OLR RESEARCH REPORT

January 31, 2013 2013-R-0051

FEDERAL CLIMATE CHANGE REPORT AND SHORELINE PROTECTION

By: Kevin E. McCarthy, Principal Analyst

You asked that we discuss the provisions in the draft federal climate change report that are most relevant to the Shoreline Preservation Task Force. Former speaker Christopher Donavan appointed a bipartisan task force to address issues of climate change and shoreline preservation in the wake of the 2011 and 2012 storms that affected Connecticut. OLR Report 2012-R-0513 presents the task force's findings and recommendations.

The draft federal climate change report is available at http://ncadac.globalchange.gov/. Much of this report is taken directly from the draft report. The draft report covers many areas not addressed here, including the impact of climate change on agriculture, forestry, and rural communities. It also includes answers to frequently asked questions in Appendix I and a description of the science behind climate change in Appendix II.

SUMMARY

The draft report has chapters addressing the impact of climate change in many areas, including:

1. urban systems and infrastructure;

2. transportation;

Sandra Norman-Eady, Director
Phone (860) 240-8400
FAX (860) 240-8881
http://www.cga.ct.gov/olr

Connecticut General Assembly
Office of Legislative Research

Room 5300
Legislative Office Building
Hartford, CT 06106-1591
Olr@cga.ct.gov

3. energy supply and use;

4. ecosystems, biodiversity, and ecosystem services;

5. human health; and

6. land use.

It also has chapters describing the impacts of historic and projected climate change by region of the country. Each of the chapters has a detailed description of data sources and methodologies.

Among the report's key findings are:

1. The global climate is changing, as is apparent across a wide range of observations. The climate change of the past 50 years is due primarily to human activities, predominantly the burning of fossil fuels.

2. Human-induced climate change has already increased the frequency and intensity of some weather extremes, such as prolonged heat waves and heavy downpours.

3. Infrastructure is being adversely affected by phenomena associated with climate change, including sea level rise, storm surge, heavy downpours, and extreme heat. Floods following heavy downpours, prolonged rains, and rapid melting of snowpack are damaging infrastructure in many parts of the nation. Extreme heat is damaging transportation infrastructure such as roads, rail lines, and airport runways.

4. Climate change is already affecting water resources, energy, the environment, and other factors at the local, national, and international levels.

5. Human-induced climate change is projected to continue and accelerate significantly if emissions of greenhouse gases continue to increase.

6. Climate change threatens human health in many ways, including impacts from increased extreme weather events; decreased air quality; diseases transmitted by insects, food, and water;and threats to mental health.

7. There is mounting evidence that the costs of climate change to the nation are already high and will increase very substantially in the future, unless global emissions of greenhouse gases are significantly reduced.

Among the report's projections are that:

1. globally, the climate will warm by 3ºF to 10ºF by the 2080s, depending on trends in greenhouse gas emissions;

2. global sea levels will rise between one to four feet by 2100, depending on trends in greenhouse gas emissions, with sea level rise in the Northeast expected to exceed the global average by up to roughly 4 inches per century;

3. the intensity of the strongest hurricanes will continue to increase as the oceans continue to warm; and

4. the frequency and intensity of extreme precipitation events will continue to increase.

The report discusses options for "mitigation" (i.e., ways to reduce the amount and speed of future climate change by reducing emissions of greenhouse gases) and "adaptation" (i.e., making changes to better respond to new conditions, thereby reducing harm or taking advantage of opportunity). According to the report, mitigation and adaptation are linked, in that effective mitigation reduces the need for adaptation.

INTRODUCTION

In December 2010, the U.S. Department of Commerce established a 60-person advisory committee to oversee the development of the climate change report. The National Oceanic and Atmospheric Administration provided support for the committee. The committee engaged more than 240 authors, primarily scientists, in creating the report.

The committee issued the draft report in January 2013. It will revise the report following review by the National Academies of Sciences and the public. After additional review, the committee will submit the report for consideration in the Third National Climate Assessment report, which is being developed pursuant to the federal Global Change Research Act of 1990.

OBSERVED AND PROJECTED CLIMATE CHANGE

Temperatures

U.S. average temperature has increased by about 1.5°F since record keeping began in 1895, with more than 80% of this increase occurring since 1980. The most recent decade was the nation's warmest on record. U.S. temperatures are expected to continue to rise. Because human-induced warming is superimposed on a naturally varying climate, the temperature rise has not been, and will not be, smooth across the country or over time.

