Interior Issues Council
Climate Change Task Force

Preliminary Vulnerability Assessment Report

1/10/2010

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Executive Summary

This report summarizes the findings to date of the Interior Issues Council Climate Change Task Force (IIC-CCTF) in studying and assessing climate vulnerability in the Fairbanks North Star Borough (FNSB or Borough). This work was performed in accordance with Borough Assembly Resolution 2007- 40, a resolution committing to the development of a local climate change impact and resilience plan in participation with the International Council for Local Environmental Initiatives (ICLEI) program (Appendix A). IIC-CCTF participants compiled information regarding the sensitivity, adaptive capacity, and vulnerability of built, natural, and socio-economic systems in the FNSB. In most cases non-climate related stresses and synergies are also included in this assessment, as they impact overall ability to react and plan for climate change. Unlike other community groups that have followed the ICLEI milestones in creating climate resilience plans, IIC-CCTF has simultaneously considered climate change adaptation and mitigation. Short- and long-term recommendations for climate change adaptation and mitigation are listed in this report.

Two University of Alaska programs, the Scenarios Network for Alaska Planning (SNAP, www.snap.uaf.edu) and the Alaska Center for Climate Assessment and Policy (ACCAP, www.uaf.edu/accap), were consulted for projected changes and potential adaptation responses. Both programs also contributed significantly through the time investment of their joint employee, Sarah Trainor, who functioned as a task force co-chair for this effort.

The climate in Interior Alaska is warming as rapidly as any other place on the planet and will likely continue to do so, with the most notable effects seen during winter and spring (November through April). Average temperatures in April and October are expected to shift from historically below freezing to above freezing in the coming century. While we expect slightly more precipitation, warmer temperatures will produce an overall net drying effect.

Rapid warming is likely to result in increased wildfire activity and accompanying smoke; increased growing season for agricultural crops, with potential increased need for irrigation; increased incidence of exotic plants, animals and insects; changes in the plant composition of the boreal forest; and increased thawing of permafrost. Our preliminary, qualitative analysis shows the areas that appear to be most vulnerable to climate change are air quality and forestry, with vulnerability also indicated in the spheres of hydrology/water resources, wildlife and fish, and public health.

There is a need for immediate action in all aspects of Borough administration and operations, and within community groups, to address climate change effects currently being experienced in Interior Alaska. There is also a need for long-term strategic planning to address larger potential impacts, adaptations, and opportunities related to climate change.

Multiple opportunities exist within the built environment for climate change mitigation, in the reduction of greenhouse gases. Some of these measures may also benefit the Borough in terms of PM 2.5 compliance and energy and cost saving opportunities.

In particular, the Borough is uniquely positioned to: (1) implement local energy conservation and air quality control, both as a cost-saving measure and to encourage individuals and businesses to follow this example; (2) educate the public about actions they can take in support of an FNSB climate change resilience plan; (3) coordinate with state and federal agencies and the university to be part of a more consistent and comprehensive effort regarding climate change in Interior Alaska; and (4) develop medium- and long-term actions that should be part of an overall climate change resilience plan. Such actions may be more costly in terms of time and expense but could be phased in gradually (e.g. LEED standards for new and renovated buildings, zoning and transportation development plans, fuel-reduction efforts, flood adaptation measures). Additional economic analysis is needed to calculate pay-back period for these investments.

Introduction

Mission, Members, and Process

The Interior Issues Council Climate Change Task Force (IIC-CCTF) is a volunteer group of citizens and public employees collaborating to establish and build a sustainable, climate-resilient community through education, public outreach, and Borough-wide actions. The group was initiated in response to Borough Assembly Resolution 2007-40 (Appendix 1) and in conjunction with Borough membership in the International Council for Local Environmental Initiatives (ICLEI) - Local Governments for Sustainability.

Co-Chairs:

Luke Hopkins, Fairbanks North Star Borough (FNSB) Assembly, Alaska Municipal League.

Sarah Trainor, Alaska Center for Climate Assessment and Policy (ACCAP) and the Scenarios Network Planning for Alaska (SNAP), UAF.

Karl Monetti, VMD, Retired. Member of Interior Issues Council Cost of Energy Task Force and the Northern Environmental Center Board of Directors.

Core Sector Group Members:

Doug Braddock, Kathryn Dodge, Suzy Fenner, Lori Hanneman, Bob Henszey, Bernardo Hernandez, Mindy Juliana, Mike Musick, Gary Newman, Lena Perkins, Bill Sackinger, Mary Shields, Kraig Smyth, Bill Stringer, Robert Wheeler.

Participants:

The following people participated in at least one of our meetings and/or served as reviewers for preliminary reports.

Clint Adler, Rich Boone, Larry Bright, Allison Butler, Peggy Carlson, Cathy Cahill, Terry Chapin III, Jessica Cherry, John Davies, Cindy Fabbri, Bud Fate, Josh Foster, Sarah Fowell, John Fox, Nancy Fresco, Steve Haagenson, Sherrie Hadley, Angie Hawks, Alan Head, Margit Hentschel, Larry Hinzman, Todd Hoener, Barry Jennings, Ron Johnson, Scott Johnson, Phil Kaspari, Jim Loftus, Steve Lundgren, Markus Mager, Chris Maisch, Sue McCullough, Paul Metz, Glen Miller, Randall Miller, Jewelz Nutter, Bradley Oen, Tom Paragai, Pete Pinney, Will Putman Zach Richter, Ann Ringstad, Michael Schmetzer, Rich Seifert, Andrew Seitz, Karina Selby, Amy Shatzkin, Elena Sparrow, Steve Sparrow, Susan Stithum, DeLaina Storhok, Kaarle Strailey, Terry Strle, Amy Tidwell, David van den Berg, Nancy Wagner, John Walsh, Jim Whitaker, Dan White, Jack Wilbur, Susan Willsrud, and Jen Yuhas.

We thank Nancy Fresco of SNAP, Brook Gamble, Eunkyoung Hong, and Tracy Rogers of ACCAP, DeLaina Storhok of Fairbanks Economic Development Corporation and Megan Boldenow, for their assistance in writing and editing sections of this report.

Climate Change in Interior Alaska – Challenges and Opportunities

We are already observing climate change in Interior Alaska, and scientists project that the observed trends will continue. Based on review of all scientific research to date, the Intergovernmental Panel on Climate Change (IPCC) finds global climate warming "unequivocal." [1] Regardless of the cause of this warming, even with

[1] See page 7 under "A Note about Mitigation and Adaptation" for more information about the IPCC and their conclusions.

moderate greenhouse gas emission scenarios, scientists project further temperature increases in Alaska over the next 100 years.

According to the University of Alaska Fairbanks (UAF) Alaska Climate Research Center, the average annual temperature in Fairbanks has been increasing since 1906, with more frequent high mean annual temperatures and less frequent low mean annual temperatures (Fig. 1). In addition, a shift in the Pacific Decadal Oscillation (PDO) that occurred in the late 1970s has had a large impact, with particular respect to winter temperatures, in Alaska.[2] It is possible that the PDO will shift into a cooler phase within the next decade. However, even taking into account natural variability in the climate system, including the PDO, there is an approximately 70% probability that the next decade will be warmer than the preceding decade (J. Walsh personal communication, Oct. 2009, research in progress).

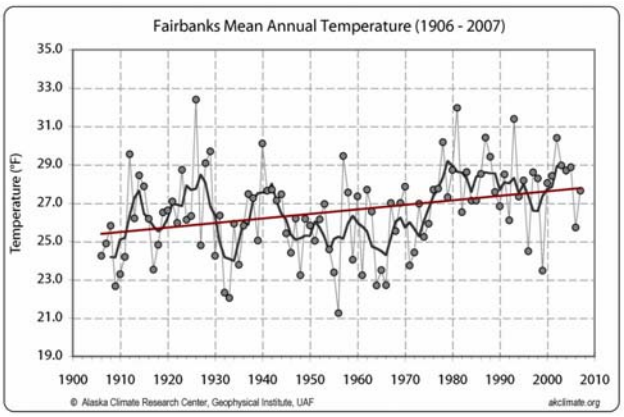

Figure 1: Fairbanks Mean Annual Temperature (1906 – 2007).
Source: Alaska Climate Research Center, UAF. The black line shows the ten-year running mean.

Such warming has tangible consequences for all Alaska residents. Two of the three most extensive fire seasons on record occurred in 2004 and 2005, and increasing temperatures will continue to bring more frequent large fire years. Other expected impacts include changing seasonality; changes in vegetation, including the potential for increased invasive species occurrences; and changes in wildlife habitat and migration patterns.

Climate change will also bring economic opportunity. Scientists have already observed a 50% increase in growing season in Fairbanks since 1904 (Fig. 2) and an increase in favorable weather for tourism in shoulder seasons (Fig. 3). Climate change will also have less direct economic consequences in Interior Alaska. It is likely that the federal government will adopt mitigation policies and actions aimed at carbon reductions, cap & trade, and carbon sequestration. This may initially lead to economic challenges but could create opportunities in new markets, such as carbon sequestration, energy efficiency, building energy retrofits, green building, and renewable energy industries. In addition, with increasing energy costs, Borough citizens and businesses will benefit from policy and action to implement cost savings and energy efficiency.

[2] Hartmann and Wendler. 2005. The significance of the 1976 Pacific climate shift in the climatology of Alaska. J. Climate, 18:4824-4839. Shulski M. and G. Wendler, 2007. *The Climate of Alaska*, University of Alaska Press, 216 pp.

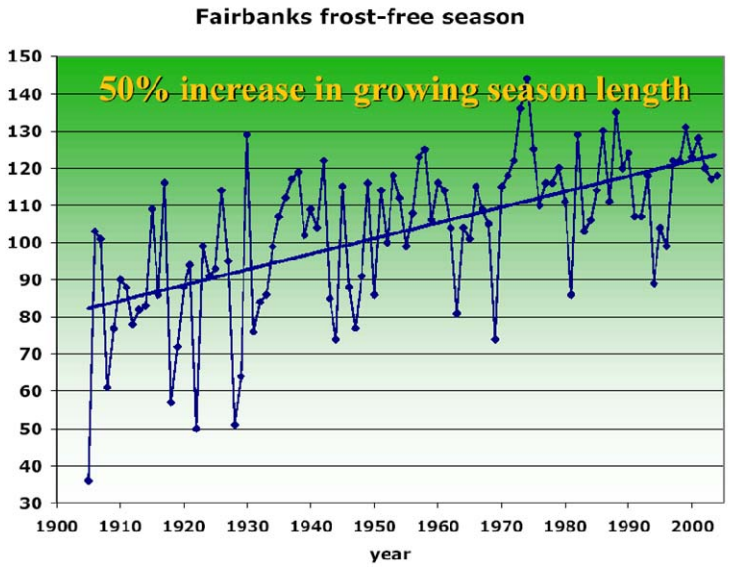

Figure 2: Fairbanks Frost-Free Season

In Fairbanks, the number of consecutive days with a daily minimum temperature of 33 degrees F or greater has increased by 50% since 1904. (Graph courtesy of Glenn Juday, UAF.) Data are from the National Weather Service: 1904-1948, University Experiment Station; 1948 to present, Fairbanks International Airport.

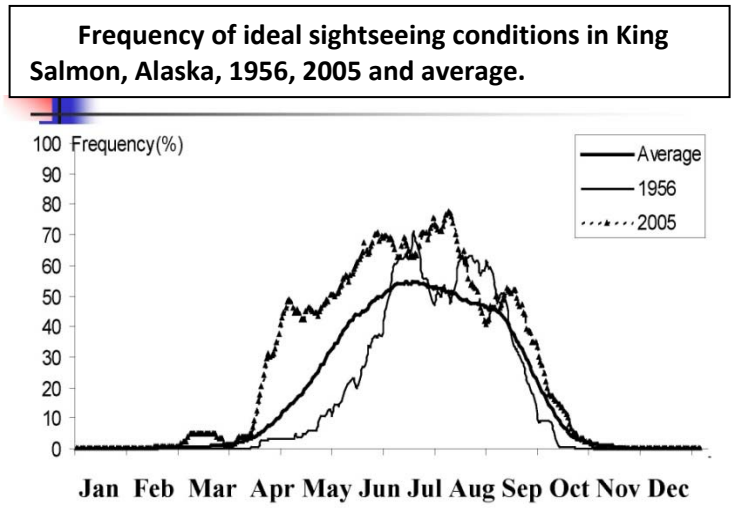

Figure 3: Frequency of ideal sightseeing conditions in King Salmon, Alaska.

Temperatures in Alaska since 1949, by season, show a warming trend in interior and coastal locations for winter, spring, and summer, while autumn shows no trend. Climate can affect the seasonal frequency of ideal sightseeing conditions. For example, in King Salmon, when the frequency of ideal conditions in 1956 is compared with 2005, data shows the season starts earlier in 2005. The time difference is as much as a couple of months. These two years were chosen as an example because they are known extremes. The average is calculated for the years 1940 – 2005. [3]

[3] Yu, Zvi and Walsh. 2009. A weather-resolving index for assessing the impact of climate change on tourism related climate resources. Climatic Change, 95:551-573.

Developing a Climate Resilience Action Plan – Responding to Climate Change Challenges and Opportunities

The IIC-CCTF was formed in February 2008 and has been meeting bi-weekly to monthly in working groups and as a whole. IIC-CCTF has followed the Five Milestone Plan developed by ICLEI- Local Governments for Sustainability. This plan has been used in similar efforts throughout the world (Appendix 2). We have used "Preparing for Climate Change: A Guidebook for Local, Regional and State Governments" as a rough guide for our process. We have consulted with Margit Hentschel, Climate Protection Services & Sustainability Director, Walsh Environmental and former Project Officer, ICLEI and Amy Shatzkin, Project Officer, ICLEI Northwest Regional Office.

Working groups were formed for natural systems, socio-economic systems, and the built environment. These groups have performed preliminary analyses on their respective subject areas, presented in the sector reports below.

The categories covered by each sector (natural, built, and social) were determined and defined by the group members. The natural systems sector includes air quality, energy production, forestry, hydrology, mining, soil, wildlife, and fish. The built environment sector includes vertical component, horizontal component, public and private buildings, utility corridors, transportation corridors, sewers, airports, landfills, and transportation. The socio-economic sector includes public health, economic development, and outreach and education.

We have been engaged in this process for over 14 months. In this period the processes of climate change vulnerability assessment and adaptation planning has evolved rapidly in Alaska and throughout the world. Most notably for Alaskans, the Governor's Sub-Cabinet on Climate Change has been engaged in a rigorous process for both adaptation and mitigation planning statewide. We have done our best to make this report as up-to-date as possible and strongly recommend that the Borough work closely with the State Sub-Cabinet on Climate Change and in particular with the Adaptation and Mitigation working groups' recommendations to learn more from their analyses, followed by implementation of appropriate recommendations and ongoing monitoring of their effectiveness.

A Note about Adaptation and Mitigation

Unlike other communities and community groups who have followed the ICLEI Five Milestone Plan, we have attempted to address climate change mitigation and adaptation together in the same process.

Mitigation

Throughout this report, **mitigation** refers to actions taken to reduce green house gas emissions, thereby taking steps to reduce the main driver of climate change. In many cases, these actions also result in mid- to long-term cost savings.

The Intergovernmental Panel on Climate Change (IPCC) is a politically neutral group of top-notch scientists from around the world who have synthesized, in a series of reports, all scientific and technical information about climate change available to date. IPCC reports reflect differing perspectives that exist within the scientific community. In their most recent report (2007), the IPCC has determined that:

1. "warming of the climate system is unequivocal" (p. 5);
2. there is "*very high confidence*" that this warming is a result of human activities that release carbon dioxide and other gases (p. 3); and

3. "global increases in carbon dioxide concentration are due primarily to fossil fuel use and land use change" (p. 2).

Reducing fossil fuel use, decreasing emissions of greenhouse gases (carbon dioxide, nitrous oxide, and methane), and addressing land-use change are important ways to **mitigate** human impacts on the climate system. If we do not reduce our emissions, we will experience "further warming" and emissions will "induce many changes in the global climate system during the 21st century that would *very likely* be larger than those observed during the 20th century" (p. 13). [4]

Adaptation

In this report, **adaptation** refers to actions taken to respond, plan, and prepare for expected, unavoidable changes due to a warming climate.

The northern latitudes are experiencing climate warming at rates nearly twice that of other parts of the globe. These changes at high latitudes are expected to continue more dramatically than at other latitudes. Because carbon dioxide and other gases remain in the atmosphere for a period of time after input rates have been reduced, we will continue to experience the biophysical impacts of climate change even as we reduce our emissions. It is therefore important to plan and prepare for the continued, unavoidable, anticipated changes.

Definitions

Vulnerability to climate change depends upon exposure, sensitivity, and capacity to adapt. Alaska is exposed to some of the most rapid climate changes on the planet.[5] Thus, on a local scale, the most relevant questions are: how sensitive are the social, natural, and built systems to climate change; and how well can they adapt to anticipated changes. We have used the following definitions, originally printed in "Preparing for Climate Change: A Guidebook for Local, Regional and State Governments." [6]

Sensitivity is the degree to which a built, natural, or human system is directly or indirectly affected by changes in climate conditions (e.g., temperature and precipitation) or specific climate change impacts (e.g., decreased water availability, increased fire frequency). If a system is likely to be affected as a result of projected climate change, it should be considered sensitive to climate change. **Adaptive Capacity** describes the ability of built, natural, and human systems associated with a given planning area to accommodate changes in climate with minimum disruption or minimum additional cost. **Vulnerability** refers to the susceptibility of a system to harm from climate change impacts. Vulnerability is a function of a system's sensitivity to climate and the capacity of that system to adapt to climate changes. In other words, systems that are sensitive to climate and less able to adapt to changes are generally considered to be vulnerable to climate change impacts. In this report, we also consider external, non-climate related factors that may impact the system's adaptive capacity and vulnerability.

