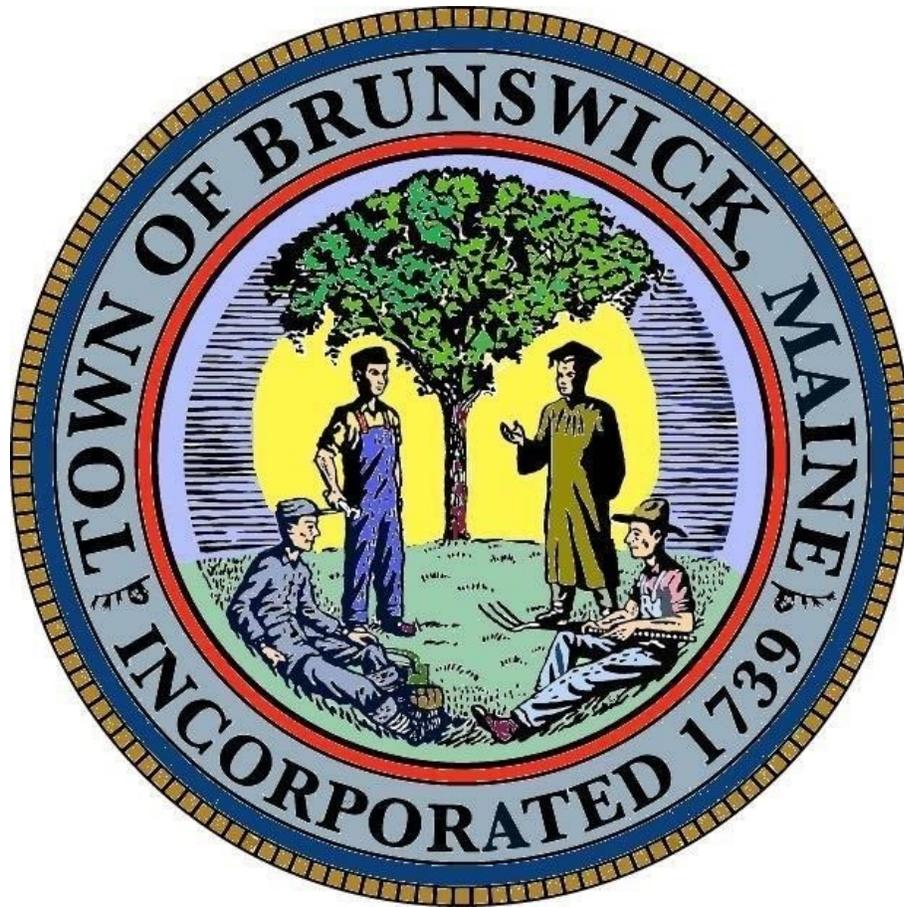


Brunswick Climate Action Plan



Developed By : Brunswick Recycling and Sustainability Committee
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0.1	03/24/2009	A. Anesko	Initial Version, A. Anesko
0.2	07/24/2009	D. Funk	Added Municipal Anaysis
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Report Prepared by: Brunswick Recycling and Sustainability Committee

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1 Forward

Northeast of Eden: On Building a Better Future for Brunswick – by Sarah Wolpow

I have a friend who lives in Eden. While I slog back from the grocery with pricey bags of produce; she laments that her neighborhood can't keep up with the persimmons and figs falling on their walks (then the sidewalks get messy, you understand). I worry about my kids crossing the relatively busy streets near our house; her kids run out the back door to visit their friends blocks away - without crossing a single street. In her neighborhood, the houses have small unfenced backyards which open onto car-free paths that interconnect the community. I know perhaps 10% of the people living in a two block radius of my house; she knows triple that number.

I have storm culverts lining the street outside my house; she has a charming stream bordered by cattails and filled, in the spring, with nesting mallards. I have too much shade to grow veggies; she has sun-drenched community garden space at the end of her block. On hot summer days all the asphalt streets absorb heat and make the town pretty toasty. The streets in my friend's neighborhood are tree-lined and unusually narrow, making her community several degrees cooler than surrounding neighborhoods.

I could go on. For example, her house, because of the narrower streets (less paving), the smaller backyards (less land purchased), the natural water retention system (no storm drains needed), initially cost less than a similarly sized house elsewhere in her town. Yet, not surprisingly, property in her development has appreciated far more than in the surrounding neighborhoods. But, I'll stop here. You get the idea.

Does she live in some sort of back-to-the-earth co-housing commune? Not at all. My friend works for Monsanto (perhaps the last place on earth a back-to-the-earth hippie would wish to be employed). Her neighbors are teachers, firefighters, and small business owners.

How was this possible? Some very smart developers in Davis, California talked a somewhat reluctant, but open-minded planning board into *overcoming the inertia behind business as usual*. They fought for needed exemptions to build a landscaped water retention system (i.e., stream with cattails) rather than putting in storm drains (this step saved \$800 per house in capital costs and the neighborhood doesn't flood when surrounding areas do). They fought for permission to build narrower streets. And on and on.

Replace the figs and persimmons with blueberries and raspberries, and there is no reason we could not be building livable, low-impact communities like this here in Maine, and indeed, in many other places.

I use the above, not as a specific roadmap for what Brunswick should do, but rather as an example of how we need to think in new ways, how we need to take a hard look at business as usual, how we need to be open-minded about change, and how the future can be better than the past.

I don't begrudge my friend her neighborhood. I love living in Brunswick. We have a small, tough community where schools are good, crime is low, and many of us can walk to our downtown. We cross country ski out our backdoors and in a few more minutes we can climb mountains and stroll along the ocean. We still grow things here, we know our farmers, and we've got lobsters.

If we are to hold onto this high quality of life we must act locally to preserve our downtown, our farmland, our schools, and our community. And, we must act globally to reduce climate-changing emissions. Failure to do either will imperil our future and our children's future.

The stakes could not be higher. In a recent speech before a Senate Committee, former Vice President Al Gore warned that "emitting greenhouse gases at current levels would bring a screeching halt to human civilization and threaten the fabric of life everywhere on the Earth." Indeed, civilization is but a thin veneer barely covering over the raw force of our planet's systems. It took only one storm to flatten the city of New Orleans.

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According to the Intergovernmental Panel on Climate Change (IPCC) we have already increased average global temperatures by 1.3 degrees Fahrenheit. Another 3-7 degree rise is predicted by century's end, depending on our ability to curb emissions. Eight of the 10 warmest years on record since the 19th century were in the last 10 years. If we don't change business as usual, loss of arctic sea ice is predicted to occur within the next decade - which may set off chain reactions leading to even higher temperatures.

