is "consumption-based." Consumption based inventories tell a more complete story of how a state contributes to GHG emissions. One example of this involves the power sector. If power plants outside of New Jersey must be called upon to supplement the power produced by plants within New Jersey, the GHG emissions associated with both in-state and out of state power plants are attributed to New Jersey for reporting purposes.

In 2009, state-wide emissions were 112 million metric tons of carbon dioxide equivalent ($MMTCO_2e$). That is less than the 125 $MMTCO_2e$ of GHG's released in 1990 and the emissions peak of 136 $MMTCO_2e$that New Jersey released in 2007. The State's original projection for 2020 was 154 million $MMTCO_2e$, which had not accounted for unexpected events such as the national economic downturn, which reduced economic productivity and related demands for energy.

Transportation is the largest sector in terms of GHG emissions, accounting for 42 percent of the New Jersey inventory. The second largest sector is the electricity generation (EGU) sector, accounting for 23.5 percent of the inventory. It is of significance to note that in the majority of other states, the relative amounts of emissions from power generation and the transportation sectors are reversed. New Jersey is unique in this sense because 52% of its in-state generation is from emission-free nuclear, with the remainder of in-state generation subject to strict controls on pollutants such as SOx and NOx , which correlate closely with levels of GHG emissions (i.e., as SOx and NOx are reduced, GHG emissions are reduced as well). The balance of energy-related GHGs are the residential, commercial and industrial fuel use sectors (RCI), where fossil fuels are used for purposes which include but are not limited to heating, cooking and manufacturing processes.

There are also some non-energy related emissions, such as land clearing, highly warming gases such as fluorinated gases, waste management, and methane releases from publicly owned treatment works (POTW's) and landfills. Highly warming gases are replacements for ozone depleting substances (ODS), and this sector will become increasingly important to monitor as ODS substances are phased out.

The graphed trend in the transportation sector from 1990 to 2009 depicts a gradual, upward-sloping curve. This trend corresponds with the recent trend for Vehicle Miles Traveled (VMT), but is less pronounced because of energy efficiency and emissions controls improvements for vehicles. In this vein, over the last two years, the trend has been a decrease in emissions from diesel vehicles. Further, diesel emissions showed further declines due to the decrease in freight movement associated with the national economic downturn.

Trends for the power sector from 1990 to 2009 show that GHG emissions peaked in 2007 and dropped significantly in 2008 and 2009. Factors contributing to this trend include changes to the fuel mix, with an increased reliance on natural gas and renewables, combined with a reduction in reliance on coal for energy as natural gas prices dropped and regulatory requirements increased.

Reductions in GHG emissions are projected to continue with. New Jersey's implementation of the goals of the 2011 Energy Master Plan (EMP) which includes: promoting a diverse portfolio of new, clean, in-State generation; rewarding energy efficiency and energy conservation and the reduction of peak demand; capitalizing on emerging technologies for transportation and power plants, and; maintaining support for the renewable energy portfolio standard at 22.5%. Currently, New Jersey is encouraging the replacement of older, less efficient gas, coal and oil-fired power generating plants with newer, cleaner and more efficient combined cycle natural gas power plants that emit 75% less GHGs than coal plants. And over 100 old, oil and gas fired peeking units totaling over 3000 megawatts are planned to go out of service by 2015. At the same time, New Jersey will rely less and less on out-of-state power plants and will continue to promote and develop our renewable energy base. Most recently, New Jersey surpassed 1 gigawatt of installed solar capacity, ranking amongst California and Arizona to lead the nation. And New Jersey continues to work with the Bureau of Ocean Energy Management for the planned development of over 1,100 MW of emission-free offshore wind power. With respect to the transportation sector, New Jersey is seeing strong resident demand for more fuel efficient, hybrid and plug-in vehicles coupled with an increasing number of electric vehicle charging stations installed by employers, commercial establishments and in private residences. As importantly, there is a clear and increasing private sector demand and supporting economics for the expansion of use of alternative fuels such as electric. CNG, LNG, and biofuels for trucks and public transportation. This increased reliance on alternative fuels amongst the various transportation sectors should lead to continued reductions in GHG emissions in the state.