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[4] Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K.B. Averyt, M. Tignor and H.L. Miller (eds.) (2007). IPCC, 2007: Summary for Policymakers. In: Climate Change 2007: the Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge. U.K. and New York, NY, USA. Available at: http://www.ipcc.ch/pdf/assessment-report/ar4/wg1/ar4-wg1-spm.pdf. More information about the IPCC is available at: http://www.ipcc.ch/organization/organization.htm.

[5] ACIA, 2005.Arctic Climate Impact Assessment. Cambridge University Press, 1042p. http://www.acia.uaf.edu

[6] http://cses.washington.edu/cig/fpt/guidebook.shtml; King County, Washington and Climate Impacts Group 2007

Climate Change in the Fairbanks North Star Borough

The University of Alaska Scenarios Network for Alaska Planning (SNAP, http://www.snap.uaf.edu/) provides predictions of how global climate change may impact Alaska's climate. Communities, businesses, and agencies work with SNAP to link these projections to ecological, social, and economic changes and to plan for the future. Projections are derived from General Circulation Models (GCMs) used by the Intergovernmental Panel on Climate Change (IPCC). Dr. John Walsh et al. analyzed each model's performance and selected the five models that provide the most accurate results for Alaska and the far north. Results are scaled down to match local conditions using data from Alaskan weather stations and the PRISM model, which interpolates from weather station data, taking into account topographic and geographic features. Further modeling can be used to link basic climate projections to factors such as ecosystem shifts, forest fires, agricultural opportunities, risks to infrastructure, and movement of game animals.[7]

Based on these modeling results, SNAP projects that over the next century average temperatures in Fairbanks will increase by roughly 10-15°F in winter and 5-10°F in summer. We can expect average temperatures in April and October to shift from historically below freezing to above freezing in the future (see Fig. 3). In the next 20 years we can expect twice as many 85°F days each summer (about 7 total), and by 2100 this will double again (see Fig. 4). In the next 20 years, the number of days above freezing between December and February will increase from an average of 3 to 5 and to an average of 6 by 2100 (see Fig. 5). We can expect more precipitation year-round (see Fig. 6). However because of hotter weather, an increase in overall drying and an increase in extreme fire seasons are expected (see Fig. 7)[8]. Flooding will be slightly more likely (see Fig. 8).

These projections can be used to help answer questions that have important ramifications across a wide range of management choices such as land use planning, industry, and infrastructure. For example, how should infrastructure and zoning be planned to deal with thawing permafrost? How can we plan for increased fire risk? How much will the growing season increase in Fairbanks, and what new crops may become viable? How will climate change impact local ecosystems and species of interest such as moose?

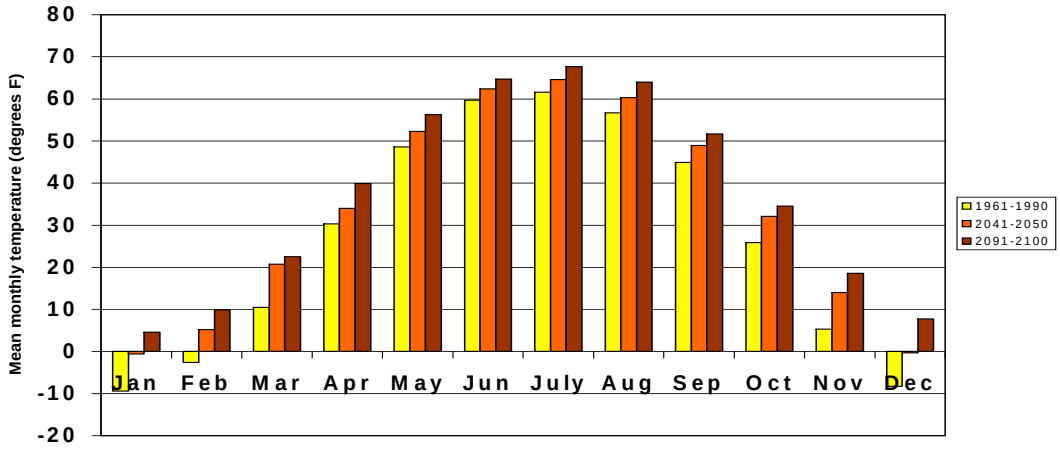


Figure 3: Historical and Projected Mean Monthly Temp

[7] Walsh, J. et al. 2008. Global Climate Model Performance over Alaska and Greenland Journal of Climate. v. 21 pp. 6156-6174. See also documents available at: http://www.snap.uaf.edu/downloads/fact-sheets-and-short-documents-0 for more information about SNAP projections and how they are calculated.

[8] See also O'Brien. Climate Change Impacts on Water Availability in Alaska. Available at: http://www.snap.uaf.edu/downloads/climate-change-impacts-water-availability-alaska.

Historical and projected mean monthly temperature for Fairbanks. Mean of five selected GCMs downscaled using PRISM. Graph provided by Scenarios Network for Alaska Planning (SNAP).

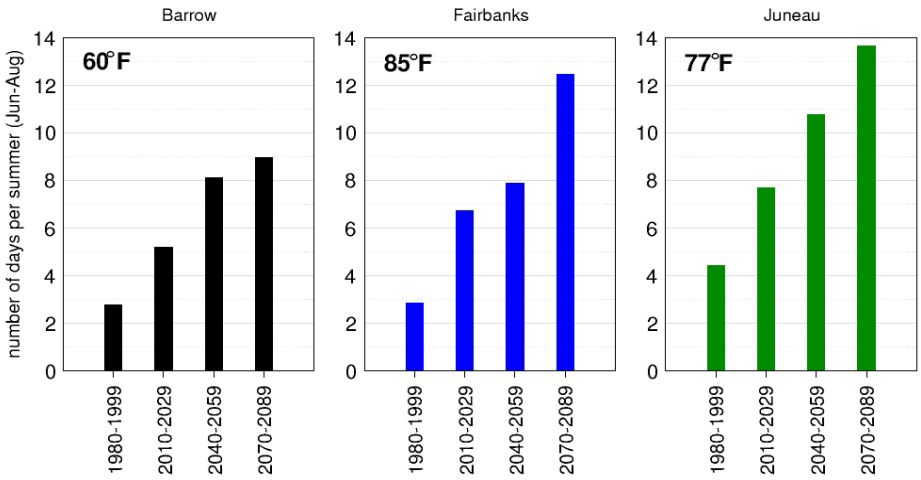


Figure 4: Number of Hot Summer Days in Future FNSB
Increase in number of projected future hot summer days in Barrow, Fairbanks, and Juneau. (Graph provided by SNAP.)

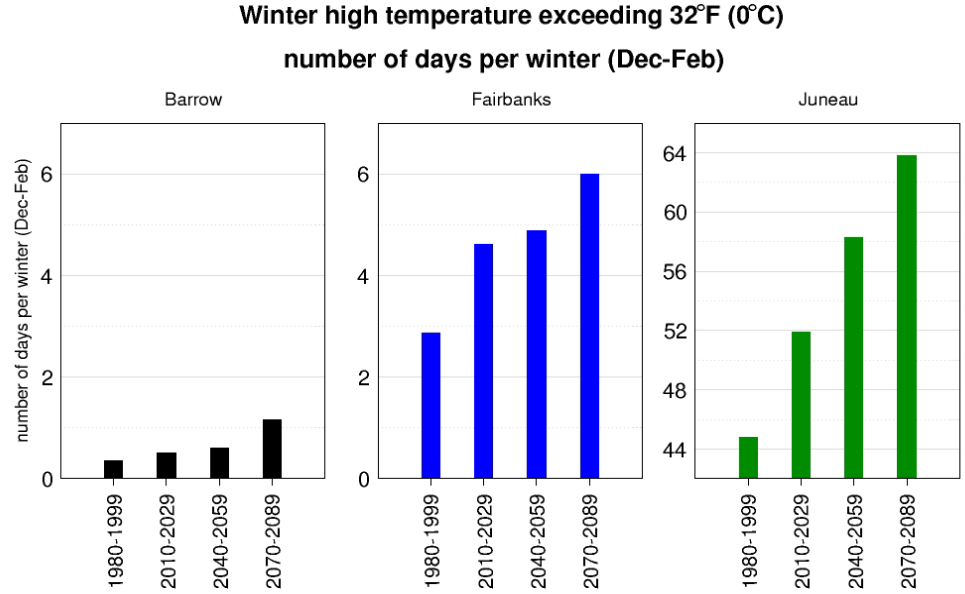


Figure 5: Winter Thaw Days
Winter thaw days are expected to increase in Barrow, Fairbanks, and Juneau. (Graph provided by SNAP.)

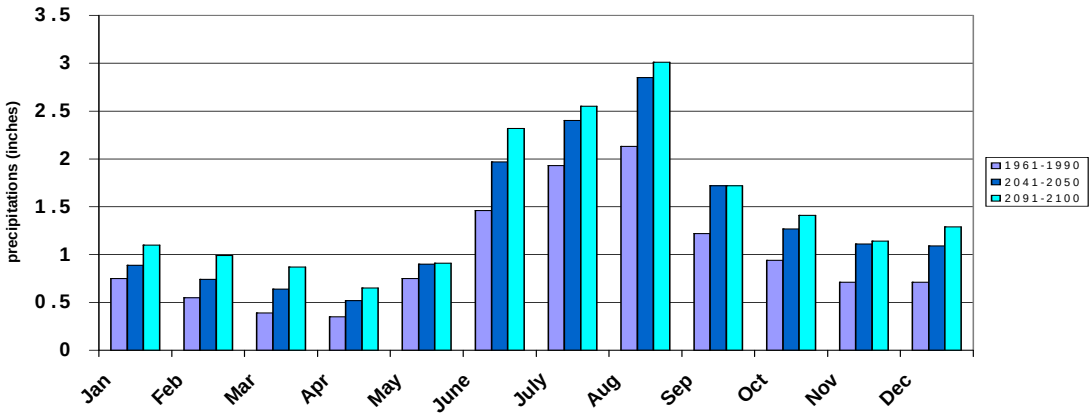


Figure 6: Historical and Projected Mean Monthly Precipitation for Fairbanks
Historical and projected mean monthly precipitation for Fairbanks. Mean of five selected GCMs downscaled using PRISM. (Graph provided by SNAP.)

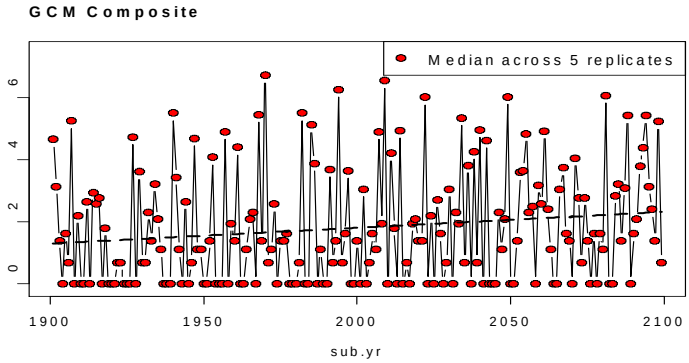


Figure 7: Fire Frequency and Area Burned
Model results project that with climate change, years with large areas burned will be more frequent, and the area burned per season will increase dramatically. This graph shows a projection of area burned in the Fairbanks North Star Borough (presented in log scale), calculated by using a composite of the 5 GCMs that perform best in Alaska and northern latitudes. (Graph provided by SNAP.)

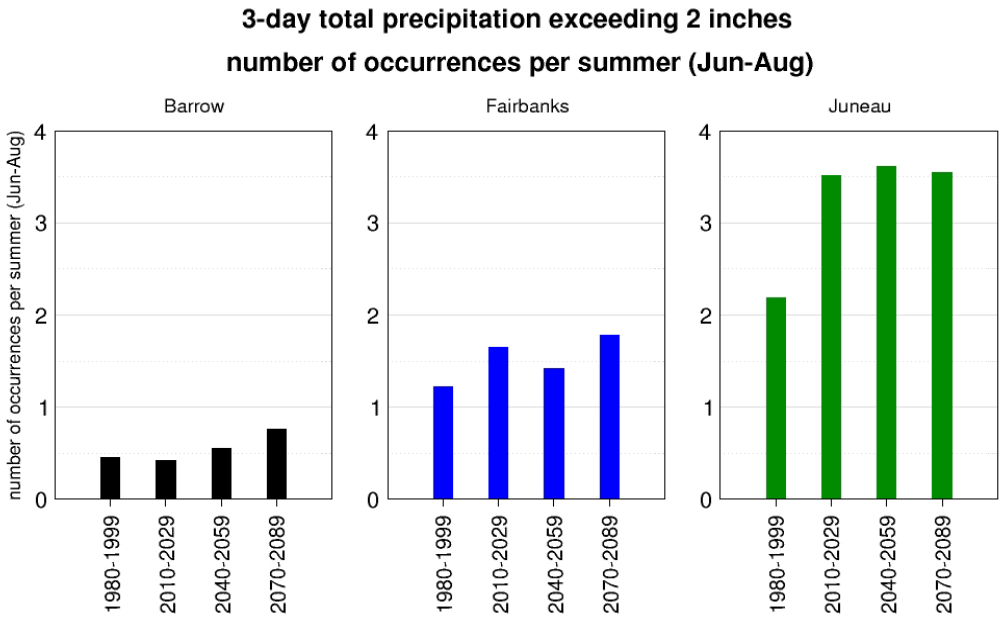


Figure 8: 3-Day Total Precipitation exceeding 2 Inches Occurrences
Flooding will be slightly more likely in Barrow, Fairbanks and Juneau. (Graph provided by SNAP.)

Prioritized Recommendations (June 8, 2009)

The following recommendations were arrived at after in-depth consideration in the natural, built and social sectors (Appendix 3). A public meeting was held in June 2009 to prioritize recommended actions. The following recommendations are the outcome of this meeting.

General

Short-Term Recommendations (1 year)

1. We recommend that the FNSB incorporate climate change mitigation and adaptation as part of all of its planning, operations, and decision-making.
2. One way to accomplish this is to establish a new position on Borough staff as climate change advisor to serve as a resource to existing Borough programs and staff as they enfold planning for climate change. We recommend this person serve as advisor for mitigation and greenhouse gas reduction, which would dove-tail with work reducing cost of energy, energy conservation, recycling and reduction of PM2.5. This person could also be assigned as advisor to incorporating climate change adaptation into Borough planning and business, school district curriculum development, and community outreach. This position should coordinate closely with the state climate change adaptation efforts.
3. As part of public outreach and education, hold public meetings to develop locally appropriate climate change adaptation plans. Information-sharing would provide a mechanism for communities to learn from approaches that have proven successful in other communities.

- Support University public outreach in climate change impacts and adaptation, including climate-change courses targeted at teachers and natural resource managers. This could involve the Alaska Center for Climate Assessment and Policy, the Scenario Network for Alaska Planning, and the Co-Operative Extension.
- Minimize paper waste.

Mid-Term Recommendations (3-5 years)

- Encourage the legislature to adjust financial incentives to encourage values other than development of every parcel as the highest and best use. Utilize revenues to preserve areas that might be better suited to agriculture, green space, or watershed protection.
- Encourage state, federal and local policies that will lead to waste reduction and recycling. Institute a comprehensive, sustainable recycling program.
- Continue to monitor the scientific results of climate projections and their implications and include in annual economic development strategic planning efforts.

Long-Term Recommendations (5-10 years)

- Continue to monitor the scientific result of climate projections and their implications and include it in annual economic development strategic planning efforts.

Natural

Short-Term Recommendations (1 year)

1. Pursue the development of fuel breaks and reduction of spruce dominated stands in fuel control zones in possible conjunction with biomass harvest for energy production. The development of shaded fuel breaks dominated by hardwoods will serve to reduce fire risk. Investigate opportunities for prescribed

fire or fuels management to preserve organic layer (control carbon emissions, opportunity for cap-and-trade.)

2. Advocate for a distributed archive, analysis and interpretation of climate change data at the University of Alaska, including communication of information to planners and decision-makers.
3. Work with land managers to plan for adaptation to climate change in our natural environment such as invasive species in riparian corridors.
4. Coordinate with State Division of Forestry for public education related to fire management plans for effective control of wildfires in protection zones near communities along with focus on removal of hazard fuels, prescribed fire, and emergency evacuation plans.
5. Evaluate climate impacts on biodiversity, sustainable forest use plans, and practice.

(Remaining recommendations – in order of votes)

- Work with Scenarios Network for Alaska Planning (SNAP) to consider landscape change in land use planning.
- Encourage utilities to generate electricity from carbon-free sources, such as solar, wind and environmentally acceptable hydro. (This does not include nuclear, as storage of long lived toxic waste remains unsolved.)
- Place extra protective efforts on critical spawning areas and nursery areas. But if an area is actually drying, or prone to disastrous events such as floods or wildfire, there is not much that we can do to protect these critical areas.
- Encourage distributed/on-site solar and wind production for electricity and heating.
- Convert dead and dying trees into value added wood products, wood composite deck materials, fuel pellets, furniture and house or saw logs.
- Investigate opportunities and necessities for planting new species in anticipation of ecosystem change.
- Update Borough flood plans to accommodate more frequent floods and higher water levels.
- Update and make available map of current permafrost sensitive areas. This map will need to be updated regularly to account for rapidly changing conditions.
- Prepare to provide public buildings as “clean-air” spaces for emergency air quality situations such as wildfire smoke.
- Education of the public about what they can do in their own homes and lives to improve air quality and reduce exposure to poor quality air.

Mid-Term Recommendations (3-5 years)

1. Evaluate risks and vulnerabilities to food security in the Borough, including food costs related to shipping.
2. Identify and create opportunities and incentives for the production and purchase of locally produced goods (including forest products and biomass) and locally grown foods.
3. Recognize the need for and incorporate adaptive management principles into Borough land use planning.

Long-Term Recommendations (5-10 years)

To be developed.