The Worldwatch institute's State of the World 2008 reports that the damage from global climate change could equal as much as 8 percent of global economic output by the end of this century. Clearly, we can't dig ourselves out of our economic straits if we must also spend more and more money mitigating the effects of severe droughts, floods and storms.

What can little Brunswick do in the face of such a gargantuan task? Roll up our sleeves and get to work. In the words of ICLEI, a group dedicated to working with towns and cities to tackle our most pressing environmental issues "Local Action Moves the World." Brunswick is now one of more than 500 communities in the United States partnering with ICLEI to do just that. These cities and towns are responsible for more than a quarter of U.S. global warming emissions.

ICLEI lays out six sensible steps for a community to follow as it works to become more sustainable. They are:

1. Make a commitment to reducing global warming emissions
2. Inventory current emissions
3. Set targets and goals
4. Establish local action plan
5. Implement local action plan
6. Monitor and evaluate progress

The report you hold in your hand is not a new beginning for the town of Brunswick. Rather, it builds on the hard work of the many individuals who have already helped move our town toward a more healthy, just, and sustainable future. In 2007 the Town Council voted unanimously to sign the US Mayors Agreement committing the town to reduce its greenhouse gas emissions.

Over the last year our committee has been hard at work on Step 2: Inventorying the town's current emissions, while beginning work on Steps 3 and 4. A summary of our results make up the bulk of this report.

2 Introduction

2.1 Scientific Basis for Global Warming

The earth is warming. Year after year, evidence accumulates showing that global warming is real, that human activity is the primary cause of it, and that transformative measures must be swiftly taken to avoid unparalleled global catastrophe. Consider these recent publications.

- In November, 2007, the Intergovernmental Panel on Climate Change (IPCC), in a report signed off by 130 nations including the United States and China, issued its strongest call for immediate action to combat global warming.¹
- In January, 2008, NASA observed that “2007 ... continues the strong warming trend of the last thirty years ... The eight warmest years in the record have all occurred since 1998, and the 14 warmest years in the record have all occurred since 1990.”² 2008 is expected to be the tenth warmest year on record despite a La Nina cooling effect.³
- In June 2008, The U.S. Climate Change Science Program and the Subcommittee on Global Change Research issued warning of “continued, increasingly extreme weather events directly attributable to global warming.”⁴
- In December 2008, the British Meteorological Office's Hadley Centre predicted a global temperature increase of at least 5°C by 2100 assuming business-as-usual energy policies, corroborating the International Energy Agency, which stating that “without a change in policy, the world is on a path for a rise in global temperature of up to 6°C.”⁵

Satellite data already confirm substantial loss of ice sheet mass occurring in both Greenland⁶ and Antarctica⁷, in response to temperature increases experienced so far. A global temperature increase of 9-11°F is now widely predicted. The consequences of an increase of that magnitude are profound: ice sheet loss resulting in sea level rise of a meter or more⁸, widespread drought and desertification⁹, enormous species loss¹⁰, and stronger and more frequent hurricanes.¹¹

Ice sheet loss is in fact outpacing the direst predictions of just a few years ago.¹² In March 2009, the Copenhagen Climate Science Congress highlighted the threat of accelerating climate change.

Recent observations confirm that, given high rates of observed emissions, the worst-case IPCC scenario trajectories (or even worse) are being realized. For many key parameters, the climate system is already moving beyond the patterns of natural variability within which our society and economy have developed and thrived. These parameters include global mean surface temperature, sea-level rise, ocean and ice sheet dynamics, ocean acidification, and extreme climatic events. There is a significant risk that many of the trends will accelerate, leading to an increasing risk of abrupt or irreversible climatic shifts.¹³

Warnings such as these come with alarming frequency, so common as to be numbing. They represent an emerging scientific consensus, delivered by the most highly respected scientists and institutions in the world. The conference in Copenhagen was attended by some 2000 of the topmost climate scientists in the world. If these scientists now seem to be singing the same tune, it is because the science has led them to it.

Their predictions follow from two well established facts, and a third more recent finding.

1. As a result of commercial and residential building, transportation, industry, agriculture, and other activities, humans have added massive amounts of greenhouse gases (GHGs), especially carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O) to the atmosphere and oceans.

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2. Temperature increases since the latter half of the 19th century are directly attributable to increased GHG concentrations. Temperature increase above the historical mean has been roughly 0.7°C to date.¹⁴
3. Several so called “positive feedbacks” have been identified, which have the effect of accelerating global warming beyond the point attributable to direct emissions. A well known example is the reduction in albedo (reflectivity) when arctic ice cover is reduced: more energy from the sun is absorbed by the darker arctic sea, which in turn results in increased temperatures. Another particularly frightening feedback is the predicted release of trapped methane in response to arctic tundra thaw.

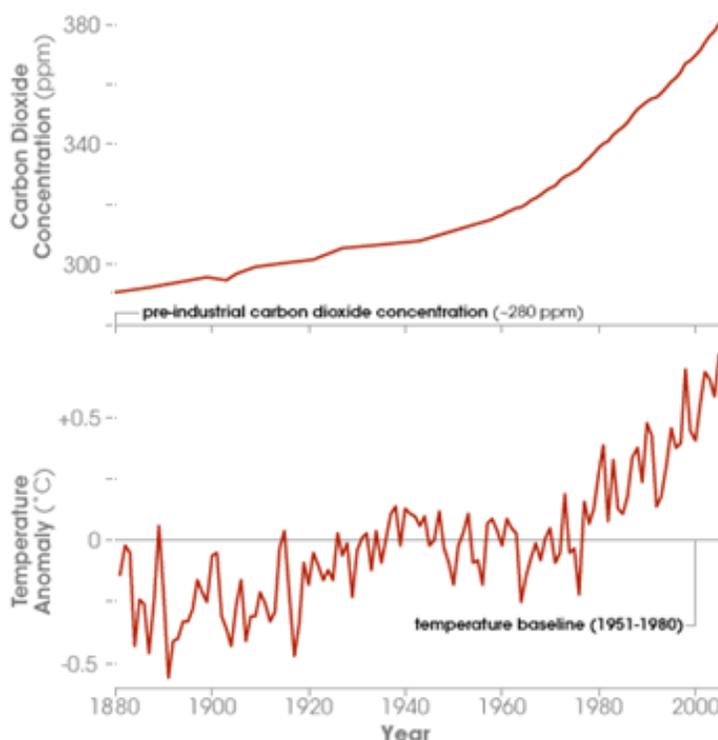


Figure 1. CO₂ and Temperature since 1880
(Source: NASA Earth Observatory: Global Warming Fact Sheet)

2.2 Impacts to Maine

Most people associate climate change with scorching hot weather and rising sea levels. But what specifically is Maine’s forecast?