VI. LIST OF ACRONYMS

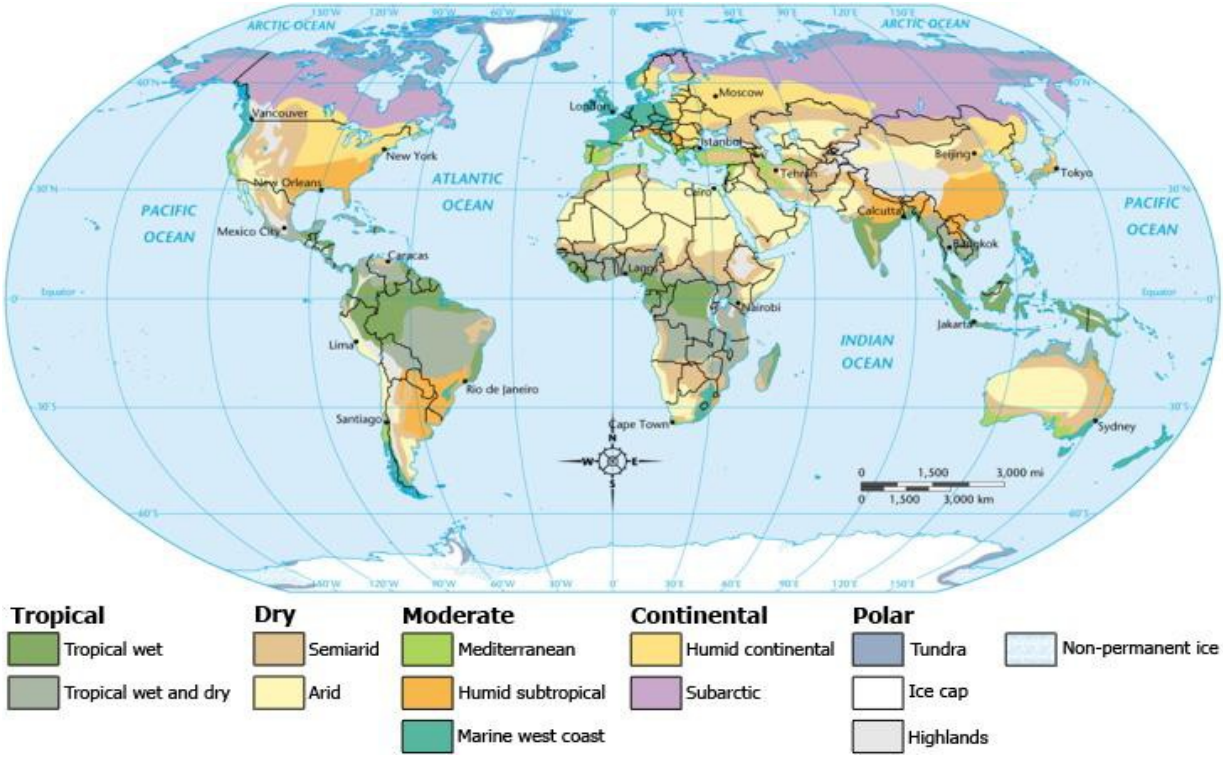
BPU	-	Board of Public Utilities
CAC	-	Clean Air Council
CDC	-	Centers for Disease Control and Prevention
CH_4	-	Methane
CMAQ	-	Community Multi-Scale Air Quality
CNG	-	Compressed Natural Gas
CO_2	-	Carbon Dioxide
CO_2e	-	Carbon Dioxide Equivalent
COPD	-	Chronic Obstructive Pulmonary Disease
DEP	-	(NJ) Department of Environmental Protection
DOH	-	(NJ) Department of Health
DOT	-	(NJ) Department of Transportation
EGU	-	Electricity Generation Unit
EJ	-	Environmental Justice
EMP	-	Energy Master Plan
EPHT	-	Environmental Public Health Tracking
EV	-	Electric Vehicle
GHG	-	Green House Gases
Gigawatt	-	One Billion (10^9) Watts; abbr. GW
GWRA	-	Global Warming Response Act
H_2O	-	Water
HFC	-	Hydrofluorocarbons

IPCC	-	Intergovernmental Panel on Climate Change
LEV	-	Low Emission Vehicle
LNG	-	Liquefied Natural Gas
Megawatt	-	One Million (10^6) Watts; abbr. MW
N_2O	-	Nitrogen Dioxide
NG	-	Natural Gas
NGO	-	Non-Governmental Organization
O_3	-	Ozone
PFC	-	Perfluorocarbons
PM	-	Particulate Matter
$PM_{2.5}$	-	Particulate Matter 2.5 Micrometers in Size
ppb	-	parts per billion
SF_6	-	Sulfur hexafluoride
SO_2	-	Sulfur Dioxide
TOXRAP	-	Toxicology Risk Assessment and Air Pollution
USEPA	-	United States Environmental Protection Agency
VOC	-	Volatile Organic Compound
VMT	-	Vehicle Miles Traveled
ZEV	-	Zero Emission Vehicles

VII. IN-DEPTH BACKGROUND ON CLIMATE AND CLIMATE CHANGE

CLIMATE

Climate has varied through time under the influence of its own internal dynamics involving changes such as volcanic eruptions and solar variations. Now, anthropogenic changes in atmospheric composition appear to be influencing climate change. Climate changes may occur in a limited number of ways including: (1) changes in incoming solar radiation resulting from changes in Earth's orbit or in the Sun itself, (2) changes in the fraction of solar radiation that is reflected back into space, otherwise known as albedo, and (3) changes in the amount of infrared radiation reflected back to earth by atmospheric GHG concentrations. The figure below depicts current general climate conditions across the globe.