Built Environment

Short-Term Recommendations (1 year)

1. Reduce energy use. Mitigation goals may be achieved through reductions in energy consumption. Consistent with the Cost of Energy Task Force reports, we recommend that reducing energy use is a win-win action that can simultaneously reduce cost of energy and greenhouse gas emissions.

2. Adopt best practices green (preferably LEED) building code for all new borough buildings. For 5-10% increased up front construction costs, expect 20-50% lower operating expenses over the life of the building. Healthier work environments also lead to fewer absences, and a more productive and pleasant work place (USGBC).

3. Analyze the potential in the economic development sector for opportunities in mitigation such as renewable energy development and job creation in weatherization and energy efficiency retrofit.

4. We recommend that all consideration for local energy production, including coal to liquid technology, be evaluated for its potential to reduce greenhouse gas emissions and that this criteria be used in prioritizing future plans for energy production in the Borough.

5. Emissions Target. We recommend that the Borough set a target for reducing emissions and review this target bi-annually to account for continuous improvements in technology and possible future federal legislation. A cost/benefit analysis on emissions reductions is advised to identify the most cost effective measures and to serve as a basis for review and revision of emissions targets. These efforts should be linked to the Cost of Energy Plan utilization charts and the Borough Greenhouse Gas inventory. Ultimately, we recommend that the Borough aim for a carbon neutral economy.

6. Conduct energy rating on every publicly owned or leased building; implement the advice gained, one building at a time. Local governments should actively pursue energy retrofits for all buildings in their jurisdictions to reduce energy consumption. (Expect to reduce energy use by 25-50%. Upfront costs are moderate to high, but in most cases will be repaid with the savings on energy consumption).

7. Provide enhanced year-round public transportation
    a. Create incentives for workplaces to offer public transportation incentives to their employees.
    b. Bus fleet could be expanded with smaller buses and fueled as efficiently as possible. Hybrids and hybrid-electric may become feasible.
    c. Allow for flag stops on rural routes.
    d. Bus routes between Interior communities and Anchorage area should be explored for non-governmental investment.
    e. To encourage bus use, the FNSB bus fleet could utilize GPS to broadcast their locations at major bus stops and on the internet.
    f. Re-investigate feasibility of allowing adults on school buses.
    g. Continue reduced cost or free use of public bus system

8. Support revision of the Environmental Atlas of Alaska used as design standards for engineers working in the Borough. New construction should use these revised standards to account for changing temperature and precipitation.

9. Increase the extent of bike paths and walking route (e.g. construct bike paths with new roadways and existing and future major rehab efforts).

10. Adapt and adopt Homer brochure for employees (See Appendix 2).

11. Adopt regulations for new wood/pellet fired boilers to comply with PM2.5.

(Remaining recommendations – in order of votes). Many of these suggestions are relatively low effort and low cost steps.

- Conduct a GVEA electrical use assessment of every FNSB building and rectify all shortcomings. (GVEA estimates 10-15% average savings in electrical costs.)
- Idling at intersections could be reduced by requesting DOT install right turn pockets and roundabouts wherever possible.
- Program all Borough computers and similar electronics to shut down after 20 minutes of non-use. The Municipality of Anchorage saves $40,000 annually with this practice (Randy Virgin, Economic and Community Development, Municipality of Anchorage).
- Replace street lights and traffic lights with LED fixtures. Evaluate which street lights can be safely switched over to LED. Evaluate long-term cost savings of installing fixtures to reduce light pollution (from Randy Virgin).
- Install occupancy or motion sensor lights in all public buildings. Reduce unnecessary lights at night to the extent possible for safety.
- Work with the Alaska Railroad to establish a commuter link between Fairbanks, North Pole, and Eielson.
- Educate the public on proper choice, installation, and use of, wood burning stoves and furnaces.
- For non-transportation lighting (commercial, yard lights, recreational lighting, ski trails, etc.), reduce consumption through planning or building requirements. Rebates for most efficient lighting could be offered. Incorporate into GVEA program.
- Install interval timers on all public parking vehicle plug-in circuits.
- Create incentives for commercial sales of energy efficient appliances, such as refrigerators, freezers, wood stoves, and furnaces.
- Seek partnerships for creative ways to reduce commercial electrical consumption. An example of a challenge might be electronics displays in stores like Sears, Fred Meyer.
- Encourage co-generation from waste heat – e.g. Fairbanks District Heating
- Enforce no idling laws
- Keep bike/walking paths clear to encourage more usage. They are often unusable during winter.
- Participate in and promote these opportunities as they are identified.
- Replace aging borough vehicles with hybrid or electric plug in models.
- Equip public employee parking spaces with timed/interval electrical plug-ins.
- Public information/education to prepare for expected transportation, air quality and insect hazards.
- Work with DOT and ACCAP graduate student, Eunkyoung Hong, to identify and develop plans to mitigate roads roads/airports/bike paths and other infrastructure susceptible to permafrost thaw and flooding.
- Evaluate the potential for climate change impacts on waste containment structures.

Mid-Term Recommendations (3-5 years)

1. Continue public education programs (K-12 and adult) related to the need for energy conservation and efficiency.
2. Modify the FNSB Comprehensive Plan, Platting and Zoning codes to strive for sustainable infrastructure.
3. Coordinate with the State of Alaska and the building trades to educate the workforce and the design professionals to implement efficient and carbon reducing building practices.
4. Encourage utilities to generate electricity from carbon-free sources, such as solar, wind and environmentally acceptable hydro.
5. Modify the property tax assessment system to reward more efficient and carbon reducing building practices for residential AND commercial construction (new and retrofit). Rewards for using fewer materials in building which would encourage smaller homes.

(Remaining recommendations – in order of votes)

- Promote city and town planning to
  - car-pool and ride share
  - reduce levels of individual travel, either distance or frequency
  - encourage production, distribution and sales of local products that do not require shipping (agriculture, value added forest products, biomass for fuels, etc.)
- Continue to employ energy conservation and efficiency techniques.
- Adopt a "best practices" building code suitable to our environment. Identify those areas susceptible to flooding, permafrost and drainage issues; establish building codes that address those areas of concern.
- Encourage distributed/on-site solar and wind production for electricity and heating.
- Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.
- Switch all aging vehicles in the Borough fleet to hybrid or full electric.
- Design and construct new public buildings to green, energy efficient standards.
- Implement energy efficiency and renewable energy development based on cost saving models identified in year one.
- Stress infilling for businesses as well as housing to decrease the need for motorized travel.
- Expand broadband capacity and work with agencies and businesses to encourage telecommuting. Suggestion to encourage downtown development might be a wireless mesh internet network as a combination of free and subscribed access.
- Encourage co-generation from waste heat – e.g. Fairbanks District Heating.
- Create incentives for coal generating plants to reduce emissions based on best available technology.
- Seek partnerships for creative ways to reduce commercial electrical consumption. An example might be creating competitive challenge to reduce electricity consumption in electronics displays in stores like Sears, Fred Meyer.
- Retrofit structures, including lift-foundations (See Built Environment Section)
- Installation of drainage systems and/or retaining walls to reduce landslide threat in highly vulnerable areas
- Monitor changing permafrost conditions in the Borough, especially in areas of new development.
- Implement energy efficiency and renewable energy development based on cost saving models identified in year one.

Long-Term Recommendations (5-10 years)

Develop zoning that encourages more compact development that would facilitate public transportation.

Social

Short-Term Recommendations (1 year)

1. Create, fund, and staff public education programs relating to:
   a. Public information/education to prepare for expected air quality.
   b. Forest fire awareness and control programs such as Fire Wise on individual, local and state levels.
   c. Water pollutants and disease related to water borne vectors
   d. Hazards from venomous and other insects
   e. Winter travel advisories as needed for safe river, road and air travel

2. FNSB should acknowledge and continue to support the work of the superintendent, the school district curriculum administrators, and the science curriculum re-write team.

3. Implement on-going water quality monitoring for rivers and sloughs (public health).

4. Encourage and participate in state-wide conversation about impacts and opportunities from opening the Northwest Passage.

Mid-Term Recommendations (3-5 years)

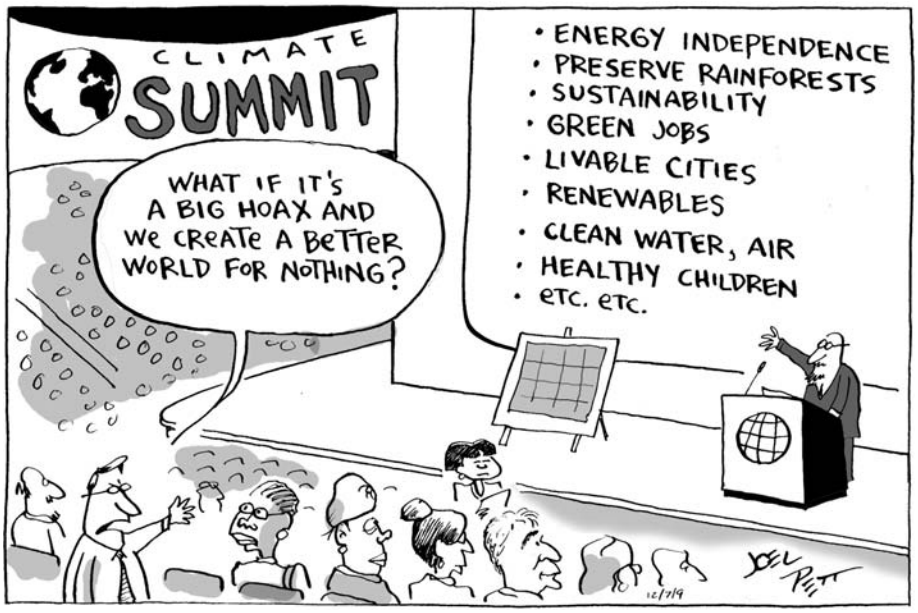
1. Promote increasing opportunities for agriculture with expanding growing season to increase self-sufficiency and reduce product transportation costs. Agricultural experts should be consulted to investigate which crops will perform best in projected temperature and precipitation regime.
2. Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.
3. Continue public education programs (K-12 and adults) related to climate change impacts and adaptation and the need for energy conservation and efficiency and sustainable/green jobs.
4. Support the development of outreach materials about climate change that are effective with the general public (There are many existing programs that are addressing this issue that should be augmented, including University of Alaska Cooperative Extension Service, Alaska Center for Climate Assessment and Policy, Scenarios Network for Alaska Planning).

(Remaining recommendations – in order of votes)

- Investigate options for economic development through carbon sequestration.
- Monitor public health conditions in the borough and create a public health strategy for the borough that incorporates expected impacts from continuing climate change.
- Support research to increase our understanding of climate change impacts on public health in FNSB and Northern latitudes.

Long-Term Recommendations (5-10 years)

- Continue to monitor the scientific result of climate projections and their implications and include it in annual economic development strategic planning efforts.
- Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.



Next Steps

Remaining Tasks:

Milestone 3. Develop an action plan.

The next step of developing an action plan is crucial. Other communities have had the most success in developing and implementing an action plan when they include agency, utility and stakeholder representatives in the process. Information and references on one such effort in New York City can be found in Appendix 4.

Next steps identified at the prioritization workshop on June 8, 2009 are:

1. Workgroups for each sector are to have a chairperson. These workgroups will take the report to 'experts' in the field for review and to ensure that we are giving accurate information.
    a. Built Sector—Chairperson (s) **Karl Monetti** and **Gary Newman**
    b. Social—Chairperson **Mary Walker**
        i. Education—**Mary shields**
    c. Natural Sector
        i. **Phillip Martin** will speak with Bob
        ii. **Meghan Boldenow** will co-chair
2. Vetting and Regroup
    a. W e will have the revised report on the website.
    b. Have a meeting after the week of August 4th.
    c. Revisit the number of priorities.
3. Political
    a. August 19th, the Steering Committee will meet and provide a draft report for the Mayor's review.
    b. We would like to get and office response/endorsement of the draft report.
4. Public Outreach
    a. This needs to be done before the report is sent to the assembly:
        i. Presentations at Rotaries, Lions', Chambers.
        ii. FEDC meetings/conference and other events
        iii. An op-ed in the News-Miner
        iv. An article in Petroleum News.
        v. Other?

Milestone 4. Implement the action plan

Milestone 5. Monitor efforts and re-evaluate the action plan.

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Appendices

Appendix 1: Borough Assembly Resolution September 2007

Fairbanks North Star Borough, Alaska
RESOLUTION NO. 2007 -40
By: Luke Hopkins
Mike Musick
Victoria (Torie) Foote
Valerie Therrien Introduced: 09/13/07
Adopted: 09/13/07

THE FAIRBANKS NORTH STAR BOROUGH RESOLUTION NO. 2007-40
A RESOLUTION COMMITTING TO THE DEVELOPMENT OF A LOCAL CLIMATE CHANGE IMPACT PLAN

WHEREAS, the Fairbanks North Star Borough Assembly has recognized the need to develop a community understanding of the potential impacts, adaptation to, and opportunities from climate change and learn what local actions could be taken and then consider appropriate steps to address these issues; and

WHEREAS, numerous Alaskan commissions and panels charged with identifying Alaska's climate change indicators, have been considering the local impacts measured through research and observations. These include the University of Alaska International Polar Year Scenarios Network for Alaska Planning (SNAP) activities, Alaska Center for Climate Assessment and Policy (ACCAP) research on public infrastructure impact costs, the Denali Commission's community surveys, Governor Palin's Sub-Cabinet Panel on Climate Change, and the Alaska Army Corp of Engineers; and

WHEREAS, numerous University of Alaska scientists have presented information developed from their research that points to both short term and long term impacts to the natural environment and surrounding communities, including forest fire response management; and

WHEREAS, local actions to increase energy efficiency and alternative energy developments are expected to reduce the high cost of energy needed to heat our homes and our businesses and, when incorporated into a borough energy plan that would reduce the use of fossil fuels, will be effective in adapting to climate impacts, producing financial savings, strengthening our economy, improving air quality and lead to a healthier, sustainable community.

NOW THEREFORE, BE IT RESOLVED that the Fairbanks North Star Borough Assembly commits to participate in the Climate Resilient Community five milestone plan and, as participant, will promote public awareness of the benefits of developing and implementing an action plan that improves our local economy, and protects our resources and borough residents.

BE IT FURTHER RESOLVED that the Fairbanks North Star Borough Assembly requests the Mayor to participate in the International Council for Local Environmental Initiatives (ICLEI) Climate Resilient Community grant program to specifically develop our local five milestone plan that includes:

Milestone 1. Study and assess climate vulnerability
The Fairbanks North Star Borough shall work with local and agency experts and University of Alaska scientists to assess vulnerabilities and opportunities associated with climate change.

Milestone 2. Set goals and prioritize

Based on the assessment, the borough shall develop a prioritized list of goals and targets that reduce climate vulnerabilities and enhance opportunities, including goals based on a Borough energy plan that prioritizes cost savings and improvements to air quality (PM 2.5). Acquire commitments from the public and stakeholders to address these goals.

Milestone 3. Develop an action plan

Produce a concise plan that describes the actions and policies for

A) Adapting to climate change by reducing the negative impacts and taking advantage of opportunities, and

B) opportunities made available from reducing the use fossil fuels through alternative energy uses, increases in energy efficiency and conservation. The plan will include a description of timing, financing, and responsible parties. Potential partners from the community include University of Alaska, non-profit organizations, agencies, and private businesses.

Milestone 4. Implement the action plan

Borough administration and potential partners will implement the action plan that includes a time line.

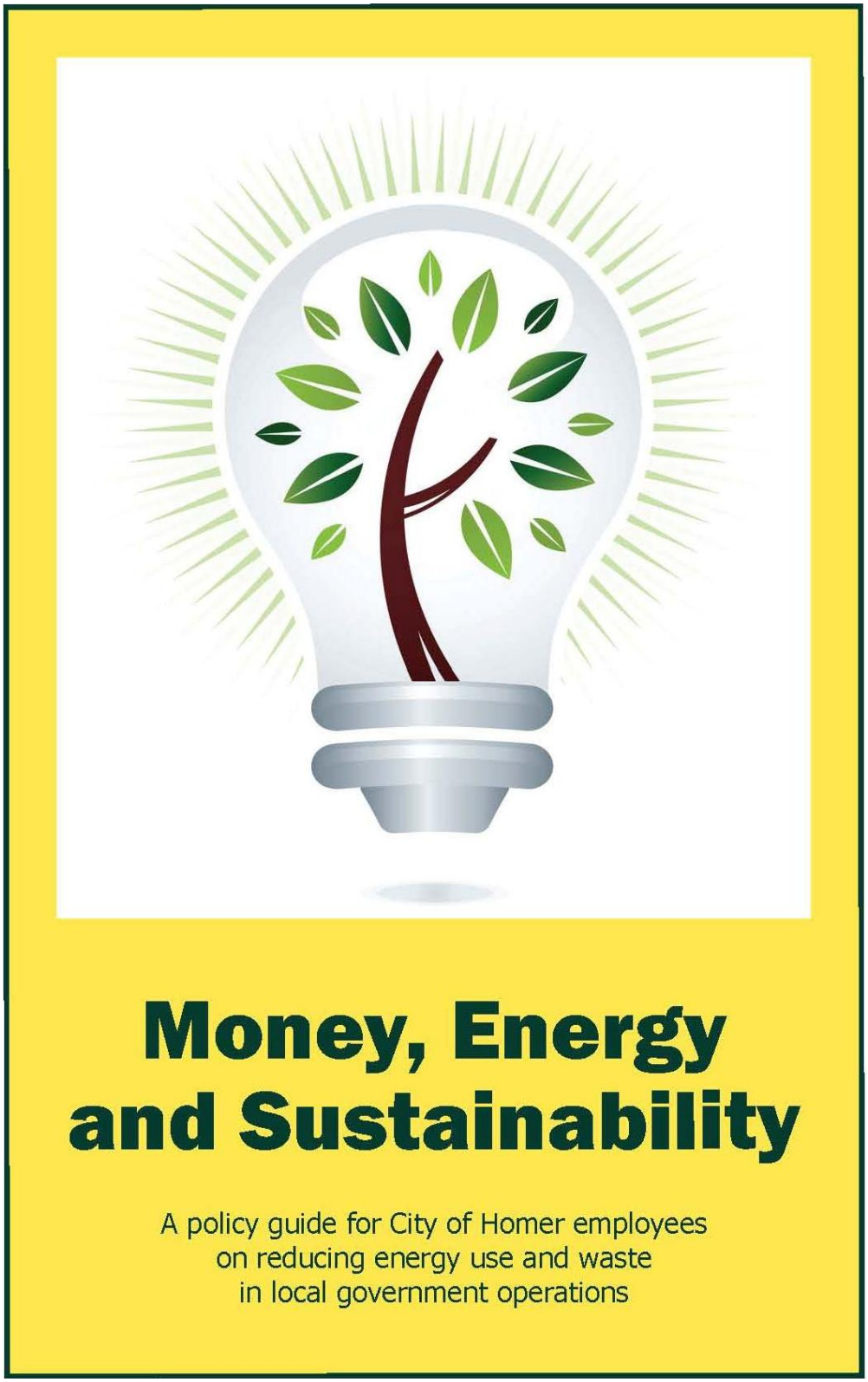
Milestone 5. Monitor efforts and re-evaluate the action plan

Document results and accomplishments toward the goals in the action plan. Re-evaluate, revise, and determine if an alternative approach is necessary to reach the goals set in the action plan. Report updates to the public, local governmental bodies and experts to evaluate progress toward the goals.