The Northeast Climate Impacts Assessment predicts that by 2100, Maine will experience “summers warming by 6 -14°F, with dramatic increases in extreme heat in cities [and] winters warming by 8 -12°F, with dramatic decreases in snow cover.”¹⁵

In an op-ed published in the Portland Press Herald in February 2009, citing a University of Maine report, John Richardson itemized some of the effects of substantially higher temperatures.

1. Forests are expected to have fewer spruce and fir trees and more oaks and maples.
2. Species such as loons, chickadees, lynx and moose could gradually be replaced by bobcat, deer and other southern species.
3. Warmer ocean waters, together with higher acidity, could affect the health of lobsters and other shellfish, while southern flounder may become more common.

And regarding rising sea levels:

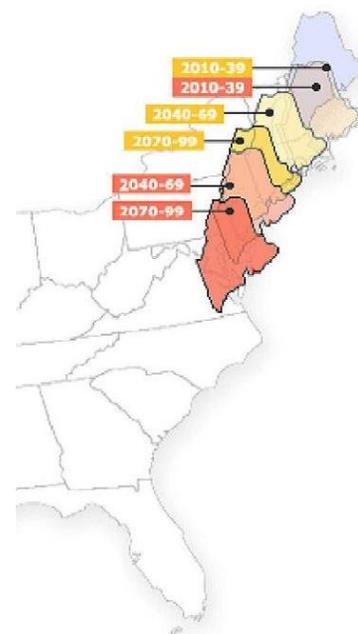


Figure 2. “Migrating” Climates
(Source: Northeast Climate Impacts Assessment (NECIA))

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4. Maine's tourism industry should prepare for rising sea levels that could threaten coastal areas, as well as shorter and wetter snow seasons and longer spring and fall seasons.

Climate models have predicted that whatever sea level rise the rest of the world experiences by 2100, it will be worse in New England. If global sea levels rise by three feet, add 8 inches to that for Maine.¹⁶

Under such conditions, there will be impacts to many Maine industries. Furthermore, Maine can expect scarcity and higher prices for goods produced locally.

2.3 Brunswick's Response: Bowdoin College

For over two hundred years, Bowdoin College has been an important part of the Brunswick community. Like Brunswick, Bowdoin recognizes the importance of acting to reduce its impacts on our climate and move towards a sustainable future.

In June 2007, the college signed on to the American College and University Presidents Climate Commitment (ACUPCC), a nation-wide pledge with nearly 650 signatories that aims to reduce global greenhouse gas emissions through action at institutions of higher education. As a signatory of the ACUPCC, Bowdoin has committed conducting an inventory of its energy use and greenhouse gas emissions, creating a climate action plan and reducing its net greenhouse gas emissions to zero by a target date to be determined by September 2009.

The inventory, completed last year, shows that the college emitted approximated 24,000 tons of CO₂ during its baseline year of 2008. The college has already taken many steps to reduce its emissions and energy use by increasing efficiency in campus buildings, switching fuels and reducing heating fuel use, investing in alternative energy sources such as solar thermal hot water and geothermal heating and cooling systems, and purchasing more local and organic foods.

The college's Climate Action Plan outlines the steps that the college will take to reduce its emissions to net zero and discusses Bowdoin's commitment to be a leader both locally and nationally in climate protection efforts¹⁷. Students and faculty of the college have been involved in Brunswick's efforts to assess its climate impact and will continue to be involved in the process of reducing the town's emissions and striving towards a sustainable future.

2.4 Brunswick's Response: Town Council

On April 23rd, 2007, the Brunswick Town Council endorsed the US Mayors Climate Protection Agreement (USMCPA). Subsequently, on April 22nd, 2008, the council formally charged its own Recycling and Sustainability Committee with developing a plan to assess Brunswick's greenhouse gas (GHG) emissions. The council specifically charged the committee to cooperate with "town staff, the Brunswick Sustainability Group, and any others with relevant expertise."

From the US Mayors Climate Protection Agreement (USMCPA), endorsed by the Brunswick Town Council:

Many cities, in this country and abroad, already have strong local policies and programs in place to reduce global warming pollution, but more action is needed at the local, state, and federal levels to meet the challenge. On February 16, 2005 the Kyoto Protocol, the international agreement to address climate disruption, became law for the 141 countries that have ratified it to date.

By the 2005 U.S. Conference of Mayors Annual Meeting in June, 141 mayors had signed the Agreement - the same number of nations that ratified the Kyoto Protocol. In May of 2007, Tulsa Mayor Kathy Taylor became the 500th mayor to sign on.¹⁸

Under the USMCPA, participating cities commit to take following three actions:

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- Urge their state governments, and the federal government, to enact policies and programs to meet or beat the greenhouse gas emission reduction target suggested for the United States in the Kyoto Protocol — 7% reduction from 1990 levels by 2012;
- Urge the U.S. Congress to pass the bipartisan greenhouse gas reduction legislation, which would establish a national emission trading system; and
- Strive to meet or beat the Kyoto Protocol targets in their own communities, through actions ranging from anti-sprawl land-use policies to urban forest restoration projects to public information campaigns; as a first step, inventory global warming emissions in City operations and in the community, set reduction targets and create an action plan.

To begin fulfilling the town's charge, the Recycling and Sustainability Committee has become a member of ICLEI - Local Governments for Sustainability. ICLEI is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development. Through ICLEI the committee has gained valuable information about what has worked in other communities as well acquiring advanced software to help track carbon emissions.

The committee is also active with Cool Cities (affiliated with Sierra Club) and including Cool Cities Maine (a/k/a Maine Partners for Cool Communities).

2.5 A Brief Note on Methodology

The primary greenhouse gases are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Although by far the largest volume of greenhouse gas emissions are CO₂, other gasses can be significant contributors to global warming because they are more potent. For example, over a 100 year period, a given amount of methane causes 25 times more warming than the same amount of carbon dioxide, and nitrous oxide causes a whopping 298 times more warming.