Between 1895 and 2011, temperatures in the Northeast increased more than the nation as a whole, by almost 2˚F. Future warming in the region will be highly dependent on global emissions of greenhouse gases. If emissions continue to increase, the report projects warming of 4.5ºF to 10ºF by the 2080s; if global emissions are reduced substantially, projected warming ranges from about 3ºF to 6ºF by the 2080s. Under both emissions scenarios, the frequency, intensity, and duration of heat waves is expected to increase, with larger increases with higher emissions.

Sea Level Rise

The oceans are absorbing over 90% of the increased atmospheric heat associated with emissions from human activity. Water expands as it warms up, causing sea levels to rise. Melting of glaciers and ice sheets also contributes to sea level rise at increasing rates.

Since the late 1800s, tide gauges throughout the world have shown that global sea level has risen by about eight inches. Other data for the period before tidal gauges were installed indicates that this rate of sea level rise is faster than at any time in at least the past 2,000 years. Since 1992, the rate of global sea level rise, as measured by satellites, has been roughly twice the rate observed over the last century.

Coastal flooding in the Northeast has increased due to sea level rise of approximately one foot since 1900. This rate of sea level rise exceeds the global average due primarily to land subsidence, although recent research suggests that changes in ocean circulation in the North Atlantic, specifically a weakening of the Gulf Stream, may also play a role.

The report projects that global sea levels will rise between one to four feet by 2100. The extent of the rise will depend in large part on the extent to which the Greenland and the West Antarctic ice sheets experience significant melting. Sea level rise in the Northeast is expected to exceed the global average by up to roughly four inches per century due to local land subsidence, with the possibility of even greater regional sea level rise if the Gulf Stream weakens, as some models suggest.

Precipitation

Precipitation averaged over the entire United States has increased, with the Northeast experiencing the greatest increase. Between 1895 and 2011, precipitation in the region increased by approximately five inches (0.4 inches per decade), or more than 10%. The report notes the variability in the region's weather. For example, parts of Southern New England (including Connecticut) that experienced heavy snows in the winter of 2010-2011, experienced almost no snow during the following winter (although the October Nor'easter knocked out power for up to 10 days for thousands of households).

Heavy downpours are increasing in most U.S. regions, especially over the last three to five decades. The Northeast has experienced a greater increase in extreme precipitation over the past few decades than any other region in the U.S.; between 1958 and 2010, the Northeast saw a 74% increase in the amount of precipitation falling in very heavy events.

The report projects further increases in the frequency and intensity of extreme precipitation events for most of the United States, although it notes that projections of precipitation changes are less certain than projections for temperature increases. The northern United States is projected to experience more precipitation in the future in the winter and spring.

Hurricanes and Severe Storms

There has been an increase in the overall strength of hurricanes and in the number of strong (Category 4 and 5) hurricanes in the North Atlantic since the early 1980s. The intensity of the strongest hurricanes is projected to continue to increase as the oceans continue to warm. Other trends in severe storms, including the numbers of hurricanes and the intensity and frequency of tornadoes, hail, and damaging thunderstorms are uncertain and are being studied intensively.

RELEVANCE TO CONNECTICUT

While the report does not specifically address the prospects of climate change in Connecticut, it has a chapter on climate change and the Northeast. It states that heat waves, coastal flooding due to sea level rise, and river flooding due to more extreme precipitation events pose a growing challenge to the Northeast's environmental, social, and economic systems. Coastal lifelines, such as energy infrastructure and evacuation routes, are increasingly vulnerable to higher sea levels and storm surges, inland flooding, and other climate-related changes.

Infrastructure

Climate change is already affecting various types of infrastructure. For example, extreme weather events are affecting energy production and delivery facilities, causing supply disruptions of varying lengths and magnitudes and affecting other infrastructure that depends on energy supply. The impacts from sea level rise and storm surge, extreme weather events, higher temperatures and heat waves, precipitation changes, and other climatic conditions are reducing the reliability and capacity of the U.S. transportation system in many ways.

According to the report, infrastructure in the Northeast will be increasingly compromised by climate-related hazards including sea level rise and coastal flooding and intense precipitation events. Even given the low end of sea level rise scenarios and assuming no changes in storms, the chance of what is now a 1-in-10-year coastal flood event in the Northeast could triple by 2100, occurring roughly once every three years, simply in response to higher sea levels. A 1.5 foot rise in sea level would expose approximately $6 trillion worth of property to coastal flooding in metropolitan areas across the region.