BE IT FURTHER RESOLVED that the Fairbanks North Star Borough requests assistance from ICLEI's Climate Resilient Community program as our borough progresses through the milestones.

PASSED AND APPROVED THIS 13TH DAY OF SEPTEMBER 2007.

Ayes: Bartos, Beck, Frank, Foote, Winters, Musick, Therrien, Hopkins
Noes: None
Excused: Rex


Money, Energy
and Sustainability
A policy guide for City of Homer employees
on reducing energy use and waste
in local government operations

(This page will contain one or more graphs or tables which show City energy use and costs by building or department, 2006-2008.)

Dear City of Homer Employee:

This handbook has been prepared to address a number of concerns:

- the escalating costs of energy, from electricity to fuel oil to gasoline, which are impacting municipal programs and services.
- the need to trim costs of local government operations in order to reduce the burden on taxpayers, who are also feeling financially squeezed.
- recognition of the impacts of fossil fuel combustion and depletion on the environment, public health, and national security.

Around the country and around the world, governments, businesses, schools, and households are looking for ways to reduce energy consumption and, in the process, save money. Many are also learning about global climate change, ocean acidification, world oil depletion, etc. and are thinking about the impact our choices today will have on future generations.

What is "sustainability"?

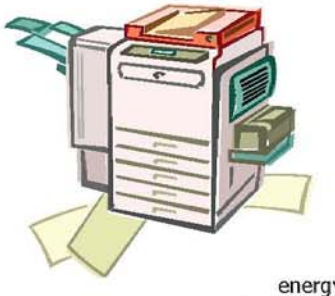
One of the simplest and most often cited definitions of sustainability refers to practices that "meet the needs of the present without compromising the ability of future generations to meet their own needs."
Source: World Commission on Environment and Development—Our Common Future (1987)

Please note that this handbook provides policy guidelines that should be carried out with common sense. It will not be possible or even wise to strictly follow every guideline in every circumstance, particularly when safety, security, or work performance would be unduly impacted. However, refusal to follow guidelines when directed to do so by a supervisor could be viewed as a violation of City personnel policies.

While the policies in this handbook have been prepared specifically for City employees, many of them can also be applied, with little or no modification, to households and businesses. It is our hope that they will be helpful to others beyond the City of Homer workforce.

Ideas for future editions of this handbook are welcome. The most current version of the handbook will be made available on the City of Homer website: www.ci.homer.ak.us.

PART 1: OFFICE AND COMPUTER EQUIPMENT AND APPLIANCES



POLICY: City of Homer employees will, at all times, practice energy conservation measures in their use of all office and computer equipment and appliances.

RESPONSIBILITIES: All City employees are responsible for utilizing City office and computer equipment and appliances in a manner that will ensure maximum energy-efficiency without unduly impacting work performance, safety, or security. Within this framework, the following strategies will be practiced:

- All employees are expected to understand and follow operating and maintenance procedures for the equipment they use.
- Enable all "Energy Star" energy-saving features on personal computers, computer monitors, printers, fax machines, vending machines, copiers, scanners, plotters, etc.
- Set copiers and printers (as default) to make double-sided copies whenever possible.
- Set copiers and printers (as default) to make black and white copies rather than color, unless color is the logical default.

Did you know...?

It costs approximately ten times more to print color copies on one of the City's leased Xerox machines than it does to print black & white copies.

- For desktop computers, set "power options" in the control panel to enable hibernation. Then set "power schemes" (Windows XP)* as follows: Turn off monitor - after 10 minutes. Turn off hard disks - never. System standby - never. System hibernates - after 30 minutes.

  Note: Close network applications such as Outlook and Caselle if you anticipate being away from your computer for 30 minutes or more. *Check with I.T. staff if your computer uses a different operating system. System standby may be more appropriate than hibernation for some older (slower) computers.

- Disable screen savers on personal computers if they interfere with the power options described above.
- Turn off computer monitors that are not Energy Star compliant if inactivity of 30 minutes or more is anticipated.
- Turn off desktop computers, printers, scanners, etc. and shut off power via the power strip/surge protector at the end of each work day.
- Energy efficient equipment and operational features will not be defeated, removed, modified, changed, or discontinued without prior written notification and concurrence of the department director.
- Employees will use refrigerators, microwave ovens, coffee-making equipment, etc. designated for group use rather than keeping such equipment for their own personal use.
- Whenever possible, all printing, copying, faxing, and scanning will be done on centrally located machines unless personal machines are assigned to ensure confidentiality.
- The last person to leave a building (or in larger complexes, a section of a building) should make sure all centrally located office equipment that can be turned off is turned off.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- To the extent possible, and in compliance with procurement regulations, all new computer equipment and appliances purchased will be Energy Star compliant.
- Old energy-inefficient refrigerators will be replaced with new Energy Star refrigerators even if the old refrigerator is still operational.
- Employees will be provided with adequate training to ensure proper use of equipment, including use of energy-saving features.

Did you know...?

Between 2000 and 2008, the average HEA electric bill for the month of October increased by more than 66%, due mostly to increases in the cost of natural gas.

Source: Homer Electric Assoc.

RESPONSIBILITIES OF SYSTEMS MANAGER/I.T. STAFF:

- Maintain a complete inventory of all City computer/printing equipment and utilize a tracking system for repair and replacement.

- Ensure that each office or workstation is equipped with a power strip/surge protector to facilitate turning off power to computer equipment at the end of each work day.
- Schedule computer backups so as not to preclude users from turning off power to computers at the end of the work day.
- Replace older/inefficient power strip/surge protectors, monitors, computers, and printers.
- Ensure that energy saving features are enabled on all computer equipment, including defaults for double-sided and black-and-white printing.
- To the extent possible, and in compliance with procurement regulations, all new computer equipment purchased will be Energy Star compliant.

Common Myths and Misconceptions About Computers and Energy Use

Switching computers on and off frequently reduces their service life. Not true. Today's computers are designed to handle 40,000 on/off cyles, and that's a number you likely won't reach before advances in technology call for replacing the computer anyway.

Leaving a computer on all day uses less energy than turning it off and back on at different periods during the day. Not true. The small surge of power it takes to power up a computer is still much smaller than the amount used to keep it on for lengthy periods.

"Screen savers" save energy. Not true. Screen savers (which don't save screens either) require at least 42 watts of power; those with 3D graphics can draw as much as 114.5 watts.

Your computer uses zero energy when "off." Not true. Unless it's unplugged, the PC utilizes "flea power," or about 2.3 watts, to maintain local-area network connectivity. Likewise, in "hibernate" mode, it uses 2.3 watts. In "sleep" mode, it uses about 3.1 watts. The good news is that computer monitors really do use zero energy when turned off.

Source: "Do you need to turn your PC off at night?" by Monte Enbysk, lead editor for the Microsoft.com network.

PART 2: LIGHTING

POLICIES:

- City of Homer employees will at all times practice energy conservation measures in their use of all City lights.
- Lights in all building areas and workspaces will not be turned on or left on unless needed.
- Exterior lighting systems including but not limited to facade, area, parking, and security lighting shall be controlled by photocells, electronic timers, or other automated control systems. Exterior lighting not required for egress or security will not be operated during daylight hours.

RESPONSIBILITIES: All City employees are responsible for utilizing lights in City buildings in a manner that will ensure maximum energy-efficiency without unduly impacting work performance, safety, or security. Within this framework, the following strategies will be practiced:

- Except for security lighting during non-work hours, all lights will be turned off in rooms that are likely to remain unoccupied for more than 30 minutes. Workers who use offices or shop areas outside of normal hours should minimize unnecessary overhead lighting.
- Use the minimum amount of light needed by limiting the number of lights turned on. Use task lighting instead of overhead lighting when possible.
- Use daylight when possible in place of artificial light sources.

- For maximum light levels, keep lamps, reflectors, shields, and shades clean.
- The last person to leave a building (or in larger complexes, a section of a building) should make sure all lights are turned off, except those deemed essential for security and safety.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- Ensure that all employees are familiar with how the lighting system in their building and workspace is supposed to operate.
- Provide adequate maintenance staff, adequate training for staff, and adequate resources to maintain City buildings for maximum efficiency.

BUILDING MAINTENANCE/PORT MAINTENANCE STAFF RESPONSIBILITIES:

- Evaluate all existing interior and exterior lighting systems to identify opportunities where efficiency can be increased; e.g., through use of Energy Star or LED bulbs and fixtures, motion sensors, or timers.
- Perform lighting replacement and maintenance, including regular cleaning and timely lamp replacement. Group relamping will be implemented wherever feasible, when determined to be cost-effective.

Did you know...?

- If all of corporate America installed energy efficient lighting systems, approximately $250/year in energy costs per square foot of floor space would be saved.
- By switching to LED holiday lights on City Hall, the City of Homer has reduced energy use associated with the lighting by 80-90%. The amount of electricity it takes to light a single 7-watt incandescent bulb lights 140 LED bulbs.

Source: Greenstar.org; Energystar.gov

- Use manual and automatic lighting controls to manage electrical usage during occupied and unoccupied periods.

PART 3: HEATING AND COOLING

POLICIES: The City of Homer will utilize the following strategies to reduce energy use relating to heating and cooling:

- Invest in all energy-efficiency measures pertaining to heating and cooling with payback periods of 10 years or less.
- Conduct energy audits within two years for all City buildings and implement recommendations for weatherization and other measures to reduce energy use.
- Ensure that all new and renovated City buildings are constructed with energy-efficiency and other conservation goals in mind.

RESPONSIBILITIES: All City employees are responsible for utilizing City buildings in a manner that will ensure maximum energy-efficiency without unduly impacting work performance, safety, or security. Within this framework, the following strategies will be practiced:

- Set heating thermostat setpoints to 68 degrees F and cooling thermostat setpoints to 75 degrees F in offices and work areas.
- Keep air registers and vents clear to allow air to flow freely throughout the room.

Did you know...?

Building operation and maintenance programs specifically designed to enhance operating efficiency of HVAC and lighting systems can save 5% to 20% of the energy bills without significant capital investment.

Source: energystar.gov

- Keep all windows closed in City buildings during periods when indoor heating or cooling systems are operating.
- Do not use individual space heaters or air conditioners for heating and cooling.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- Provide adequate maintenance staff, adequate training for staff, and adequate resources to maintain City buildings for maximum efficiency.

BUILDING MAINTENANCE STAFF RESPONSIBILITIES:

- Maximize the use of energy management systems to reduce energy consumption by scheduling shut-down of appropriate HVAC equipment during times when the space served is unoccupied.
- Ensure that up-do-date operational procedures and manuals are available.
- Implement preventive maintenance programs complete with maintenance schedules and records of all maintenance performed for all building equipment and systems.
- Implement a monitoring program that tracks and documents building systems performance to help identify and diagnose potential problems and track the effectiveness of the O&M program. Include cost and performance tracking in this analysis.

PART 4: VEHICLE USE

POLICY: The City of Homer will at all times implement all available fuel conservation strategies for the City fleet, provided such strategies will not disrupt services to the health, welfare, and safety of city residents.

RESPONSIBILITIES: Vehicle operators are responsible for operating City vehicles in a manner that will ensure maximum fuel-efficiency without unduly impacting work performance, safety, or security. Within this framework, the following strategies will be practiced:

- Limit unnecessary trips. Plan trips to minimize mileage.
- Remove extra weight from the vehicle; only carry those items you need.
- Warm up engines on gasoline-powered cars and trucks according to the following guidelines:
  - At temperatures above 20°F, warm up for no more than 30 seconds or as long as it takes to manually remove snow and ice from windows. (In cold weather, longer warm-up times may be appropriate for older vehicles or those that use conventional rather than synthetic oil.)
  - At temperatures of 20°or less, plug in vehicles equipped with engine heaters for 2-3 hours before warming up 30 seconds to 10 minutes, depending on temperature.
- Practice moderation in driving; i.e., do not over-accelerate; avoid constant braking. Drive at or under the speed limit. Try to anticipate stops and let vehicle coast down as much as possible.

NOTE: Employees are urged to use common sense in following all guidelines in this handbook. Guidelines should not be applied so strictly that they unduly impact work performance, safety, or security.

- Keep tires properly inflated. Check pressure once a month and before long trips.
- Take vehicles to Public Works Motor Pool for maintenance as scheduled.
- Do not allow gasoline-powered vehicles to idle for more than 30 seconds, or diesel-powered vehicles for more than three minutes in a 60-minute period, except in the following situations:

- ▷ A vehicle may idle while forced to remain motionless because of traffic congestion, when required to yield right of way to responding emergency vehicles, at an official traffic control device or signal, or at the direction of a law enforcement official.
- ▷ A vehicle may idle to prevent a safety or health emergency.
- ▷ A vehicle may idle to operate auxiliary equipment such as on-board operations for Public Works and law enforcement.
- ▷ An emergency vehicle or any vehicle being used in an emergency capacity may idle while in emergency or training mode.
- ▷ A vehicle may idle for maintenance, servicing, repairing, or diagnostic purposes if idling is required for such activity.
- ▷ See previous bullets regarding engine warm-up time.

- ▶ Use the most fuel-efficient vehicle available that will serve the purpose for any given trip.
- ▶ If so equipped, use overdrive gear at cruising speeds.
- ▶ If so equipped, use cruise control at cruising speeds.
- ▶ Do not rev engine before shutting it off.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- ▶ Develop and implement a plan to retire older less efficient vehicles.
- ▶ Buy the most fuel-efficient vehicle that will meet most of the department needs, and rent other vehicles for infrequent needs.
- ▶ Buy electric, hybrid, or other alternative-fueled vehicles for greater fuel efficiency if available and practicable.
- ▶ Buy 2-wheel drive vehicles unless job or tasks truly require 4-wheel drive.
- ▶ Assign the most fuel efficient vehicles to employees who drive the most miles.
- ▶ Provide adequate motor pool staff, adequate training for staff, and adequate resources to maintain City fleet for maximum fuel efficiency.
- ▶ Ensure that City vehicles are used for work purposes only.
- ▶ Promote teleconferencing as an alternative to driving to meetings.
- ▶ To reduce vehicle miles traveled for employee commutes,

- ▷ promote pedestrian, bicycle, transit, and rideshare options.
- ▷ Make bike parking visible, accessible, and if possible, under cover at all City buildings.

MOTOR POOL EMPLOYEE RESPONSIBILITIES:

- ▶ Monitor the preventive maintenance program to ensure that vehicle maintenance is performed according to established schedule.
- ▶ Keep tires properly inflated and wheels aligned.
- ▶ Track fuel consumption on all vehicles as a means of detecting problems. Monitor and report fuel consumption by department.
- ▶ Use API-certified "energy conserving" motor oil, either conventional or synthetic. Use the service classification and viscosity specified for each vehicle.

Did you know...?

- ▶ An idling vehicle gets zero miles per gallon.
- ▶ Gentle acceleration and braking can improve fuel economy by up to 33%. Slow-and-go (versus stop-and-go) saves fuel because it takes more energy to move a stopped vehicle than to keep a vehicle moving.
- ▶ Every 5 miles over a 60 miles-per-hour speed is like paying an additional 36 cents per gallon for gas (assuming a fuel price of $4/gallon).
- ▶ Today's automobiles using synthetic oil do not need a warm-up period before driving. At temperatures above 20°, running your engine for 30 seconds (just enough time for the oil to circulate throughout the engine) is all you need. Your vehicle will reach its optimum operating temperature much faster when you are driving, rather than idling.
- ▶ You can achieve the same effect as a 50% drop in gasoline prices by driving a car that gets twice the gas mileage as the one you drive now.

Source: fueleconomy.gov and ecodrivingusa.com

PART 5: RECYCLING AND WASTE REDUCTION

POLICY: It will be the policy of all City employees to implement recycling and waste reduction to the maximum extent practicable taking into consideration the amount of recyclables generated in each facility, what materials can be recycled, storage space, and fire and safety regulations.

COLLECTION OF MATERIALS: Materials will be collected where they are generated. This involves placing recycling bins for paper products at each work station, bins for office paper near copiers, containers near printers to collect toner cartridges, bins for glass, aluminum, and plastic in kitchen areas, and bins for cardboard, newspapers, and household batteries in designated central locations. In addition, electronics to be recycled will be stored as necessary and then transported for recycling during the annual Homer Electronics Recycling Event.