As different fuels are burned they release different combinations of greenhouse gasses. Scientists use the term *carbon dioxide equivalents* (CO₂eq) to describe the global warming effect of a given mixture of GHGs, typically over a time period of 100 years. In other words, CO₂eq describes the amount of CO₂ that would have to be emitted to have the same warming effect as the given mixture. The CO₂eq content of various fuels is listed in an appendix.

2.6 Goals of this Document

This plan fulfills the Town Council's charge outlined above. It also fulfills the first part of objective C1 of the US Mayors Agreement, "inventory global warming emissions in City operations and in the community, set reduction target goals and create an action plan." (See Appendix.)

This plan is intended to be a primary resource for Brunswick's efforts to reduce its GHG emissions. It is also a working document. It is meant to be continually revised. We expect that future assessments and recommendations will be added to the plan, and that recommendations put into practice will be described and tracked herein.

3 Emissions Assessment

3.1 What's Included in this Assessment

This plan assesses emissions from Brunswick's municipal operations only.

1. Municipal electricity consumption for all of Brunswick's operations including buildings, schools, water and sewer, Curtis Memorial Library, street and traffic lights, the transfer station, and pumping stations;
2. Municipal fuel consumption for heat, hot water, and cooking purposes, for all of the above entities;
3. Municipal vehicle fleet fuel consumption;
4. Municipal employee commutes.

3.2 What's Planned for Inclusion in a Future Assessment

The Following emissions sources are not assessed.

1. Community electricity consumption (where "Community" comprises all of Brunswick, municipal and non-municipal, including private businesses and residences);
2. Community fuel consumption for heat, hot water, cooking, and other purposes;
3. Non-municipal vehicle fuel consumption;
4. Landfill and composting emissions;
5. Effects of vegetation and soil, including water and sewer, forests, wetlands, etc.;
6. Emissions associated with consumed goods and services, including purchases and food;
7. Brunswick Naval Air Station.

3.3 Municipal Analysis

The Municipal government emissions are divided into six different categories. They are **Buildings and Facilities, Streetlights & Traffic Lights, Water Delivery Facilities, Vehicle Fleet, Wastewater Facilities, and Employee Commute**.

We are still collecting data for the final two categories: **Wastewater Facilities, and Employee Commute**. We have a complete assessment for the others.

3.3.1 Buildings and Facilities

The Buildings and Facilities owned and operated by the Municipal Government emitted in the 2008 calendar year approximately **3,600 tonnes of equivalent CO₂** and used approximately **55,000 MMBtu of energy**. This section was the largest single contributor to the municipal emissions in 2008 at **58.4%**. Electricity alone is costing the town around **\$146,200.00** while heating costs are around **\$238,800.00**. A further breakdown of specific buildings will be in spreadsheet below. Schools are included in the carbon emissions but are omitted from the total cost due to difficulty in obtaining that information.

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3.3.2 Streetlights & Traffic Lights

Streetlights & Traffic Lights accounted for **2.2%** of the municipal share. They emitted approximately **130 tonnes of equivalent CO₂** and used **2,000 MMBtu of energy**. Operating these lights cost the city of Brunswick **\$179,728.64**.

3.3.3 Water Delivery Facilities

The water delivery facilities, owned by both Brunswick and Topsham, emitted (in Brunswick) close to **220 tonnes of equivalent CO₂**. The pumping stations and other facilities used by the water district consumed approximately **3,350 MMBtu**. This is **3.6%** of the total and costs the town **\$98,636.00** in electrical costs. Heating and motor vehicle costs have not been incorporated.

3.3.4 Vehicle Fleet

The Brunswick vehicle fleet has the second largest share of the town's emissions at **26.9 %**. The vehicle fleet is made up of every car from police cruisers and dump trucks to reimbursed travel. Burning gasoline and diesel, the vehicle fleet emits approximately **1,650 tonnes of equivalent CO₂** and costs the town **\$289,761.78**. This cost does not include school bus fleets.

3.3.5 Wastewater Facilities

The wastewater Facilities, at **5.7%** of the total, emitted a total of approximately **350 tonnes of equivalent CO₂**. The facilities utilized approximately **3,357 MMBtu** and costs the town \$_____. The methane emissions from the wastewater treatment plant are not included in this inventory currently but will be in later editions.

3.3.6 Employee Commute

The Brunswick municipal employees travel a total of approximately **380,000 annual miles** to travel to and from work. The longest commute is a round trip distance of 66 miles. Though the town does not pay for it, this travel is costing the municipal employees close to **\$200,000.00** (multiply the VMT by a rate of \$0.55 per mile to get the assumed cost of ownership and gas –set by the IRS and town). This section comprises **3.2%** of the total emissions, releases close to **200 tonnes of CO₂ equivalent** and uses **2,716 MMBtu**. It is important to note that only 69% of the municipal employees are included in this section.

3.4 Municipal Emissions Breakdown

Total Emissions Breakdown

The following illustrates the breakdown of emissions per sector.