CLIMATE CHANGE

While some global warming has a natural cause, there is evidence that human activity is disproportionally contributing to the measured warming. The primary focus of this human contribution is fossil fuel combustion, which releases black carbon, carbon dioxide and other greenhouse gases (CH_4, N_2O, HFCs, PFCs, SF_6), and changes in land use. The introduction of external greenhouse gases into the atmosphere alters the radiative balance of the earth by changing its atmospheric composition, which enhances the natural greenhouse effect.

The increase in global temperatures is just one consequence of a changing climate. The various components of the climate and earth system are linked through complex feedback mechanisms, so that a change in one component, such as temperature, can induce changes and adjustments in other components. In addition to the largely adverse environmental impacts already observed, such as rising sea levels, changes in rainfall patterns, and an increase in frequency of extreme weather events, numerous adverse health outcomes are beginning to emerge. As temperatures continue to rise and remain elevated for longer durations, urban heat island effects will lead to an increase in heat stress symptoms, increased emergency room visits, an increase in cardiorespiratory failure. At present, due to increased air pollution and extreme weather anomalies, hospitals are seeing an increase in respiratory disease, such as asthma and chronic obstructive pulmonary disease (COPD). In addition to direct health effects of heat and changes in air quality, climate change may lead to outbreaks of vector-borne diseases, water-borne diseases, and a strain on water resources and the nation's food supply.