RESPONSIBILITIES:

- All City employees will make use of recycling receptacles and programs as much as possible.
- Employees are also encouraged to practice waste reduction by reducing the amount and toxicity of trash thrown away and by reusing containers and products when practicable. Following are suggested practices for conserving valuable resources, saving energy, and reducing waste:
  - Reuse paper clips, folders, rubber bands, and binders.
  - Print and copy only what you need.
  - Make double-sided copies.
  - Conserve paper by reducing printed page margins.
  - Use email or voice mail rather than paper.
  - Use scrap paper for internal memos.
  - Proof documents on screen.
  - Replace fax cover sheets with fax-it sticky notes.
  - Store documents electronically.
  - Reuse file folders - fold them in reverse or cover up old labels with new ones.
  - Reuse envelopes, boxes, and packaging materials.
  - Donate old magazines to hospitals or nursing homes.
  - Route and share newspapers and magazines.
  - Print addresses directly on envelopes instead of using labels.

Recycling collection sites in Homer

The Homer Baling/Landfill Facility (235-6678), operated by the Kenai Peninsula Borough, accepts the following materials for recycling:

Newspaper - Newspapers and inserts only. Place loose in container. Should be clean and dry.

Corrugated cardboard - You can tell corrugated cardboard by the wavy-type layer sandwiched in the cardboard. Should be flattened and placed in metal bin. NO waxed cardboard or paperboard.

Mixed paper - copy paper, notebook paper, greenbar computer paper, envelopes (with or without windows), magazines, catalogs, paperboard (e.g., cereal boxes and milk cartons), fax paper, carbonless paper, manila and bleached file folders, astrobright colored paper, glossy and construction paper, shredded paper, post-it notes, and phone books. Remove paper clips, comb bindings, binder clips, and plastic spouts. Staples are OK.

PETE#1 and HDPE#2 plastic - Look for recycle symbol and imprint on plastic to verify that it is PETE#1 or HDPE#2. Containers should be clean. No chemical containers or plastic tubs.

Used oil - Can leave up to 10 gallons at a time; maximum 25 gallons per month. Oil only. Cannot have water, antifreeze, etc. included.

Household batteries - All sizes/volts.

Vehicle lead-acid batteries - No more than 10 per year. Please ask facility attendant to direct you to battery totes.

Vehicles - Special preparation required. Contact landfill for instructions and forms.

Hazardous waste - Accepted only on designated collection days, four times a year. Check with facility for dates.

Source: http://www.borough.kenai.ak.us/SolidWaste/RECYCLEMAILER.pdf

Containers in the Save-U-More parking lot at 3611 Greatland Street also accept newspaper, corrugated cardboard, aluminum cans, and glass.

Total Office Supply accepts empty toner and inkjet cartridges, all brands. **Tech-Connect** accepts inkjet cartridges on behalf of McNeil School, which collects them for fundraising purposes.

- Mail items in the smallest envelopes or boxes they will fit in.
- Remove your name from unwanted mailing lists.
- Use mechanical pencils and refillable pens and tape dispensers.

(more→)

- ▷ Use overheads or chalkboards instead of handouts for presentations.
- ▷ Return unneeded supplies to the supply closet.
- ▷ Use a washable mug or cup for beverages.
- ▷ Drink tap water rather than bottled water.
- ▷ Bring your lunch in reusable containers or bags.
- ▷ Donate unused prepared food to local food recovery programs.
- ▷ Share other waste prevention ideas with your supervisor.

Major source: epa.gov/epawaste/partnerships/wastewise/checklist.htm

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- ▶ Provide resources for setting up recycling receptacles in all buildings.
- ▶ Assign a designated person or persons (or contract with a local business) to collect and deliver recyclables to appropriate collection centers.

Did you know...?

- ▶ Alaskans generate 6 pounds of trash per person each day, compared to the national average of 4.4 pounds.
- ▶ Americans throw away enough aluminum to rebuild our entire commercial air fleet every three months.
- ▶ The energy saved from recycling one aluminum can will run your TV for three hours.
- ▶ A ton of 100% recycled paper saves the equivalent of 4,100 kWh of energy, 7,000 gallons of water, 60 pounds of air emissions, and three cubic yards of landfill space.
- ▶ Changing the margin default in Microsoft Word from 1.25 inches each side down to .75 inch would reduce paper use by 4.75%.
- ▶ According to the EPA, recycling cuts global warming pollution by the equivalent of removing 39.6 million passenger cars from the road.

Sources: greenstarinc.org, City of Portland Office of Sustainable Development, WashingtonPost.com and the Natural Resources Defense Council

PART 6: WATER USE

POLICY: The City of Homer will at all times practice water conservation measures in the use of water.

RESPONSIBILITIES: All City employees are responsible for utilizing water in City buildings and work processes in a manner that emphasizes conservation without unduly impacting work performance, safety, or security; including compliance with the following strategies:

- ▶ Check for water leaks, report leaks, and request repairs.
- ▶ Consider alternatives to discretionary uses of water that are not related to health and safety. For example, use a broom instead of a hose to routinely clean sidewalks and driveways.
- ▶ Turn off water-using equipment when not in use, including dishwashers, garbage disposals, and food troughs.
- ▶ Do not leave a water faucet running unnecessarily.
- ▶ Do not use more water than necessary for a task.

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- ▶ Work with all employees to develop methods and procedures to reduce water use in kitchens, shop areas, and other sites.
- ▶ Incorporate water-saving strategies in landscaping and gardening projects. (See next page for tips.)
- ▶ Reduce fleet washing or use water reclaim systems. Eliminate car lot washing and hosing.
- ▶ Share water conservation tips with Homer water customers.

Did you know...?

- ▶ Withdrawing less water from streams and lakes helps keep those water bodies healthy.
- ▶ When we use less water, we also use less energy for pumping and treating water, which reduces costs and greenhouse gas emissions.
- ▶ Reducing wastewater means fewer resources spent on collection, treatment, and disposal.

Source: epa.gov/watersense

BUILDING MAINTENANCE/PORT MAINTENANCE STAFF RESPONSIBILITIES:

- Evaluate all existing water systems to identify opportunities where efficiency can be increased.
- Perform maintenance and/or replacement of all leaking water lines, valves, spigots, and other water system components.
- Utilize manual and automatic controls to manage water usage during occupied and unoccupied periods.

Tips for saving water in landscaping and gardening

- Use organic mulch around plants to retain moisture.
- Use drip irrigation for shrubs and trees to apply water directly to the roots where it's needed.
- Reduce the amount of lawn by planting shrubs and ground covers appropriate to the site and climate.
- Choose low water use plants for year-round landscape color.
- Adjust your lawn mower to a higher setting. A taller lawn shades roots and holds soil moisture better than if it is closely clipped.
- Water only when necessary. More plants die from over-watering than from under-watering.
- Use a trowel, shovel, or soil probe to examine soil moisture depth. If the top two to three inches of soil are dry it's time to water.
- Direct water from rain gutters and HVAC systems toward water-loving plants.
- Adjust sprinklers to direct water where it's needed. Avoid watering sidewalks and streets as much as possible.
- Make use of timers to avoid overwatering.

Source: wateruseitwisely.com

PART 7: PROCUREMENT

POLICY: The City of Homer commits to the following:

- To the extent possible, procure products using criteria established by the U.S. Environmental Protection Agency's Comprehensive Procurement Guidelines.
- Procure Energy Star-qualified products when available and practicable.
- Procure environmentally preferable products and services using EPA's Environmentally Preferable Purchasing Program guiding principles:
  - Include environmental considerations as part of the normal purchasing process.
  - Emphasize pollution prevention early in the purchasing process.
  - Examine multiple environmental attributes throughout a product's or service's lifecycle.
  - Compare relevant environmental impacts when selecting products and services.
  - Collect and base purchasing decisions on acurate and meaningful information about environmental performance.
- Integrate environmental factors into the City's buying decisions where external authorities have not established criteria. Examples:
  - Replace disposables with reusables or recyclables.
  - Support eco-labeling pratices by buying products bearing such labels in preference to others, where they are available and provide value for money.
  - Take into account lifecycle costs and benefits.
  - Evaluate, as appropriate, the environmental performance of vendors in providing products and services.
  - Integrate energy efficiency as a requirement in City contracts.
- Raise employee awareness of the environmental issues affecting procurement by providing relevant information and training.
- Encourage suppliers and contractors to offer environmentally preferable products and services at competitive prices.

Examples of products described in the EPA's Comprehensive Procurement Guidelines

- aluminum roofing with recovered materials content of 20-95%
- plastic trash bags with a post-consumer content of 10-100%
- toner cartridges that can be returned when empty for remanufacturing
- bathroom tissue with 20-60% post-consumer fiber
- reprographic (copy) paper with 30% post-consumer fiber
- plastic fencing with 60-100% post-consumer content or 90-100% recovered materials
- fertilizers made from up to 100% recovered organic materials

Source: www.epa.gov/epawaste/conserve/tools/cpg/products

- Encourage providers of services to consider environmental impacts of service delivery.
- Comply with all environmental legislative and regulatory requirements in the procurement of products and services.

Nothing in this policy shall be construed as requiring a department, agency, or contractor to procure products that do not perform adequately for their intended use or are not available at a reasonable price in a reasonable period of time.

More detailed procedures and guidelines may be established as necessary to ensure the continuation of a strong procurement program that saves energy and fuel use and reduces waste.

RESPONSIBILITIES: All City of Homer departments and offices shall identify and purchase products and services that are available for the intended purpose and that meet the performance requirements. Factors that should be considered when determining the preferable good or service include, but are not limited to the following:

- Minimization of virgin material use in product or service lifecycle
- Maximization of recycled products used in product or service lifecycle
- Environmental cost of entire product or service lifecycle
- Reuse of existing products or materials in product or service lifecycle
- Recyclability of product

- Minimization of packaging
- Reduction of energy/water consumption
- Toxicity reduction or elimination
- Elimination of uncertified hardwoods in product or service lifecycle
- Durability and maintenance requirements
- Ultimate disposal of product

CITY MANAGER/DEPARTMENT DIRECTOR RESPONSIBILITIES:

- Develop and maintain information about environmentally preferable products and recycled products containing the maximum practicable amount of recycled materials to be purchased by employees, consultants, and contractors whenever possible.
- Inform employees and contractors of their responsibilities under this policy and provide implementation assistance.
- Institute product testing and trial service to evaluate environmentally responsible alternatives pursuant to established testing guidelines.
- Require the use of recycled materials and recycled products by incorporating them into bid specifications where practicable.
- Disseminate information on recycled and environmentally preferable product procurement requirements, specifications, and performance to assist vendors with procurement opportunities with the City.
- Establish guidelines governing the review and approval of specifications for the procurement of selected materials based on

Sample Energy Star procurement language: *The vendor must provide products that earn the ENERGY STAR and meet the ENERGY STAR specifications for energy efficiency. The vendor is encouraged to visit energystar.gov for complete product specifications and updated lists of qualifying products.*

Sample RFP language: *Our company has adopted policies to support an ethic of sustainability. To advance these goals, products and services contracted for will be evaluated in part based on their environmental attributes. Specific factors to be considered include greenhouse gas emissions, habitat impacts, regulatory compliance, recycled content, energy efficiency, water efficiency, and toxic chemical reduction. Please address these concerns when submitting your proposals.*

Sources: energystar.gov and nrdc.org

considerations of recycling, energy and water conservation, lifecycle costing, and other environmental considerations.

- Submit reports of policy impacts on an annual basis.
- Require a maintenance staff review before purchasing equipment that requires maintenance.

Did you know...?

- Utilizing Energy Star and Federal Energy Management Program (FEMP) purchasing criteria would save $1 billion a year and keep more than 4 million tons of greenhouse gas emissions out of the atmosphere if used by all state and local governments as well as the federal government.
- The old refrigerator in the City Hall breakroom costs $430 a year in electricity*—5.6 times more than a similar sized Energy Star model. A new Energy Star refrigerator will pay for itself in two years, saving taxpayers thousands of dollars over time.
- A typical Energy Star fax machine can cut energy costs by almost 50%. It will also scan double-sided pages, which reduces both copying and paper costs.
- The standard model cold drink vending machine in City Hall costs taxpayers more than $740 a year in electricity.* An Energy Star model would use 50% less energy and keep products just as cold.
- Although paper with recycled content requires less energy and other resources to produce, it generally costs 7-10% more than virgin paper. Much of the cost of virgin paper is hidden, consisting of federal (taxpayer) subsidies to the timber industry. Economies of scale are also more favorable to virgin paper, which is produced and sold in greater quantities. Governments, businesses, and households that adopt recycled paper purchasing policies will help bring costs down by creating a larger market for recycled paper.

Source: energystar.gov; Homer Electric Association; conservatree.org
*Dollar costs reflect January 2009 HEA rate of 21.5 cents per kwH.

This booklet is printed on 100% post-consumer waste recycled paper.

invisible type

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Appendix 3: Climate Change Impacts, Opportunities, and Suggested Planning Actions

This table outlines probable impacts from climate change in the FNSB. We have listed the mechanism for impact, further information or coordination that would be helpful for planning and potential and suggested planning actions. We acknowledge that some of these impacts will affect infrastructure and entities that are outside of FNSB jurisdiction and list likely relevant city, state, and federal entities in the far left column. We encourage the Borough to coordinate with these entities in planning and preparing for expected impacts from climate change.

	IMPACTS	MECHANISM	DATA NEEDED	SUGGESTED PLANNING ACTION
1.	**Public & Private Infrastructure; Facility Administration & Maintenance** FNSB: Departments of Public Works, Solid Waste, and Facilities Maintenance City of Fairbanks: Public Works Department, Building Department State: Department of Transportation and Public Facilities Federal: Department of Transportation	Permafrost thaw – damage to public and private infrastructure (i.e. roads, airport runways, sewer & water systems, buildings, bridges.)	Permafrost Map (B. Henszey) Inventory of infrastructure located on permafrost (ACCAP graduate student Eunkyoung Hong is currently working on related project).	Consider warming temperatures and potential permafrost thaw in land use planning and zoning.
2.	**Emergency Response/Preparedness** FNSB: Departments of Emergency Operations, Public Works, Rural Services, City of Fairbanks: Police Department, Fire Department State: Department of Environmental Conservation, Department of Natural Resources- Forestry, Department of Military and Veterans Affairs, Division of Homeland Security, Department of Transportation and Public Facilities Federal: Department of Transportation	Increased wildfire activity – fire suppression; evacuation, Red Cross, communications, logistics coordination Permafrost thaw - Toxic/hazardous release from compromised tank farms, sewage lagoons, garbage dumps, oil pipeline Changes in seasonality, winter freezing rain events – police and emergency response for traffic accidents Changes in seasonality, warmer spring and autumn temps – emergency response, hazardous travel on partially frozen waterways Changes in precipitation and permafrost thaw – potential flooding	Info from State Forestry re current hazard fuel mitigation plans and projects. Inventory of industry, military and other dump sites located on permafrost. Are current emergency response plans – adaptable to include more readiness? Are flood planners aware of this potential?	Account for expected increased fire, permafrost thaw, changes in seasonality, and flooding in community readiness communication plans. Coordinate with city, state, and federal entities to incorporate climate impacts in emergency management plans.
3.	**Public Health** FNSB: Departments of Emergency Operations, Transportation State: Department of Health and Social Services	Increased wildfire activity – smoke/air quality Insects-There is evidence of increased incidence of hospital reports due to venomous insects in Interior Alaska (Dr. Demain) Disease	Does the Borough have readiness plans for summer heat waves and wildfire smoke refuges? Can we expect additional harmful insects to increase with warmer temps and more precip? To public health? Which disease vectors can be expected to increase with increased temps and precip? How can we prepare for them?	Collaborate with state and federal agencies to incorporate climate impacts into public health plans.

	IMPACTS	MECHANISM	DATA NEEDED	SUGGESTED PLANNING ACTION
			For example, is West Nile Virus a threat?	
4.	**Land Use** FNSB: Departments of Land Management, Public Works City of Fairbanks: Public Works Department State: Department of Environmental Conservation, Department of Natural Resources, Department of Transportation and Public Facilities	Increased wildfire activity – on-going maintenance for hazard fuel reduction Permafrost thaw Changes in seasonality, warmer spring and autumn temps. – changes in vegetation, invasive species	See above re DNR hazard fuel projects	Incorporate expected climate impacts into Borough land use planning and zoning.
5.	**Hydrology and Water Resources** FNSB: Department of Public Works City of Fairbanks: Public Works Department State: Department of Environmental Conservation, Department of Natural Resources	Changes in precipitation and permafrost thaw – water supply and access, water quality; potential flooding (see also Emergency Response)	Are water and sewer lines at risk? Is drinking water supply at risk?	Evaluate climate related risks to water and sewer lines and drinking water quality and supply. Support water quality monitoring programs.
6.	**Borough Administration & Intergovernmental** FNSB: Mayor's Office State: Department of Environmental Conservation	State and/or federal CO^2 mitigation policy – direct and indirect costs of potential carbon tax or similar mitigation policy, potential incentives for renewable energy development, and carbon sequestration programs	Monitor federal legislation related to carbon tax, carbon sequestration, and cap & trade.	Evaluate economic and biological potential for carbon sequestration programs and renewable energy development. Coordinate with the State Climate Change Sub-Cabinet, other state entities, and federal entities to maximize economic development potential
7.	**Tourism & Recreation** FNSB: Departments of Economic Development, Parks and Recreation	Increased wildfire activity – potential impacts re: summer smoke Changes in seasonality – decreased reliability on good snow for winter recreation (dog mushing, snow machining, skiing, dependable sub-zero conditions for ice festival), potential long-term changes in habitat and migrations of game animals (hunting), song birds and migratory water fowl.	See above re: Emergency Response and Land Use. What is the likelihood of consistent above - freezing days in Feb and March in future? (Consult with SNAP)	Consult with SNAP for shorter term projected changes in shoulder season conditions. Consider these projections in event and recreation planning.
8.	**Subsistence and Other Native Impacts** State: Board of Game, Department of Fish and Game	Changes in seasonality and precipitation – changes in vegetation, animal and fish habitat, and migrations		Beyond Borough jurisdiction.