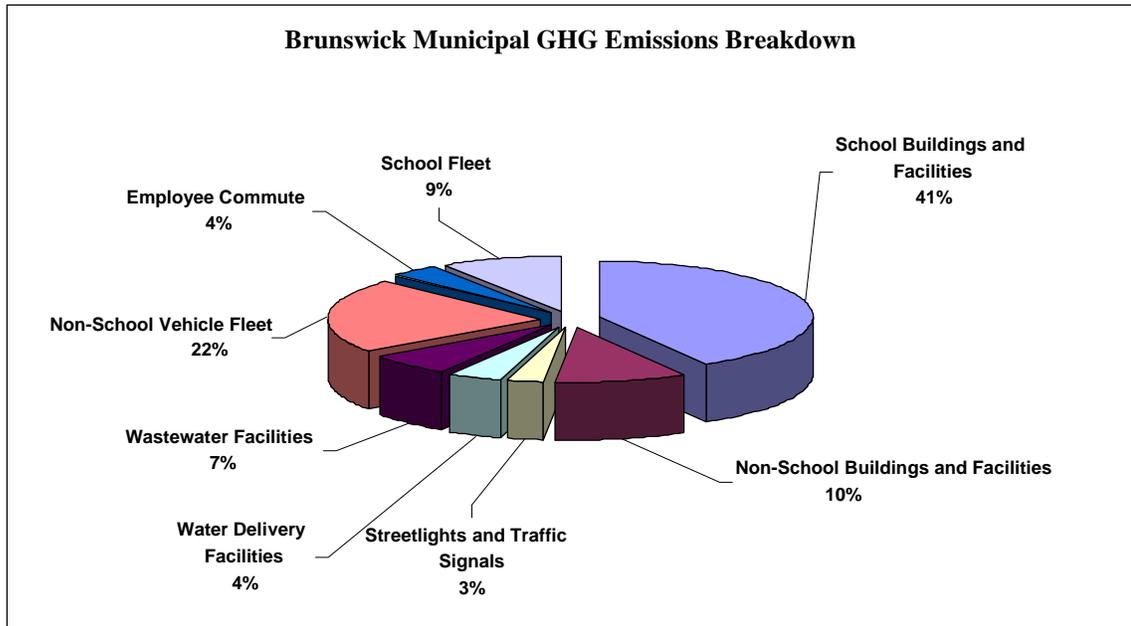


Figure 3. Brunswick Municipal GHG Emissions Breakdown by Sector

Facility	Metric Tons CO2eq
School Buildings and Facilities	2204
Non-School Buildings and Facilities	531
School Fleet	490
Non-School Vehicle Fleet	1164
Employee Commute	196
Streetlights and Traffic Signals	146
Water Delivery Facilities	220
Wastewater Facilities	352

Table 1. Metric Tons CO2eq per Sector

We can see that school buildings comprise the greater portion of building emissions and a significant portion of fleet emissions. Furthermore, the school district has contracted with Siemens to perform an energy audit on its facilities. This audit is for the schools only. It therefore makes sense to evaluate emissions for the schools and non-school facilities separately.

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Emissions Breakdown for the Schools

The following illustrates the breakdown of emissions for the schools.

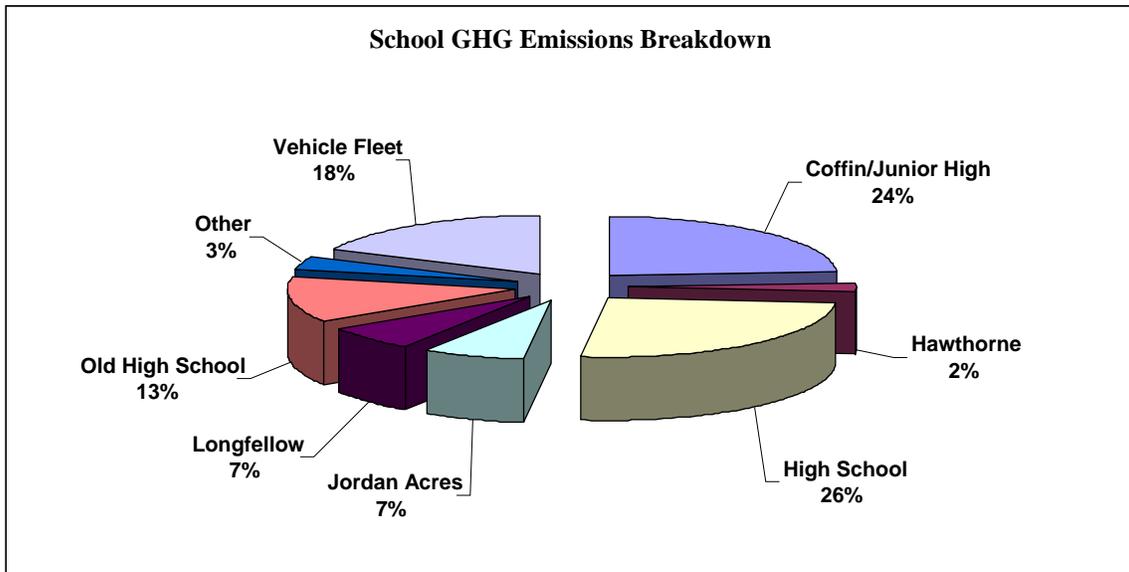


Figure 4. Brunswick Schools GHG Emissions Breakdown

Facility	Metric Tons CO ₂ eq
Coffin/Junior High	643
Hawthorne	64
High School	690
Jordan Acres	199
Longfellow	177
Old High School	345
Other	86
Vehicle Fleet	490

Table 2. Metric Tons CO₂eq per Sector

Emissions Breakdown Not Including the Schools

The following illustrates the breakdown of emissions for municipal facilities not including the schools.

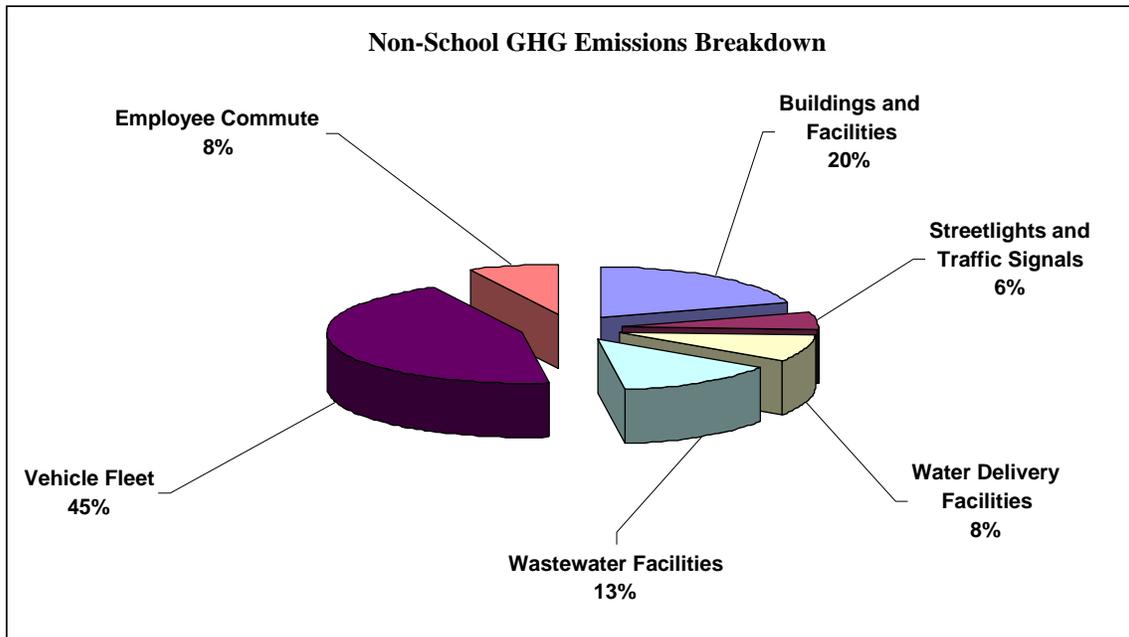


Figure 5. Brunswick GHG Emissions Breakdown for Non-School Facilities

Facility	Tonnes CO ₂ eq
Buildings and Facilities	531
Streetlights and Traffic Signals	146
Water Delivery Facilities	220
Wastewater Facilities	352
Vehicle Fleet	1164
Employee Commute	196

Table 3. Metric Tons CO₂eq per Sector

4 Brunswick's Accomplishments To Date

Over the past few years, Brunswick has made a number of energy efficiency upgrades. Listed below are upgrades made to municipal works, not including the schools.