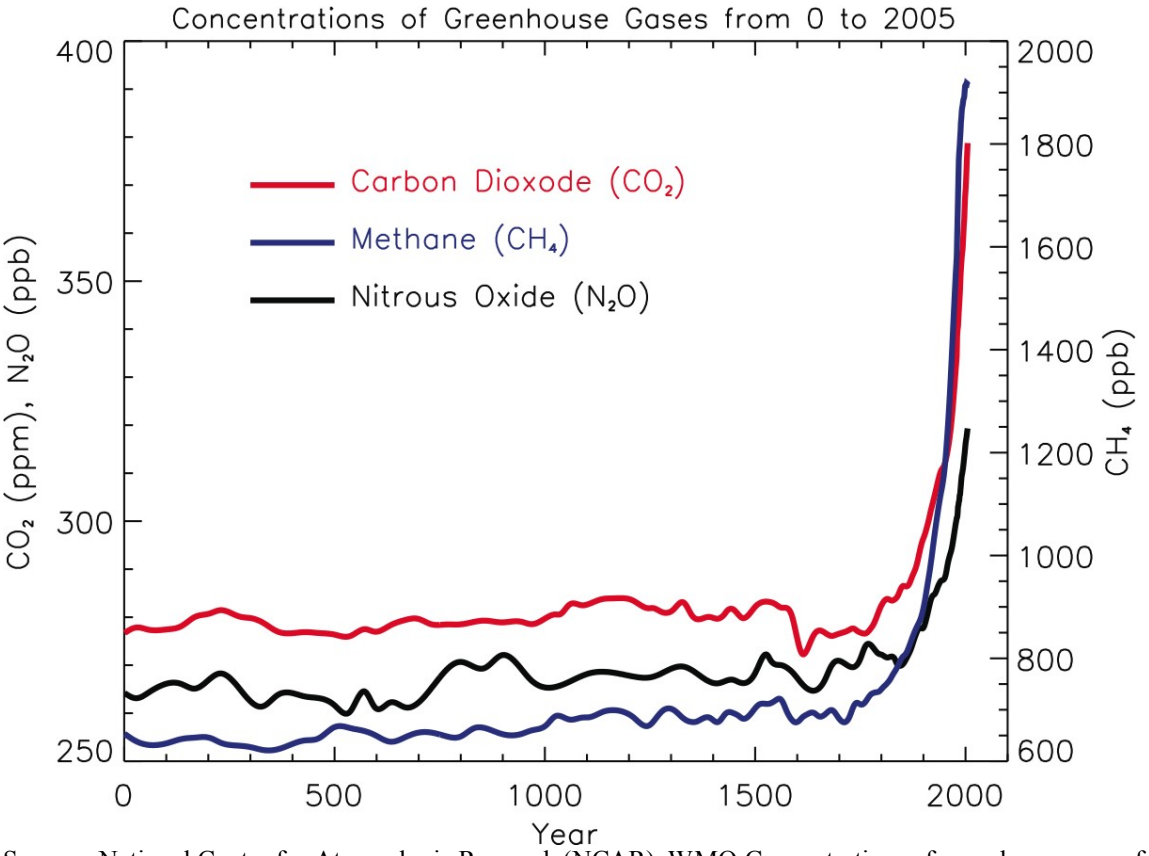
GREENHOUSE EFFECT

The most abundant greenhouse gases in Earth's atmosphere are water vapor (H_2O), carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and ozone (O_3). Carbon dioxide, methane, and nitrous oxide are naturally occurring but are also created from anthropogenic sources. After water vapor, carbon dioxide is the second most abundant greenhouse gas. It occurs naturally as part of the carbon cycle, which includes inputs from animal and plant respiration, ocean-atmosphere exchanges of gases, as well as outgassing from volcanic eruptions. It is also estimated to be responsible for up to a quarter of the greenhouse effect. Since the mid-18th century, anthropogenic activity has increased the concentration of carbon dioxide and other greenhouse gases. This activity has resulted in average daily atmospheric concentrations of carbon dioxide of greater than 400 ppm – more than 100 ppm higher than pre-industrial levels – levels not occurring for at least three million years.

Methane (CH_4) is the third most abundant greenhouse gas, and remains in the atmosphere for approximately 9-15 years. It is over 20 times more effective in trapping heat than CO_2 over a 100-year period. It is formed from a variety of natural and anthropogenic processes. Methane occurs naturally when organic material decomposes. The major anthropogenic sources are landfills, natural gas and petroleum systems, agriculture, and coal mining. The figure below illustrates concentrations of carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) in the atmosphere from year 0 to 2005.

Nitrous oxide (N_2O) is the fourth most abundant greenhouse gas. Despite its lower concentration, it is 310 times more powerful at trapping atmospheric heat than carbon dioxide, and remains in the atmosphere for 120 years. It is naturally emitted from oceans and soils, but there are also anthropogenic sources including agricultural (mostly nitrogen fertilization) and industrial activities, fossil fuel combustion, and nitric acid production.

Between 10,000 years ago and 150 years ago, atmospheric concentrations of CO_2, CH_4, and N_2O were relatively stable. In the last 150 years, concentrations of CH_4 and N_2O increased 148% and 18%, respectively.



Source: National Center for Atmospheric Research (NCAR), WMO:Concentrations of greenhouse gases from 0 to 2005, http://gcmd.nasa.gov/records/GCMD_WMO_Concentrations_greenhouse_gases0-2005.html

CLIMATE CHANGE ADAPTATION AND MITIGATION

The Intergovernmental Panel on Climate Change (IPCC) defines adaptation as:

The adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.[29]

Adaptation may be more simply defined as *coping*. Climate scientists agree that climate change will occur in the future, even if the rates of GHG emissions decline. Adapting to climate change will therefore become necessary in certain regions in order to protect or sustain human populations, certain environmental systems, species and habitats. The need for adaptation may be increased by continued growth of populations in areas vulnerable to extreme events. However, according to the IPCC:

Adaptation alone is not expected to cope with all the projected effects of climate change, and especially not over the long term as most impacts increase in magnitude.

The IPCC defines mitigation as:

An anthropogenic intervention to reduce the sources or enhance the sinks of GHGs.

Mitigation for climate change will involve changes in environmental and industrial behavior and practices such as reducing the rates of GHG emissions and increasing the rates of GHG sequestration. Decreasing consumption of fossil fuels may be the best way to reduce GHG emissions, although these may be reduced by other ways such as conservation and recycling practices and utilizing alternative forms of energy.

There are several key human health impacts associated with climate change, some of which can have a greater adverse impact on more vulnerable individuals, such as children, the elderly, and those with pre-existing respiratory and cardiac conditions. A sustained increase in temperature will increase the risk of health-related illnesses and death. Air quality conditions can also worsen as a result of a temperature shift, leading to elevated levels of ground-level ozone which can exacerbate lung disease and lead to premature death. In addition, changes in temperature and precipitation patterns can alter (e.g., extend) the pollen season, affecting human exposure to asthma and other respiratory diseases.

VIII. HISTORY OF THE CLEAN AIR COUNCIL

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

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