	IMPACTS	MECHANISM	DATA NEEDED	SUGGESTED PLANNING ACTION
9.	**Other Economic Impacts** FNSB:: Department of Economic Development	Permafrost thaw, increased wildfire activity, changes in seasonality – impacts on mining industry, insurance, cost financing, military (including Stryker training), energy providers (ice roads for oil exploration, infrastructure, cost of energy)	Spatial distribution of industry, infrastructure, roads located on permafrost.	More detailed evaluation of likely economic impacts from climate change.

	OPPORTUNITIES	MECHANISM	DATA NEEDED	SUGGESTED PLANNING ACTION
1.	**Potential increased economic activity from fire fighter service** FNSB: Department of Economic Development	Increased wildfire activity		Work with the Bureau of Land Management, Alaska Fire Service and Alaska Department of Natural Resources, Department of Forestry for potential increased seasonal fire fighting employment.
2.	**Opportunity for increased agricultural activity (biomass for fuel) to match increased demand for biomass for energy generation and land use planning.** FNSB: Department of Economic Development	Changes in seasonality, warmer spring and autumn temperatures, increased precipitation	What limitations to agriculture exist due to day length? How can biomass for energy generation meet PM 2.5 requirements?	Evaluate actual economic and biological capacity for expanded commercial agricultural production and biomass for energy production.
3.	**Economic opportunities in jobs and increased borough cost savings** FNSB: Department of Facilities Maintenance	Borough purchasing, energy conservation (including heating and lighting), reduced consumption and waste, retrofitting, recycling Increased demand for local employment in energy raters, designers, builders, and skilled labor in retrofit projects Potential for cost savings in planned infrastructure retrofit rather than full replacement; embodied energy (see #1 under Impacts). Saved money stays in the community Increasing green collar jobs. (retrofitting, weatherization, renewable energy production)	Cost savings analysis.	Conduct cost savings and feasibility analyses in energy conservation. Implement suggestions outlined below.

4.	**Opportunities for attracting tourism and retirees** FNSB; Department of Economic Development	Changes in seasonality, warmer spring and autumn temps.	.	Consider projected climate changes and energy conservation in planning for retirement housing, services, open space, trails preservation
5.	**Transportation** FNSB: Department of Transportation	Opportunity for energy conservation, CO^2 mitigation. Potential for double advantage w/ PM 2.5. Transportation corridor planning (including bike paths), public transit options	Public transportation planning. Feasibility of establishing designated bike lanes or bike routes.	See suggested actions below
6.	**Construction** FNSB: Departments of Economic Development, Facilities Maintenance	Changes in seasonality – more cost effective construction season (shorter winter, longer summer – decadal average, inter-annual variability).		See suggested actions below

	Other			
1.	**Outreach and Education** FNSB: Mayor's Office, FNSB School District UAF: Co-operative Extension Service			Coordination with school district science curriculum revisions to include education about the science of climate change.
2.	**Financial Expert**		Need for financial expert to locate financial resources to ensure milestones can be completed	Search for funding mechanisms to fund implementation, monitoring, and revision phases.

Sector Reports

Summary: Expected results of climate change in Interior Alaska are a general warming trend, with increased precipitation balanced by increased evapotranspiration, causing an overall drying effect on our climate.[9] The results of this warming will likely be increased wildfire activity, more widespread and faster permafrost thawing, longer yet drier growing season, and longer construction season.

Increased wildfire activity will threaten structures in the built environment and also impact wildlife and fish, forests, air quality, and public health. It will also further enhance permafrost thaw in burn areas.

[9] See O'Brien. Climate Change Impacts on Water Availability in Alaska. Available at: http://www.snap.uaf.edu/downloads/climate-change-impacts-water-availability-alaska.

Much of the land in the FNSB is underlain with permafrost. As permafrost thaws, the ground beneath existing structures becomes unstable and can cause damage to both horizontal (pipelines, power lines, roads) and vertical (buildings) components of the built environment. Most structures built on permafrost are designed to maintain frozen ground. However, as the climate changes, it will become more and more important to use up-to-date design climate standards to fully assess future building sites for permafrost and ensure longevity of structures and roads built upon local soils. It will also be important to ensure that design standards for new and replacement infrastructure account for climate change so that they are compatible with the projected climate 30-50 years from now.

Climate change may bring opportunities such as increased growing season for agriculture, lengthened construction season, energy cost savings in mitigation, and improvements in energy efficiency. Climate change may also bring indirect challenges. For example, public health may be affected by increased wildfire smoke. Indirect economic challenges may result from increased shipping through the Northwest Passage, which could impact the FNSB's position as the transportation and shipping hub of the Interior and North Slope regions of Alaska. There is continued need to build climate change literacy among the public and in K-12 education.

All information in this document is based on available information provided by task force members, Borough officials, UAF faculty, and other experts. More detailed analysis will be needed for more accurate predictions. The information below, including sensitivity, adaptability, and vulnerability ratings may change as more detailed analyses are performed and as continuing changes occur and are observed.

Natural Systems

Air Quality

Sensitivity	High
Adaptability	Low-Moderate
Vulnerability	High

Climate change results:

- Due to more frequent large fire years and longer fire seasons, wildfire smoke (both particulates and volatile organic compounds), is expected to adversely affect public heath, both physical and mental.
- Climate change might alter the factors that generate pollutants from foreign countries, as well as the meteorological transport patterns bringing those pollutants into the Borough.
- Warmer temperatures may cause permafrost thaw, which will in turn release CO2 and methane into the atmosphere, both of which are greenhouse gases.

Non-climate change related stresses to air quality are:

- Existing coal fired power plants may be required to reduce their emissions and improve air quality.
- Proposed new coal fired power plants or coal-to-liquids plants and fuel transport may increase emission sources and affect air quality. (Refer to Interior Issues Council Cost of Energy Task Force Report.)
- In response to high fuel costs, more people have switched to coal, wood, pellet, or other biomass fuels for heat, some of which are inefficient. This increases particulate matter, CO, and volatile organic compound (VOC) emissions (i.e. methane) during the cold months when temperature inversions make the problem even worse. This component is expected to increase. Increased population in the Borough will lead to additional heating and transportation requirements, which could result in increased emissions and enhanced resource consumption.

- With increasing use of inefficient biomass fuels to heat homes within the FNSB, PM 2.5 and other air quality standards are becoming increasingly difficult to meet,
- Second hand poor air quality (dust storms and wildfire) from Russia are likely to continue in future years. China and India are increasingly using coal and oil with few regulations on emissions of particulates, noxious chemicals, or greenhouse gasses.
- The EPA allows us to use the 'natural hazards exclusion' clause to remove the wild fire smoke impacted days from determination compliance with the PM2.5 rule. If we have a case where a long-range smoke transport occurs and we cannot prove that it was fire and we could not control it, then we could be determined to be out of compliance on that day (see DEC and FNSB Air Quality Department).

Non-climate change related synergies:
- Increases in particulate matter, CO, and VOC emissions from a switch to biomass fuels in home heating sources will likely affect PM 2.5 or other air quality regulations.
- Regulation of wood burning stoves and change from fossil fuels to renewable energy sources such as wind, solar, small scale hydro and geothermal could help clean the air.
- Existing coal fired power plants may be required to reduce their emissions and improve air quality.
- Carbon dioxide sequestration could reduce emissions from existing or proposed coal fired electrical generation plants. Carbon sequestration is expected to be a requirement for new coal fired power plants or coal-to-liquids plants.
- Tighter PM2.5 regulations being implemented by the EPA will require the Borough to reduce sources of pollution in the Borough.

Adaptation: The Borough should take action to prepare for anticipated poor air quality from wild fire and international sources by establishing public clean air zones (e.g. library, Carlson Center, schools) for use during these events. The Borough can investigate retrofitting other public buildings with air filtration devices. FNSB, perhaps through cooperation with UAF or other entities, can work to improve air quality forecasts through modeling and additional measurement sites to better inform the public of potential near-future poor air quality. Improved public education and communication might occur via web pages and local broadcasts.

Complete fire suppression for the purpose of reducing the incidence of poor air quality from wildfire smoke is unrealistic, especially since some fires originate in Russia and other non-Alaska regions. In addition, prolonged fire suppression results in hazard fuel build-up, creating greater risk for catastrophic fires in the future. However the Borough can help to reduce the incidence of fires at private residences by improving public education programs and regulations regarding hazard fuel reduction and proper wood stove use.

Suggested short-term actions (1 year): Institute a public education program about what Borough residents can do in their own homes and lives to improve air quality and reduce exposure to poor quality air. One component of this program might be education regarding choice, installation, and use of wood burning stoves and furnaces.

Suggested mid-term actions (2-5 years): Incorporate PM 2.5 monitoring air quality analysis into future actions related to climate change adaptation and mitigation. Take reasonable measures to reduce incidence of forest fires locally, for example by mechanically reducing fuels. Coordinate with State Department of Forestry (DNR) and Alaska Fire Service (BLM) regarding federal, state, and local suppression and pre-suppression policy and action. See Forest Resources section for recommendations on response and preparedness for forest fires. Incorporate PM 2.5 monitoring air quality analysis into future actions related to climate change adaptation and mitigation. Work with GVEA to encourage participation in the Sustainable Natural Alternative Power program. Consider a Plug-In at 20 campaign such as that in the Municipality of Anchorage. Discourage idling in parking lots (perhaps offering incentives to businesses to install more plug-ins in order to discourage idling.

Suggested long-term actions (5-20 years):
Continue above actions, incorporating changes as situations evolve.

Links to other sectors:
Built: Increased particulates and VOCs could lead to requirements for the installation of air filtration systems in more buildings and make air filtration systems desirable in more homes.
Public health: Higher incidences of respiratory problems and possibly depression are anticipated.
Economic development: Reduced air quality could affect tourism, as well as local recreational enjoyment.
Forestry: Expected increases in wildfire frequency and extent will impact local air quality.

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Energy Production

Sensitivity Low
Adaptability High
Vulnerability Low

Climate change results:
- Climate change will likely have minimal impacts on current forms of energy production in Interior Alaska, mostly related to access to and extraction of coal, oil, timber, and biomass/firewood.
- More research is needed to estimate the magnitude of impact from changes in precipitation, temperature and evapotranspiration on renewable energy projects, especially hydroelectric and solar.
- Changes in precipitation and evapotranspiration resulting from climate change may impact planned hydroelectric projects.
- Changes in cloud cover, which is expected to increase in conjunction with increased precipitation, may impact planned solar energy projects.
- Climate impacts on coal mining outside the Borough may impact the cost of energy within the Borough.
- Climate-related changes, such as permafrost thaw, may present obstacles to resource extraction, subsequently impacting energy production and availability.

Non-climate change related stresses to energy production

- Some forms of energy production will be phased out, while others will be phased in, dictated by cost and/or availability of the resource (e.g. coal, oil, biomass).
- Environmental costs associated with energy resource use may also play a role in energy production and availability.
- Although coal is globally abundant and fairly cheap, its use comes with a high price tag to the environment. Borough efforts toward reduction of greenhouse gas emissions may reduce coal consumption in the Borough.
- However, because coal-fired electricity is relatively cheap, it is likely the operation of existing coal-fired electric plants will persist, and new plants will be constructed. With potential decreased availability and increased cost of petroleum and natural gas resources, coal may become of increased importance, particularly if CO2 and other pollutants can be minimized or sequestered.
- Proposed construction of a large storage hydroelectric dam (potentially at Lake Susitna or Lake Chakachamna) or a natural gas line could possibly obviate the need for coal as an energy source.
- The possible imposition of a carbon tax or cap and trade on carbon will affect energy-related industries in the Borough and Borough fiscal policy regarding energy production. (See Cost of Energy Task Force documents.)
- Industry decisions regarding emissions, which will affect energy production, will be influenced by federal policy regarding environmental protection, institution of a carbon tax, and availability of cap and trade, in conjunction with economic feasibility.

Non-climate change related synergies to energy production:

- Coal to liquids technology currently under consideration may increase coal demand.
- The cost of energy locally has prompted formation of the IIC- Cost of Energy (CoE) Task Force, which has been charged with determining the best affordably priced future energy source options for Fairbanks and Alaska. The results from that task force will largely drive policy, at least within the Borough, regarding energy production. See IIC-CoE Task Force documents at www.investfairbanks.com for a full discussion of this topic.
- Efforts to reduce greenhouse gas emissions may create subsidies and incentives for renewable energy generation. The FNSB may see a burgeoning industry in wind, solar, small scale hydro, biomass, and geothermal electricity generation-.
- Locally, experimental projects involving biomass and waste-to-energy electricity production are planned in the next two years, and deep well geothermal electrical generation is also under consideration
- A large hydroelectric energy source might be used in projects incorporating Fischer-Tropsch technology with clean coal or biomass electricity generation to produce zero-sulfur, zero-NOX diesel, heating oil, and jet-A fuels for local consumption and shipment to Alaska Bush communities.
- Creation of new industries and distributed renewable energy generation may contribute to economic development, stabilization of our energy prices, and reduce our dependence on foreign oil.

Adaptability:

Advances in engineering and technology will allow some of the current climate-related obstacles to resource extraction and exploration, such as permafrost thaw, to be overcome. Emerging technologies using renewable energy sources, such as wind, solar, geothermal, biomass, and small scale hydroelectric, are expected to help meet future energy production demands. However, when planning for increased production from renewable sources, climate change factors such as increased precipitation (cloud cover) and net surface drying (precipitation and evapotranspiration) should be taken into account.

Mitigation:
Energy conservation and efficiency, practiced at all levels from the individual to the top levels of government, could save 20-50% of our energy costs. Energy conservation and efficiency is the primary recommendation of the IIC- Cost of Energy Task Force.

Suggested actions: See IIC- Cost of Energy Task Force recommendations. The IIC- CoE Task Force treats the topic of energy production, availability, and use in the FNSB with much more depth than this report. The overarching message of the IIC- CoE for our purposes is to encourage and practice energy conservation and efficiency, at all levels, now and into the future. Implement the recently developed Fairbanks Energy Plan to the extent it complies with reducing our carbon footprint while stabilizing the supply and cost of energy.

More research is needed to understand the type and magnitude of impacts from changes in precipitation, temperature, and evapotranspiration on renewable energy projects. Work with UAF and other entities, applying climate change modeling efforts to understand impacts to cloud cover, water availability, and wind patterns in terms of planned energy projects (e.g. solar, hydroelectric, and wind generation). Also model potential impacts of climate change (e.g. permafrost thaw) to non-renewable energy resources in order to better understand implications for the energy industry and the population of the FNSB.

Links to other sectors:
Built environment: Energy use, mostly from fossil fuels, within the Built Environment sector, drives energy production. Since emissions from fossil fuel energy sources are understood to be the main cause of climate change, a plan that decreases reliance on fossil fuels and places more emphasis on using renewable sources of energy that do not produce GHGs will help curb climate change.
Mining: Ties to coal exploration and extraction.
Hydrology: Overall drying in Interior Alaska could have negative implications for large or small scale hydroelectric projects.
Soils: Permafrost thaw could potentially affect energy exploration and extraction of resources such as coal and oil.
Economy: High energy costs in turn increase the cost of commodities, freight, travel (both commuter and recreational), and the overall cost of doing business. This could hinder economic growth in the Borough.

RESOURCES
Interior Issues Council Cost of Energy Task Force, Fairbanks Energy Plan (2007).
http://www.investfairbanks.com/documents/FairbanksEnergy2.pdf

Forestry

Sensitivity	High
Adaptability	Low
Vulnerability	High

Climate change results:
In an already constantly changing system such as the boreal forest, it can be difficult to sort out which changes are the results of climate change and which are due to "normal" dynamics of the system. If warming trends continue, positive (i.e. amplifying) feedback loops may accelerate the intensity of the stresses, impacts, and changes to the boreal forest that supports the majority of life in the FNSB. Actual, observed results show

changes occurring more quickly than anticipated. Climate change may also make the ecosystem more vulnerable to other stresses.

- Climate change projections for Interior Alaska show warmer summer and winter temperatures, with increased precipitation, but overall drying due to increased evapotranspiration. This will likely affect a number of aspects of forestry. Most notably, increased permafrost thaw and increased flooding that would likely result from projected primary changes may lead to erosion problems that alter the forest landscape, access for logging, recreation, and habitat.
- Shorter, warmer winters could decrease logging access on snow covered frozen soils and/or ice bridges.
- Drought stress to trees may limit growth and decrease resistance to insects and disease.
- There may be a shift in species ranges; existing tree and plant species may move north and/or upward in elevation. There may be a shift in existing forest composition, particularly related to species dominance.
- Some invasive species and/or migrating species (e.g. lodge pole pine) may move northwest from our southeastern border, competing with and perhaps replacing native species.
- Temperatures fluctuating above and below freezing in mid-winter may create physiological problems for trees, as reflected by winter kill of foliage, buds, and branches.
- Ice storms may cause tree breakage and a reduction in timber volume.
- Earlier snow melt, greater number of summer lightning strikes, overall drying of biomass, and greater abundance of standing dead (insect- and disease-killed) trees will likely lead to more frequent wildfire seasons with very high acreage burned and a decreased fire return interval. This could result in loss of timber products and jobs locally, changes in recreational activities (e.g. hunting, berry-picking, bird watching), and increased social costs (e.g. loss of man-made structures to forest fires).

Non-climate related stresses:

- A possible increased biomass harvest, for uses such as plywood manufacturing and pellet production for biofuels, could alter local forest diversity and abundance and potentially impact sustainability.
- Planting biomass as an energy crop could yield effective fire breaks around communities.