Accomplishment (2000)

Description: PWD vehicles equipped with LED strobes (allows vehicle to be shut down when strobes are on).

Accomplishment (2002)

Description: All traffic light heads changed to LED bulbs with an estimated 80% reduction in power consumption.

Accomplishment (2003)

Description: LED bulbs in all town luminary exit signs.

Accomplishment (2006)

Description: PWD adopts ant-idle policy.

Accomplishment (2007)

Description: Old Times Record outside insulation.

Accomplishment (2007)

Description: Old Times Record 20 year old AC units upgrade to new energy efficient models.

Accomplishment (2007-2008)

Description: Lighting upgrade for Town Hall.

Accomplishment (2008)

Description: Natural gas boiler and hot water system for the Rec Center.

Accomplishment (2005, 2008)

Description: Programmable thermostats set at 68 degree in Town Hall and PWD buildings.

Accomplishment (2000-2008)

Description: The replacement of all CRTs with new flat screens, est. 90% percent less energy.

Accomplishment (2004-ongoing)

Description: Replacement of inefficient windows in Town Hall with energy efficient windows.

Accomplishment (2007-ongoing)

Description: PWD diesel powered heavy equipment being upgraded to new EPA emission standards.

5 Recommendations

The following project proposals were assembled by Craig Worth in the Spring of 2009, and submitted to the Town Manager, who picked three: Dual Fuel Burner and Chimney Repair at Curtis Memorial Library; Boiler Replacement at Public Works Office and Garage; and Convert Burner at Superintendent's Office. These three were presented in an application for an Energy Efficiency Community Block Grant (EECBG). Brunswick has been awarded just over \$100,000 through the EECBG.

5.1 Lighting upgrade for Public Works Office, Garage and Storages Buildings

Recommendation

Description: There are five buildings in total. The main building at 6 Industry Road is 16,000 square feet, 10 Industry is 5,000 square feet, sewer building is 1,200 square feet, storage building 1-6 is 3,200 square feet, and recycling building is 2,900 square feet. These together use approximately 225,000 kWh electricity per year.

Work would entail changing out inefficient fluorescent and mercury vapor lighting with High Efficiency T8 electronic Technology - High Intensity Fluorescent Lighting.

Estimated Annual Electricity savings 30,000 kWh, which equals a reduction of 6,822 kg CO₂EQ.

Cost: \$28,542.

Status: *Recommended.* Energy saved makes this project cost a short payback period. NOTE: Efficiency Maine may offer incentive program.

5.2 Boiler Replacement at Public Works Office and Garage

Recommendation

Description: The building at 9 Industry Road is 16,000 square feet and consumes 7,000 gallons #2 fuel oil a year, producing 72074 kg CO₂EQ per year.

Option #1: Replace 1950's forced hot water boiler with high efficiency oil or gas fired boiler (no dual fuel burner available), abate asbestos, and line chimney. Estimated reduction of 2,100 gallons #2 fuel oil per year, reducing emissions by 21622 kg CO₂EQ per year.

Option #2: If natural gas is used to fuel the new high efficiency boiler, than an additional 13968 kg CO₂EQ would be eliminated ((7000-2100) gal * 0.139957 MMBtu/gal * (73.567457-53.200036) kg/MMBtu).

Cost: Boiler, chimney = \$27,329

Status: *Approved.*

5.3 Boiler Replacement and Insulation for Public Works Storage Building

Recommendation

Description: The building at 10 Industry Road is 5,000 square feet and consumes 3,800 gallons #2 fuel oil a year, producing 39126 kg CO₂EQ.

Option #1: Replace 1950's steam boiler with high efficiency gas fire boiler, convert steam system to force hot water, abate asbestos, line chimney and install new roof with R30 insulation. Estimated reduction of 1,500 gallons #2 fuel oil per year, reducing emissions by 15444 kg CO₂EQ per year.

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*Option #2: If natural gas is used to fuel the new high efficiency boiler, than an additional 6556 kg CO2EQ would be eliminated ((3800-1500) gal * 0.139957 MMBtu/gal * (73.567457-53.200036) kg/MMBtu).*

Cost: Boiler, chimney, and heating system conversion = \$29,758

Status: Recommended. Will save 40% on the fuel amount. If a natural gas burner is used, another 30% could be saved on fuel cost.

5.4 R30 Insulation with New Roof

Recommendation

Description: R30 Insulation with new roof at 10 Industry Road. 3% fuel savings by reduction in heat loss.

Cost: \$39,800

Status: Recommended. Roof work is beyond repair. Roof decking and joist damage will begin if not addressed.

5.5 Lighting Upgrade at Recreation Center

Recommendation

Description: Main Building at 30 Federal Street. 20,400 square feet Annual Electricity Usage is approximately 56,000 kWh. Work would entail changing out inefficient fluorescent and mercury vapor lighting with High Efficiency T8 electronic Technology (High Intensity Fluorescent Lighting) Estimated Annual Electricity savings 15,000 kWh equals a reduction of 3,411 kg CO2EQ.

Cost: \$44,475

Status: Recommended. Energy saved makes this project cost a short payback period. NOTE: Efficiency Maine may offer incentive program.

5.6 Dual Fuel Burner and Chimney Repair at Curtis Memorial Library

Recommendation

Dual Fuel Burner

Description: Install dual fuel burners for two boilers at Curtis Memorial Library. CML is a 16,000 square feet building currently consuming 10,000 gallons a year of #2 fuel oil, which produces 102963 kg CO2EQ. Installation of dual fuel burners will require repair of chimney cracks and defects to bring the chimney up to code.

Cost: \$20,333 (+\$18,850 chimney repair) (+\$4,900 for breeching work if converted to natural gas)

Status: Approved.

5.7 Boiler Replacement for Town Hall

Recommendation

Description: The main building at 28 Federal Street is 15,900 square feet and consumes 4,500

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gallons #2 fuel oil per year, producing 46333 kg CO₂EQ.