Many of the region's key highways (including I-95) and rail systems span areas that are prone to coastal flooding. In addition to temporary service disruptions, saltwater damage associated with storm surge flooding can severely undermine or disable critical infrastructure along coasts, including wastewater treatment plants and electrical substations.

Both sea level rise and more frequent and intense coastal flooding will (1) increase salt water encroachment and damage to low-lying communications, energy, transportation, water, and wastewater infrastructure not built to withstand saltwater and (2) increase maintenance costs and shorten replacement cycles.

Other impacts of future sea level rise include:

1. increased rates of coastal erosion or permanent inundation of low-lying areas, threatening coastal power plants;

2. increased release of pollution and contaminant runoff from sewer systems, treatment plants, brownfields, and waste storage facilities;

3. increased saltwater infiltration into water distribution systems; and

4. decreased clearance levels for boats under bridges

More frequent and intense coastal flooding will exacerbate flooding of low-lying streets, bridges, power plants and equipment, as well as structural damage to infrastructure due to wave action. It will increase the number and duration of local power outages due to flooded and corroded equipment. It will also decrease levels of service from flooded roadways and increase delays from congestion during street flooding episodes.

Environment

Climate change and other human modifications of ecosystems often increase their vulnerability to damage from extreme events. At the same time, these modifications reduce their natural capacity to modulate the impacts of these events on ecosystems.

According to the report, coastal ecosystems are particularly vulnerable to climate change because many have already been dramatically altered by human stresses. Climate change will result in further reduction or loss of the environmental services that these ecosystems provide, including potentially irreversible impacts. Salt marshes and barrier islands defend these ecosystems as well as infrastructure, including roads and buildings, against storm surges. Their loss from coastal development, erosion, and sea level rise increase the risk of catastrophic damage during or after extreme weather events.

Similarly, floodplain wetlands absorb floodwaters and reduce the effects of high flows on land along rivers. Extreme weather events that suddenly increase water flow, often carrying debris and pollutants, can decrease the natural capacity of ecosystems to process pollutants.

Public Health

According to the report, climate change will influence human health in many ways; some existing health threats will intensify, and new health threats will emerge. Since the hottest days in the Northeast are often associated with high concentrations of ground level ozone and other pollutants, the combination of heat stress and poor air quality can pose a major health risk to vulnerable groups: young children, the elderly, and those with health conditions including asthma. Vulnerability is further increased as key infrastructure, including electricity for life-saving cooling, is more likely to fail precisely when it is most needed – when demand exceeds available supply. Significant investments may be required to insure that power generation keeps up with increases in demand associated with rising temperatures, not even accounting for extreme events.

The report predicts increased health-related impacts and costs, such as premature death and hospitalization due to even modest increases in heat in the Northeast's urban centers. Increased ground-level ozone due to warming is projected to increase ozone-related asthma emergency department visits by 7.3% in 2020 in the New York City metropolitan area, which includes southwest Connecticut.

MITIGATION AND ADAPTATION

Mitigation refers to actions that reduce the human contribution to the planetary greenhouse effect, including reducing emissions of greenhouse gases like carbon dioxide and methane.

The report assesses four mitigation-related topics. It:

1. presents an overview of greenhouse emissions and their effect on climate to provide a context for discussion of mitigation efforts;

2. analyzes activities contributing to U.S. emissions of greenhouse gases, considering both industrial and land-use activities;

3. summarzes current government and voluntary efforts to manage these emissions; and

4. assesses the adequacy of these efforts relative to the magnitude of the problem and discusses preparation for potential future action.

While the report presents a brief overview of mitigation issues, it does not provide a comprehensive discussion of policy options or attempt to review or analyze the range of technologies available to reduce emissions.

The report describes adaptation initiatives (i.e., changes to respond to new conditions) by federal, state, and local governments and private sector entities. While most states and several municipalities in the Northeast have begun to incorporate the risk of climate change into their planning activities, implementation of adaptation measures is still at early stages. There has been cooperation across levels of governments. For example, the report notes that in Connecticut, Groton partnered with federal, state, regional, local, non-governmental, and academic partners through the Environmental Protection Agency's Climate Ready Estuaries program to assess vulnerability to and devise solutions for sea level rise.

Common approaches to adaptation planning include integrating climate adaptation into existing management plans (e.g., those addressing hazard mitigation, ecosystem conservation, water management, public health, risk contingency or developing stand-alone adaptation plans). Many actors are focusing on identifying the relevant climate risks and conducting current and future risk and vulnerability assessments of their assets and resources.

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