Adaptation: Wide-scale prevention or treatment of wildfires or infestations of damaging insects is not cost effective or perhaps even possible considering the huge scope and area involved. Therefore, we consider forest management systems to be minimally adaptive to climate change and, consequently, highly vulnerable to change.

Suggested actions:

Development and implementation, in the short-term, of forest fire awareness and control programs, such as Fire Wise (http://www.firewise.org/), on individual, local and state levels.

Coordinate with State Department of Natural Resources, Division of Forestry (DOF) and the BLM Alaska Fire Service (AFS) regarding federal, state, and local suppression and pre-suppression policy and action

Fire management plans for effective control of wildfires in protection zones near communities may need to be enhanced, along with more focus on emergency evacuation plans. This should be coordinated with the Division of Forestry (DNR) and the Alaska Fire Service (BLM).

- Consider climate impacts in sustainable forest use plans and practice.
- Consider prescribed fire as a management tool to ultimately reduce carbon emissions.

The development of shaded fuel breaks dominated by hardwoods will serve to reduce fire risk. Pursue the development of fuel breaks and reduction of spruce dominated stands in fuel control zones, in possible conjunction with biomass harvest for energy production.

Convert dead and dying trees into value-added wood products, such as wood composite deck materials, fuel pellets, furniture, and house or saw logs.

Links to other sectors:
Air quality: Increased wildfire activity may result in more VOCs and particulates.
Built environment: Exposed, burned over ground may accelerate permafrost thaw, damaging structures.
Wildlife/Fish: Possible loss or change of habitat for animal species dependent on white spruce/birch forest.

Hydrology/Water Resources

Sensitivity	Moderate
Adaptability	Low
Vulnerability	Moderate

Climate change results: Flooding events may be slightly more likely due to increased precipitation, increased snow melt, a possible increase in ice jam events, and increased glacial melt. Glacial melt in the headwaters of the Tanana basin may change river level and flow seasonally and over time. An overall surface drying is also expected due to increasing evapotranspiration (see presentation by Brenden O'Brien): http://www.uaf.edu/accap/water_resources.html)

- Clear water streams and rivers may have over-all reduced flow, affecting navigation and resulting in an increase in the concentration of pollutants and disease vectors immediately downstream of pollution sources, such as Fairbanks.
- Drying may also threaten water supplies in rural communities in the FNSB.
- Permafrost thaw may lower the water table, causing slumps and ponds, leaching of minerals from surface soils, and drying up of some ponds and wetlands on non-ice soils. This is unlikely to affect ground water (i.e. FNSB's main drinking water source) but will affect surface water availability and soil moisture.
- Decreased precipitation in the form of snow and earlier snow melt may decrease ground water recharge rates in upland (i.e. non-wetland) areas; wells may dry up because, although increased precipitation is expected, a net surface drying due to increased evapotranspiration is also expected. This suggests that benefits to agriculture from a longer growing season may be less than otherwise expected.
- River and lake-front property values my decrease due to changing water levels. Additional impacts to property owners may result from a change in land ownership (both from private to state and state to private ownership) through natural accretion and X.
- Overall drying could impact potential for hydroelectric projects statewide, either large storage or local run-of-river projects

Non-climate related (external) stresses:
- If agriculture increases in the area, there may be increased need for irrigation.
- Increased cost of energy may impact cost of water delivery to homes, businesses, and farms.
- There is a potential for increased industrial development, associated with energy development and other proposed projects. Such development may increase wastewater discharge, with the potential to increase the concentration of pollutants in local waterways.

- Increased development, (e.g. gas and mineral exploration; construction of bridges, roads, stream crossings, and settling ponds; and changes in stream beds resulting from placer mining or other activities) may impact ground water level and increase pollution.
- If increasing demand for electricity is met with power plants that require water for cooling, this will impact water supplies and temperatures.

Adaptation:
There are several ways that we can plan and prepare for anticipated changes:

- Some adaptive actions will involve engineering and design solutions that will likely be expensive. Engineers can design and plan infrastructure, such as levees and bridges, for expected increased flooding and ice jams.
- Increased agriculture, in combination with projected overall drying, may necessitate changes in agricultural practices. One solution might be to encourage crops that do well with limited water.

Mitigation

- Homeowners can switch to delivered water if wells run dry. Net surface drying should be factored into future projects, for example when estimating potential advances in agriculture or use of water as a source of electricity generation.

Suggested actions:
- Revise Borough flood plans to accommodate more frequent floods and higher water levels.
- Water quality monitoring in rivers should be implemented, including monitoring and testing for pollutants and water borne disease vectors.
- A public health education program regarding water pollutants and disease related to water borne vectors should be developed and implemented.
- Implement on-going water quality monitoring for rivers and sloughs.
- Monitoring and testing for ice and road travel safety should be increased, and FNSB should ensure that emergency rescue teams are trained and ready to respond.
- Seasonal travel advisories should be enhanced as needed.

Link to other sectors:
Built environment: There is a potential for damage to infrastructure, which necessitates preparations for a slight increase in flooding. There are possible impacts of availability of well water in the populated hills surrounding the City of Fairbanks.
Public health: There is potential for increased exposure to pollutants and vector borne disease.
Socio-economic: There is a potential for a decrease in river and lake-front property values, as well as changes to property boundaries. Impacts to navigation on rivers, with effects to tourism, recreational, and commercial navigation are anticipated. Negative impacts to tourism-based fishing and local fishing as recreation and a supplemental food source may also result. There may be an increased need for agricultural irrigation.
Wildlife and fisheries: Impacts on fish and wildlife habitat are expected.

Sensitivity Moderate
Adaptability High
Vulnerability Low

Regional Mining Industry Inventory (some outside FNSB):

Gold: 2 large mines (Pogo, Ft. Knox); 500 mechanical placer mines, most in the Interior and in the Brooks Range; 1500 suction dredge mines ***Coal***: 1 (Healy). ***Gravel***: Local. ***Peat***: Local. ***Other precious metals:*** None local

Climate change is impacting the timing, duration, and magnitude of the seasons and is expected to increase areas of permafrost thaw. Some of the anticipated impacts across the mining sector, for both large and small scale operations, include:

- Lowered ground and surface water levels, affecting sluicing and settling ponds for total dissolved solids. These changes may impact waste management and containment.
- Climate change impacts to water quality may change laws and policies regarding water quality, with ramifications for the mining industry.
- Changes to physical access to claims, especially in shoulder seasons (e.g. because of unstable ice roads, changes to river navigability).
- Potentially more difficult and costly mineral exploration.
- Potential damage to road and rail transport infrastructure associated with thawing permafrost.
- Altered timing windows for exploration and development. This might result in negative impacts due to a shortened season for winter travel on frozen surfaces (due to warmer winter temperatures, earlier spring warming, and later fall freeze-up); or the longer summers that Interior Alaska is already experiencing could result in a longer window of opportunity for summer exploration and extraction of minerals, thereby providing an economic benefit to the industry.

Non-climate change related stresses:

- As local sources of minerals are depleted, new infrastructure will be required to access, extract, process, and transport resources from new deposits in outlying areas.
- Possible royalty charges for ore, coal, gravel, and other mined resources, like those for the oil industry, could greatly increase operating costs.
- International mining issues.
- The availability or lack of venture capital is a potential stressor for the mining industry.
- Market value of extracted resources influences whether or not the cost and risk of exploration and development is worth the potential revenue generation at any given point in time.

Non-climate change related synergies:

- Increasing values of minerals may outpace increased costs of production.

Adaptability: The mining industry has a fairly good ability to adapt by using different or specialized equipment. In fact, some areas where climate related changes have already occurred are being mined through the use of different or specialized equipment. Advances in technology may allow for continued adaptation to changing conditions.

Suggested actions: Evaluate the potential for climate change impacts on waste containment structures.

Links to other sectors:
Socio-economic: Longer summer seasons may increase opportunities for mining. There may be increased costs for waste management.
Public Health: Changing soil and water conditions may impact discharge and waste. Altered snow depth in winter, along with generally warmer air temperatures in winter, may translate into more favorable over-wintering conditions for certain insects and therefore more frequent "outbreaks" (for example, more frequent summers of high yellow-jacket populations).

Soils

Sensitivity	High in permafrost areas, Low in non-permafrost areas
Adaptability	Moderate
Vulnerability	Moderate

The thawing of permafrost due to increased temperatures releases carbon dioxide and methane gases, creating a positive feedback loop for global climate change. Globally, thawing permafrost is a potentially very large source of carbon release, as the stored carbon available for release in boreal and arctic soils is more than the amount currently contained in the atmosphere. More research is necessary to determine the magnitude of potential greenhouse gas emissions from permafrost thaw within the Borough.

Soil types: The FNSB contains the following soil types. Most are developed from wind-blow loess, with a few developed from existing rock parent material.

Hills: Bedrock, North Aspect Slope, South Aspect Slope, Toe and Foot Slope
Floodplain: Alluvial Apron, Alluvial Plain

Bedrock areas and some thaw stable alluvial gravels should not be affected by climate change. South Aspect Slope and Alluvial Plain soils (Fairbanks proper) have some permafrost areas that may affect existing and future infrastructure if they become unstable through thawing processes.

Toe and Foot Slope, Alluvial Apron, and North Aspect Slope soils will be at highest risk due to extensive permafrost and ice wedges in these soils.

Adaptive capacity: Soils themselves cannot adapt, but we can adapt engineering principles to accommodate soil instability due to permafrost thaw. Northern building techniques dealing with unstable soils have been in use for decades and are under constant refinement (see Built Environment Section).

- Soils under some existing structures can be stabilized.
- Soils can be stabilized beneath new construction if updated engineering standards that account for changing permafrost temperatures are used.

Suggested short-term actions:
- Identify sensitive areas and monitor permafrost thaw, especially in areas of new development.
- Make available a map of current permafrost-sensitive areas. This map will need to be updated regularly to account for rapidly changing conditions.
- Account for changing soil stability in permitting new construction. Investigate potential climate-related soil impacts on agricultural potential, including future opportunities.

Suggested mid-term actions:

- Retrofit structures, including lift-foundations (see Built Environment Section).
- Install drainage systems and/or retaining walls to reduce landslide threat in highly vulnerable areas where infrastructure is at risk.
- Monitor changing permafrost conditions in the Borough, especially in areas of new development.

Suggested long-term actions:

- Plan and build to changing soil conditions, including potential landslides in road cuts.

Links to other sectors:

Built environment: transportation, permafrost thaw, leading to unstable ground on which to build, or subsidence of ground under existing structures, buildings and roads, utility corridors, airports, railroads, etc. *Hydrology:* altered ground water levels may affect existing ponds and lakes, or create new ones. *Forestry, Wildlife/Fish:* migration of flora and fauna associated with the black spruce boreal ecosystem

RESOURCES

Y. Cai et al. Temporal Variations in organic carbon species and fluxes from the Chena River, Alaska (in press). Limnology and Oceanography.
Personal communication with Laodong Guo, Stennis Space Center.
Guo, L., C.L. Ping, and R.W. Macdonald (2007). Mobilization pathways of organic carbon from permafrost to arctic rivers in a changing climate. Geophysical Research Letters, (34:L13603).
Personal communication with Dennis Mulligan, United States Department of Agriculture.
Personal communication with Chien-Lu Ping, University of Alaska Fairbanks.

Wildlife and Fish

Sensitivity	Moderate
Adaptability	Moderate
Vulnerability	Moderate

Climate change results:

The overall surface drying in the Interior, coupled with a predicted increase in severe, random weather events and changes in sedimentation, may affect wildlife and fisheries in the following ways:

- Overall surface drying will result in loss or change of wetlands and loss or alteration of browse or fodder for wildlife, including moose, waterfowl, beavers, and fish.
- Changes in river courses and flooding may alter Essential Fish Habitat (especially spawning habitat), as defined by the National Marine Fisheries Service.
- Loss or change in composition of forest habitat may result from increased insect or disease infestation, forest fires, or invasive animal or plant species.
- Loss or alteration of breeding and nesting sites for birds.
- Earlier arrival of spring could cause some migratory bird species to miss the early growth of plants or hatching of insects they rely on for food.
- Warmer waters, changing riparian zones and potential stream bank slumping from permafrost thaw may affect the life cycle, abundance, and diversity of water plants, insects, and fish, particularly salmonids.
- Increased forest fire activity may change wildlife habitats, with particular respect to successional stages. This may result in benefits to some wildlife (e.g. increasing availability of browse for moose).

- Changing habitats may decrease the availability of certain fish and game species and increase the availability of others. Many people supplement their diet and/or meet a large portion of their nutritional needs by hunting and fishing locally for food.
- If the extent of boreal forest is significantly diminished, species that depend on the boreal forest habitat will experience population stress.
- On a local level, the distribution and numbers of native species of animals and fish might be severely altered by climate change, necessitating increased attention to invasive species.

Non-climate related (external) stresses: Continued expansion of industrial, agricultural, and residential development decreases wildlife habitat. Researchers suspect that the increasing incidence of disease and deformities in fish and birds, particularly in salmon and chickadees, may be related to climate change; but the cause is yet to be determined.

Adaptive capacity: Fish and wildlife are moderately adaptable to climate change, usually by migration to more favorable environmental conditions. Fish species that are able to adapt to changing conditions are generally those species with broader distributions and less stringent habitat requirements (e.g. Alaska blackfish, sculpin, northern pike). Other species with restricted distributions and strict habitat requirements (e.g. steelhead, arctic char, salmon) may not be able to adapt. If threshold conditions are reached that shift ecosystems into a new and different state, there may be negative consequences to habitat and to populations of wildlife and fish.

Suggested actions:
Critical fish spawning and nursery areas should be afforded extra protection. Draw from new and developing research at the Scenarios Network for Alaska Planning on wildlife habitat corridors in consideration of new development.

Links to other sectors:
Forestry: See Forestry section for expected changes in forest habitat.
Public health: Increase in venomous insects (e.g. yellow jacket) and new insect species may increase incidence of unusual diseases (e.g. West Nile virus, equine encephalitis, canine dirofilariasis, tularemia, and Lyme disease).
Economic: Reduced local supply of meat animals (moose, caribou, bear, ducks, and geese) and fish (salmon) for local consumption; reduced recreational and tourism opportunities for fish and wildlife harvest, photography, or viewing; and lower income for fish and game guides.

Built Environment Systems

Definition: The built environment includes infrastructure such as public and private buildings, utility corridors, and landfills. The built environment also includes modes of transportation (public and private vehicles, trains, air travel) and their related infrastructure (road corridors, rail lines, airports). Built environment systems deal with systems that use energy, most of which have been supplied by carbon based fuels, the major source of the greenhouse gas (GHG) emissions that are considered a cause of global climate change.

The built environment consists of a vertical component (e.g. public and private buildings), a horizontal component (e.g. utility corridors, transportation corridors, water and sewer lines, airports, landfills), and a transportation component (e.g. public and private vehicles, trains, air travel).

Sensitivity Moderate
Adaptability Moderate to high, with some cost
Vulnerability Low to moderate

Impacts that are predicted to result from climate change will entail costs to everyone. The rising price of energy will likely bring reductions in energy consumption within the built environment and thus a reduction in the generation of carbon emissions, which is a priority in mitigating climate change. .

As the price of some energy sources (e.g. oil) increases, the use of cheaper fuel sources to heat and power the built environment (e.g. wood and coal) will also increase. Use of wood and coal in areas subject to thermal inversions, such as the greater Fairbanks area, can lead to air that is unhealthy to breathe. Investment now in energy conservation and emissions reductions will help avoid air quality costs and more costly adaptation efforts in the longer term.

Climate change effects:

- The expected effects of climate change on the built environment include more widespread thawing of permafrost, a possible increase in flooding events in developed areas, and increased wildfire activity. Each of these could result in damage to infrastructure.
- We can expect more precipitation and more frequent and protracted temperatures above freezing during the winter season. These changes make the built environment more susceptible to drainage and icing issues, which could manifest, for example, as freezing gutters or more frequent incidences of unsafe road conditions.
- With warming temperatures, Interior Alaska will become more susceptible to destabilization of the frozen soils (i.e. permafrost) upon which portions of our transportation corridors are built. As the magnitude and extent of thawing permafrost increases, along with the frequency of freeze-thaw cycles, maintenance costs can also be expected to increase for our existing transportation corridors (e.g. roadways, trails, rail lines) and other transportation-related infrastructure (e.g. bridges, airports, parking lots).
- Permafrost thaw and increased frequency of freeze-thaw cycles may also affect building foundations, and buried and above-ground public and private utility corridors (e.g. sewer and water lines, power lines, pipelines). Impacts to infrastructure will necessitate repair and possibly replacement.
- The unstable ground conditions created by thawing permafrost may require more expensive engineering and construction techniques for new infrastructure.
- Changes in precipitation and glacial melt may cause flooding, which could lead to road washouts.
- Increased snow loads and more frequent freeze-thaw cycles and icing conditions may lead to unsafe road or river travel in winter and during shoulder seasons.
- Decreased summer air quality due to increased wildfire activity may require modifications to existing buildings such as increasing building ventilation and installing air filtration systems (see air quality section).
- Increased wildfire incidence will increase risk of damage or loss of structures.
- Lighting load will be unaffected by climate change.
- Although we expect temperatures to vary from year to year, overall, cooling needs may increase and heating needs may decrease for public and private buildings.
- A warmer climate may provide a longer building season in Interior Alaska.

Non-climate related external stresses:

- The need to meet federal PM2.5 air quality standards and high energy costs are currently the most compelling non-climate stressors to the built environment in the FNSB.
- High energy costs are leading more people to heat with wood, often in inefficient stoves/furnaces, adding to PM 2.5 and other air quality problems.

- Energy costs, in particular, are driving a trend toward energy efficiency and conservation in new construction and through retrofitting of existing structures.
- Due to an absence of strict building codes and abundance of owner-built structures in the FNSB, houses and even some commercial buildings are not always engineered to withstand changing environmental conditions. Additionally, a focus on energy efficiency has traditionally been absent in building codes, and housing and commercial buildings in the FNSB are often energy inefficient.