Option #1: Replace 1967 forced hot water boiler with high efficiency oil or gas fire boiler (no dual fuel burner available), abate asbestos, and line chimney. Estimated reduction of 1,350 gallons of #2 fuel oil per year, reducing emissions by 13900 kg CO₂EQ per year.

Option #2: If natural gas is used to fuel the new high efficiency boiler, then an additional 8979 kg CO₂EQ per year would be eliminated.

Cost: \$25,158

Status: *Recommended. Will save 30% on the fuel amount. If a natural gas burner is used, another 30% could be saved on fuel cost.*

5.8 Convert Burner at Superintendent's Office

Recommendation

Description: *The Town is taking over operation of the Superintendent's Office. This building consumes 3,800 gallons of #2 fuel oil per year, producing 39126 kg CO₂EQ per year. Converting the burner from oil to natural gas will reduce emissions by 10832 kg CO₂EQ per year.*

Cost: \$30,000

Status: *Approved.*

6 What's Next?

There are a few next steps that Brunswick is already committed to.

- Develop a detailed plan to reduce emissions, including targets;
- Complete the Emissions Assessment to include non-municipal emissions totals;
- Implement the Recommendations listed in the preceding chapter.

And so, we could just leave it at that.

But it is useful to see what other communities are doing to combat global warming. Each of the following cities and towns is struggling with the same problems we identify in this document. Each is taking steps to address them according to its own needs and abilities. Some towns have long been engaged in climate change abatement, others are just getting started.

Brunswick should take notice of their actions. These towns are all close by, mostly within commuting distance, and they collectively share many of Brunswick's characteristics. Any comparisons Brunswick might wish to make in order to evaluate its own climate action plan should start with these towns.

Brunswick should also be inspired! We are by no means alone in the effort to fight global warming, whether locally or statewide. Moreover, Brunswick is neither ahead nor behind the pack in terms of what it has already accomplished, or plans to accomplish, if we may judge by the following group of Maine towns.

Finally, keep in mind that many of the actions taken by these towns thus far are innovative and save them money, in addition to reducing GHG emissions.

6.1 Bath

- Completed emissions inventory
- Installed insulated bay doors at the public works garage
- Updating heating system in City Hall
- Replacing street lights with LEDs
- Updated lighting in City Hall and installed motion sensors

6.2 Falmouth

- Built LEED certified police station
- Completed some efficiency upgrades in response to audits of town buildings
- Updated lighting
- Switched from oil heating to propane in city hall
- Purchased four hybrids (including one for the police chief)
- Transitioned to four day work week in City Hall
- Looking into wind and solar power potential

6.3 Freeport

- Transitioned to four day work week in City Hall

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- Installed occupancy sensors
- Conducted audits on town buildings and made recommended upgrades
- Changing street lights over to CFLs
- Investigating geo-thermal potential
- Changing some zoning ordinances such as allowing smaller parking lots

6.4 Portland

- Implemented “green” purchasing policies
- Built LEED certified schools
- Doing efficiency upgrades
- Built and maintained a network of trails
- Supporting public transportation, walking, and bicycling

6.5 Saco

- Replaced lights in city buildings with CFLs and street lights with LEDs
- Replaced refrigerators and computer screens with more efficient models
- Installing new insulation, windows, and doors
- Erected two wind turbines
- Installed geo-thermal heating and cooling in Saco transportation center
- Installed solar panels and solar hot air heaters
- Distributed CFLs to residents on election day
- Purchased an electric car and a hybrid

6.6 York

- Performed audits and made recommended upgrades in schools
- Changed ordinances to allow for wind turbines
- Approved \$100,000 for the newly formed Energy Steering Committee to conduct its work

Appendices

A.1 Text of the US Mayors Climate Protection Agreement

(As endorsed by the 73rd Annual U.S. Conference of Mayors meeting, Chicago, 2005)

A. We urge the federal government and state governments to enact policies and programs to meet or beat the target of reducing global warming pollution levels to 7 percent below 1990 levels by 2012, including efforts to: reduce the United States' dependence on fossil fuels and accelerate the development of clean, economical energy resources and fuel-efficient technologies such as conservation, methane recovery for energy generation, waste to energy, wind and solar energy, fuel cells, efficient motor vehicles, and biofuels;

B. We urge the U.S. Congress to pass bipartisan greenhouse gas reduction legislation that 1) includes clear timetables and emissions limits and 2) a flexible, market-based system of tradable allowances among emitting industries; and

C. We will strive to meet or exceed Kyoto Protocol targets for reducing global warming pollution by taking actions in our own operations and communities such as:

1. Inventory global warming emissions in City operations and in the community, set reduction targets and create an action plan.
2. Adopt and enforce land-use policies that reduce sprawl, preserve open space, and create compact, walkable urban communities;
3. Promote transportation options such as bicycle trails, commute trip reduction programs, incentives for car pooling and public transit;
4. Increase the use of clean, alternative energy by, for example, investing in "green tags", advocating for the development of renewable energy resources, recovering landfill methane for energy production, and supporting the use of waste to energy technology;
5. Make energy efficiency a priority through building code improvements, retrofitting city facilities with energy efficient lighting and urging employees to conserve energy and save money;
6. Purchase only Energy Star equipment and appliances for City use;
7. Practice and promote sustainable building practices using the U.S. Green Building Council's LEED program or a similar system;
8. Increase the average fuel efficiency of municipal fleet vehicles; reduce the number of vehicles; launch an employee education program including anti-idling messages; convert diesel vehicles to bio-diesel;
9. Evaluate opportunities to increase pump efficiency in water and wastewater systems; recover wastewater treatment methane for energy production;
10. Increase recycling rates in City operations and in the community;
11. Maintain healthy urban forests; promote tree planting to increase shading and to absorb CO₂; and
12. Help educate the public, schools, other jurisdictions, professional associations, business and industry about reducing global warming pollution.

A.2 Global Warming Potential of Greenhouse Gases

The primary greenhouse gases (GHG) are carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Global warming potential (GWP) is a quantitative measure of how much a given mass of a particular GHG contributes to global warming.

Carbon dioxide has a GWP of 1 by definition. Other GHGs are scaled with respect to CO₂. The following table shows GWP of methane (CH₄) and nitrous oxide (N₂O), the second and third most important GHGs, globally.

Greenhouse Gas (GHG)	Global Warming Potential (GWP)		
	20 years	100 years	500 years
Carbon dioxide (CO ₂)	1	1	1
Methane (CH ₄)	72	25	7.6
Nitrous Oxide (N ₂ O)	289	298	153

Table 2. Global Warming Potentials for CO₂, CH₄, and N₂O
(Source: IPCC AR4 WG1, 2007; Chapter 2, Table 2.14)

Following ICLEI protocol, we use *carbon dioxide equivalent* (CO₂eq) units to describe the global warming effect of a given mixture of GHGs, over a time period of 100 years. CO₂eq describes the amount of CO₂ that would have to be emitted to have the same effect as the given mixture.

Note that for combustion of fossil fuels, some 99% of the GWP is due to CO₂, so that the effect and quantification of other GHGs is a relatively minor detail.

A.3 CO₂eq Content of Various Fuels

Each fuel is assigned an energy content expressed in MMBtu per unit fuel amount, and an emissions content expressed in CO₂eq per unit of fuel energy. These values are obtained from the CACP software.

Fuel Type	Unit	Energy Content (MMBtu/unit)	CO ₂ eq Content (kg/MMBtu)
Electricity	1 kWh	0.003413	66.628
Gasoline	1 gallon	0.125603	77.265
Diesel	1 gallon	0.122014	78.772
Natural Gas	1 therm	0.100000	56.048
Light Fuel Oil (No. 2)	1 gallon	0.139957	74.992
Propane	1 gallon	0.093305	65.662
Kerosene	1 gallon	0.139957	74.992

Table 3. Energy and CO₂eq Content of Fuels
(Source: ICLEI Clean Air and Climate Protection Software (CACP) Version 1.1, June 2005)

NOTES

Figures obtained from ICLEI CACP software except where noted below.

CO₂eq content of electricity is obtained by dividing the CO₂eq kg/kWh figure from CMP (0.2274) by the standard figure for electricity MMBtu/kWh (0.003413). Note that despite inefficiencies inherent in producing and delivering electricity, it is emissions-competitive with other fuels.

CO₂eq content of gasoline and diesel varies according to vehicle type due to differences in particulates and other non-CO₂ GHGs. This difference is small compared to the fixed emission factor of CO₂. The values in the table above are for a typical full size automobile.

CACP does not provide a figure for Kerosene. We use the same coefficients as for #2 fuel oil.

A.4 Appendix: ICLEI – Local Governments for Sustainability

Brunswick has joined an international organization called ICLEI - Local Governments for Sustainability. From ICLEI's website:

ICLEI - Local Governments for Sustainability is an international association of local governments and national and regional local government organizations that have made a commitment to sustainable development. More than 815 cities, towns, counties, and their associations worldwide comprise ICLEI's growing membership. ICLEI works with these and hundreds of other local governments through international performance-based, results-oriented campaigns and programs.

ICLEI provides technical consulting, training, and information services to build capacity, share knowledge, and support local government in the implementation of sustainable development at the local level. Our basic premise is that locally designed initiatives can provide an effective and cost-efficient way to achieve local, national, and global sustainability objectives.

ICLEI was founded in 1990 as the 'International Council for Local Environmental Initiatives'. The council was established when more than 200 local governments from 43 countries convened at our inaugural conference, the World Congress of Local Governments for a Sustainable Future, at the United Nations in New York.

The USMCPA does not provide a tool to assess emissions. ICLEI has developed a software program that does so called Clean Air Cool Planet (CACP). We use this software as the fundamental tool to track and assess Brunswick's GHG emissions. It is described in more detail below.

ICLEI has partnered with a number of other organizations: Cool Cities (affiliated with Sierra Club), including Cool Cities Maine (a/k/a Maine Partners for Cool Communities). We are active with these organizations as well.

7 Endnotes

¹ IPCC *Climate Change 2007: Synthesis Report Summary for Policymakers*, Nov 2007. http://www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

² NASA GISS Surface Temperature Analysis: *Global Temperature Trends: 2007 Summation*. <http://data.giss.nasa.gov/gistemp/>

³ World Meteorological Organization *Press Release No. 835*, Dec 2008. http://www.wmo.int/pages/mediacentre/press_releases/pr_835_en.html

⁴ CCSP 3.3 Report *Weather and Climate Extremes in a Changing Climate*, Jun 2008. <http://www.climate-science.gov/Library/sap/sap3-3/final-report/default.htm>

⁵ IEA *World Energy Outlook 2008*, Nov 2008. <http://www.iea.org/w/bookshop/add.aspx?id=353>

⁶ Chen J L, Wilson C R and Tapley B D *Satellite Gravity Measurements Confirm Accelerated Melting of Greenland Ice Sheet*. *Science*, Jul 2006. <http://www.sciencemag.org/cgi/content/abstract/1129007v1>

⁷ Velicogna I and Wahr J *Measurements of Time-Variable Gravity Show Mass Loss in Antarctica*. *Science* 311 1754–6, Mar 2006. <http://www.sciencemag.org/cgi/content/abstract/1123785>

⁸ Grinsted A, Moore J C, Jevrejeva S *Reconstructing sea level from paleo and projected temperatures 200 to 2100 AD*. *Climate Dynamics*, Jan 2009. <http://dx.doi.org/10.1007/s00382-008-0507-2>

⁹ Also known as “Desertification, Land Degradation, and Drought” (DLDD). See e.g. UNFCCC Climate Change Talks in Bonn, Germany, June 1-12 2009. <http://unfccc.int/meetings/sb30/items/4842.php>, and others.

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¹¹ PEW Center on Global Climate Change *Hurricanes and Global Warming FAQs* <http://www.pewclimate.org/hurricanes.cfm>

¹² Hare B *Ice Sheets and Sea Level: New insights since IPCC 2007* Earth System Analysis, Potsdam Institute for Climate Impact Research <http://copportal1.man.poznan.pl/Doc.ashx?id=51&Mime=application/pdf&Presentation=True>

¹³ <http://climatecongress.ku.dk/>

¹⁴ Hansen J, Sato M, Ruedy R, Lo K, Lea D W, Medina-Elizade M *Global temperature change* *Proc. Natl Acad. Sci.* 101 16109–14, 2006.

¹⁵ Anderson B *Climate Change in Maine* Northeast Climate Impacts Assessment (NECIA), Boston University, 2007.

¹⁶ Yin J, Schlesinger M R, Stouffer R J *Model projections of rapid sea-level rise on the northeast coast of the United States* *Nature Geoscience* 2, 262 – 266, 2009.

¹⁷ (Bowdoin’s CAP available September 2009)

¹⁸ Mayors Climate Protection Center. <http://www.usmayors.org/climateprotection/revised/>