Non-climate related external synergies:
- Partnerships can be developed with the IIC Cost of Energy task Force regarding mitigation efforts.
- There is a growing nation-wide movement and increasing resources for climate change adaptation and mitigation.
- Federal incentives and a trend toward more sustainable living have encouraged private homeowners to invest in retrofitting technologies that enable energy efficiency and conservation.
- Ten percent of each state's federal funding through the Surface Transportation Program must be set aside for Transportation Enhancement Activities, which include facilities for pedestrians and bicycles. This law, enacted in 1991, has resulted in an increase in pedestrian- and bike-friendly corridors around the FNSB.
- The creation of new jobs in retrofitting, green building and energy conservation and efficiency may stimulate the local economy.
- More energy efficient construction may increase property values.

Adaptive capacity of the built environment to climate change:
- Damaged buildings and other infrastructure can be repaired, redesigned, and relocated or rebuilt on more stable ground.
- New structures can be built, with designs that take into account expected impacts from climate change. This might include building foundations that can withstand changes in permafrost conditions and measures to increase energy efficiency. There may be opportunities to retrofit existing infrastructure to adapt to changing conditions associated with climate change. For example, buildings might be equipped with air handling systems for particulates and methane gas from wildfires and/or smoke from organic (i.e. wood) home heating sources (see air quality section).

Mitigation capacity of the built environment to climate change:
The built environment sector has a large capacity to reduce greenhouse gas (GHG) emissions and mitigate climate change. Much of the technology to mitigate GHG emissions is already available. Much of it is relatively cheap, easily and quickly installed or implemented, and has a relatively short economic payback period. By using best practices building standards in new construction and incorporating energy efficient retrofit techniques into existing structures, the energy consumption of public and private structures can be reduced by 25-50%.

Options to reduce climate change impacts from other components of the built environment include enhancing the availability of public transportation; encouraging alternative forms of transportation through pedestrian- and biker-friendly planning efforts; and encouraging concentrated development in existing areas (rather than continuing to develop new areas that require more transportation, perhaps over longer distances). In addition, aging borough vehicles can be replaced with more fuel-efficient ones.

Suggested actions:
The Cost of Energy Study, prepared in 2007 under the Interior Issues Council, offers a number of good recommendations for reduction of energy use within the built environment. FNSB should build upon these recommendations, with a focus on reduction in carbon emissions. This would both mitigate for climate change, a goal of the Climate Change Task Force, and takes steps toward the Cost of Energy Task Force

mandate (i.e. reduction of energy costs). Some suggested actions, including and in addition to those discussed in the Cost of Energy Study, are outlined below.

Suggested short-term actions (1 year):

- The Borough should work with the State Climate Change Sub-Cabinet, and in particular with the Adaptation and Mitigation working groups' recommendations, to learn more from their analyses, followed by implementation of appropriate recommendations and ongoing monitoring of their effectiveness.
- The FNSB should establish and fund an Office of Sustainability, which would report directly to the Mayor. The mandate of this office could be the coordination of efforts within the various FNSB departments toward greenhouse gas reduction policies. This office could also coordinate and collaborate with other local, state, and federal government agencies, local communities, and non-governmental groups in efforts to accomplish this goal.

Energy Conservation and Efficiency within the Built Environment

- The Cost of Energy Study prepared in 2007 under the Interior Issues Council offers a number of good recommendations. Its fundamental policy was to reduce energy use. We recommend focusing on reducing our carbon emissions to mitigate climate change to both meet the Cost of Energy Study AND reduce our climate change policy.
- To the maximum extent possible, the Borough should encourage distributed and on-site solar, wind, and waste to energy production for electricity and heating. While initial capital outlay may be high, long-term pay-offs will also be high, especially if carbon taxes are imposed at the local, state, or federal level.
- The Borough should work with the IIC- Cost of Energy Task Force to implement suggested actions that would encourage energy efficiency and conservation within the built environment.
- FNSB should work with GVEA to conduct an electrical use assessment for every Borough-owned or leased building.
- FNSB should implement an energy conservation policy within all FNSB offices. FNSB might require that computers be programmed to shift into energy saving mode to the extent practicable (this might include turning off and/or unplugging computers during non-working hours) and occupancy or motion sensor lights be installed and use of lighting at night be reduced to the maximum extent possible (taking safety considerations into account).
- FNSB should investigate the use of waste heat in FNSB-owned and leased buildings.
- The Borough should set policies encouraging higher standards of efficiency for all new buildings proposed for construction within the FNSB. The Borough might start with the design and construction of new public buildings to green, energy efficient standards.
- Newly established building codes should stress energy efficiency for both heating AND cooling.
- Timers should be installed for all vehicle plug-ins at Borough-owned or leased buildings.
- New vehicles purchased for Borough use (including passenger vehicles and public buses) should utilize the best-available and practicable technology with regards to energy efficiency. Aging vehicles should be replaced, wherever practicable, with hybrid or highly fuel efficient options.
- FNSB should work with ADOT&PF and other entities, as appropriate, to keep bike paths and sidewalks clear, encouraging more use. They are often unusable during winter.
- FNSB should develop and implement a program to educate the driving and cycling public regarding commuter bicycle rules of the road.
- The Borough should use planning or other processes, such as building requirements, to reduce the consumption of non-transportation lighting (e.g. commercial, yard, recreational lighting).
- The Borough, perhaps through a Task Force, should seek partnerships for creative ways to reduce commercial electrical consumption (one area of opportunity might be electronics displays in box stores).
- Strive for paperless processes in the Borough and increase recycling.

Vulnerability of Infrastructure

- Identify those areas within the FNSB that are susceptible to flooding and drainage issues, with priority given to those areas of current and planned development.

Suggested mid-term actions (2-5 years):

Energy Conservation and Efficiency of the Built Environment

- The Borough should begin to implement the advice gained during energy audits/ratings, one building at a time.
- The Borough should actively encourage and pursue energy retrofits for all buildings in their jurisdictions, according to the standards that would be set for new construction (see short term). The Borough might start by conducting energy ratings/audits for every Borough-owned or leased building. This might include efforts to coordinate with the State of Alaska to revitalize the home weatherization program and major energy retrofits and to establish a commercial sector weatherization program.
- Consider modifications to the property tax assessment system to reward more efficient, carbon- reducing building practices for residential and commercial construction.
- Energy-efficient lights should be used on FNSB-managed properties.
- The Borough might require energy efficient lighting for new commercial development (e.g. in parking lots).
- The Borough should take steps to enforce no idling laws, starting with the creation of incentives to eliminate the unnecessary idling of vehicles. For incentives to be successful, the motivations (behavior patterns) of idling drivers must be understood. The Borough might consider partnering with UAF or the FNSB public schools to create a student-run study of the reasons drivers idle.
- Reduce idling at intersections by encouraging DOT to install right turn pockets and roundabouts wherever possible. The Borough should work with DOT&PF to expedite the development of an alternate route into the Bentley Trust development, bounded by the Steese Hwy, Johansen Expressway, and the Alaska Railroad, in order to reduce traffic congestion and idling.
- Switch street and traffic lights to LED and determine which street lights can be safely switched off.
- Increase carbon capture from coal fired power plants.
- Implement steps to reduce single-commuter vehicles within the FNSB. This might include enhanced planning for additional biking and walking routes and the creation of workplace incentives for carpoolers, public transportation riders, and pedestrians and bike riders. It should also include the continued expansion and support of mass transit, to provide an alternative to private vehicles.
    - FNSB public transportation should strive for lowest carbon emissions possible.
    - The bus fleet could be expanded with smaller buses, fueled as efficiently as possible. Hybrids and hybrid-electric may become feasible.
    - Expand to rural routes and allow for flag stops.
    - Provide park and ride areas out of town (with plug-ins) along with increased public transportation to and from these places. Encourage car-pool and ride share.
    - Strive for low-cost ridership.
    - Bus routes between Interior communities and Anchorage area should be explored, perhaps as a partnership with the Municipality of Anchorage and other local governments along the service route.
    - To encourage bus use, the FNSB bus fleet might utilize GPS to broadcast their locations at major bus stops and on the internet.
    - Continue to create incentives for use of the existing public bus system.
- Continue to work with the Alaska Railroad to study the feasibility of establishing a commuter rail line link between Fairbanks, North Pole, and Eielson.
- Encourage telecommuting for employees working within the FNSB by taking steps such as downtown development of a wireless internet network (perhaps as a combination of free and subscribed access).

- Borough planning efforts should include in-filling for businesses, as well as housing, to decrease the need for motorized travel.
- The Borough should encourage new commercial development to provide priority parking areas (i.e. parking spaces nearest to building entrances) to compact vehicles, which are generally more fuel efficient.

Vulnerability of Infrastructure

- The Borough should encourage GVEA to prepare for more icing incidents, which could lead to damaged power lines and subsequent winter power outages.
- The Borough should incorporate information pertaining to those areas identified as showing susceptibility to future flooding and drainage issues into planning efforts.
- Establish building codes that address those areas of flooding.
- Work with the Department of Transportation and Public Facilities (DOT&PF) to identify and develop plans to mitigate for damage to roads, airports, and other infrastructure susceptible to thawing permafrost.
- Bike paths are at risk from permafrost thawing. As such, DOT&PF and the Borough will need to set aside funds for regular rehabilitation.
- Encourage DOT&PF to prepare for more road icing incidents.
- Encourage the Alaska Railroad to evaluate their infrastructure susceptibility to projected effects of climate changes and plan for actions to adapt and mitigate for vulnerabilities.
- Consider modifications to the property tax assessment system to encourage values other than development of all parcels as the highest and best use. Investigate opportunities to utilize assessing and tax policy to preserve areas that might be better suited to agriculture, green space, or watershed protection. Strengthen landscaping ordinances, including a focus on balancing requirements in rural areas with recommendations for defensible space, to decrease the vulnerability of infrastructure to wildfires.
- As pollution from summer forest fires increases, management of air quality needs to be addressed. Better micro particulate/VOC filtration systems should be built into occupied structures, and users should be educated regarding system maintenance. This might be done through existing programs (e.g. through coordination with volunteer fire departments using Fire Wise programs).

<u>Other</u>

- Endorse recommendations of the Borough recycling commission that may include new state policy on recycling programs.
- Encourage the State of Alaska to analyze the feasibility of building a chlorine free pulp mill to receive paper for recycling. It might be located where expertise exists and to provide a sustainable employment for areas such as Ketchikan. We'd have a recycled AND an Alaskan product. Paper pelletizing as a fuel source is a final use that should be considered only if not otherwise recyclable
- Bottle/can bill – proceeds to pay for cost of recycling/reuse.
- FNSB waste stream collection – more separation and recycling, suggest staffing the transfer stations (will address other issues of misdirection of hazardous waste, privacy concerns). Incorporate method for encouraging paper separation at household level. Idea: free disposal if items separated, charge for disposal if not.
- Increased opportunities from agriculture can increase self-sufficiency and reduced product transportation costs.

Suggested long-term actions (5-20 years):

Incorporate all short and mid-term goals into "business as usual" policy. Continue to monitor climate change impacts and greenhouse gas emissions and actively seek opportunities to increase energy efficiency and reduce vulnerability of infrastructure.

Links to Other Sectors

Air Quality

- Decreased summer air quality due to increased wildfire activity may require modifications to existing buildings such as increasing building ventilation and installing air filtration systems

Energy Production

- Energy costs, in particular, are driving a trend toward energy efficiency and conservation in new construction and through retrofitting of existing structures.
- High energy costs are leading more people to heat with wood, often in inefficient stoves/furnaces, adding to PM 2.5 and other air quality problems.
- By using best practices building standards in new construction and incorporating energy efficient retrofit techniques into existing structures, the energy consumption of public and private structures can be reduced by 25-50%.

Socioeconomic

- The creation of new, local jobs in retrofitting, green building, and energy conservation and efficiency could stimulate the local economy.
- Because the money saved stays in the FNSB community, the continued savings from energy efficiency and conservation efforts will continue to strengthen our local economy.
  More energy efficient construction may increase property values and increase the tax base.

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Socio- Economic

Public Health

Sensitivity	High
Adaptability	Moderate
Vulnerability	Moderate

There is limited research related to public health impacts in urban centers, such as the FNSB, in Arctic and sub-Arctic regions; and therefore, there is need for continued research and analysis in this area.

Climate change may have the following effect on public health:

- Warmer, longer spring and summer seasons may impact respiratory health by causing an increase in pollen allergens.
- Respiratory and smoke-related illnesses may increase due to an increase in wildfire activity (see Air Quality, Natural Systems). If wildfire smoke remains in the Borough air-shed for prolonged periods, secondary effects may include an increase in the incidence of depression (mental illness).
- There may be a continued increase in the numbers and frequency of venomous insects such as yellow jackets. There is also a potential for insect species not previously seen in Interior Alaska (e.g. poisonous spiders). Both have potentially negative public health impacts.
- We can expect increased transportation hazards on frozen rivers and lakes due to warmer autumn and spring periods, with a direct negative impact on public safety.
- More variable winter temperatures may increase freeze-thaw and rain events, leading to increased road icing, resulting in traffic accidents.
- With expected slight increases in flooding, there may be flood-related health impacts, such as contaminant exposure (e.g. through drinking water contamination), increased exposure to water-borne diseases (e.g. exposure to fecal coliform), and drowning.

Non-climate related (external) stresses:

- As detailed in the air quality section, we might experience local air quality issues related to energy production, home wood burning, community growth, and international sources (see also IIC- Cost of Energy Task Force Report).
- High energy costs in rural communities may lead to in-migration to the greater Fairbanks area, increasing the population of the FNSB. Additionally high local energy costs may put financial strain on individuals living within the FNSB. In combination, these non-climate stresses may create a need for more public shelters or low-income housing in population centers. Displaced people sometimes struggle with adapting to a new environment, which may in turn lead to an increased demand for social services.
- High energy costs also increase costs of commodities, freight, travel, recreation, getting to and from work, the cost of doing business, and hinders economic growth in the Borough.

External synergies:

- Warmer temperatures could encourage more outdoor activities and reduce cold-related stresses (e.g. related to air quality and mental health).
- Local actions to reduce PM 2.5 emissions, in order to meet federal standards, may improve air quality.

Adaptive capacity:

- For air quality-related issues, options include publicly-available accurate and up-to-date air quality information, installation of air filtration systems, medication, and relocating or temporarily leaving the area during the worst times of the year.
- Public education about venomous insects can decrease the dangers (e.g. through education about treatment).
- Monitoring ice conditions, public education about river ice safety, and increased emergency response capacity/awareness are options for adaptation to ice travel hazards.
- Continued monitoring and public education related to flood events.

Mitigation:

- There is potential to improve air quality by controlling the emissions generated from human activity; but due to the fire-prone conditions and extent of the boreal forest surrounding the FNSB, it is impractical to attempt reduction in carbon emissions from wildfire (see Built Environment section).

Suggested short-term actions (1 year):
- Public information/education to prepare for expected transportation, air quality and insect hazards.
- Public buildings providing "clean-air" spaces for emergency air quality situations.

Suggested Mid-Term Actions (2-5 years):
- Continue research to increase our understanding of climate change impacts on public health in FNSB and at Northern latitudes in general.
- Monitor public health conditions in the Borough, and create a public health strategy for the Borough that incorporates the above items.

Suggested long-term actions (5-20 years):
- Continue short and mid-term actions above.

Links to other sectors:
Air quality: wildfire and wood heating smoke air filtration.
Forestry: wildfire
Hydrology: flooding/ground water changes.
Built Environment

Economic Development

Sensitivity	Low
Adaptability	High
Vulnerability	Low

Businesses and economic development operate on different time scales than the science of climate and their projections. Businesses focus on daily, weekly, monthly, quarterly and annual trends. Most business cycles are discussed in terms of years, not multiples of decades. Business charts address hours, days, months, quarters and finally years, whereas climate change charts are measured in multiples of decades with interim multiples of decades not depicted to indicate trends. The differences between these lenses made it difficult for the business and economic development community to respond to the question of the impact of climate change on the FNSB. After working through this difference between systems, the economic development team concluded that FNSB businesses should be able to readily adapt to the climate change impacts projected by the scientists and other group leaders that provided input to this study.

Sensitivity of economic development to climate change:
- A warmer, longer spring/summer season may create an opportunity to grow new crops or perhaps increase the number of cuttings of forage crops. Experts should be consulted to determine agricultural potential given projected temperature and precipitation regimes.
- Consistent wildfires of sufficient size to cause smoke to overlay the Fairbanks valley could impact Fairbanks' reputation with tour companies resulting in reduced tourism.
- The possibility of the Northwest Passage opening up more consistently in the summer seasons could lead to increased tourism and the possibility of developing year-round mining along the Arctic coast. This is probably beyond the 20 year horizon, but within a 30 year horizon.

Non-climate related (external) stresses:

- CO_2 legislation is a political, rather than physical, response to climate change. This legislation, along with EPA's listing of CO_2 as a pollutant requiring regulation, could have significant impact on the cost of energy in the FNSB.
- High energy costs also increase costs of commodities, freight, travel, recreation, getting to and from work, the cost of doing business, and hinders economic growth in the Borough.

External synergies:

Anticipated CO_2 legislation and/or regulation may also be an opportunity if the community involves itself in influencing the legislation and works to develop innovative technical solutions to the problem.

- If the Northwest Passage becomes navigable during the summer tourism may increase to Barrow or the coastal communities which might increase air travel between Fairbanks and those communities. Additionally, at this time Prudhoe Bay is the only port served by road year-round on the American/Canadian side of the Arctic.
- If the extension of the growing season allows additional crops to be grown, the FNSB could increase its role as an agricultural producer. If it is able to grow crops like canola then it might be able to begin locally producing bio-fuels. There would also be potential for increased community based and commercial agriculture contributing to local food supply and sustainability.
- As forests are cleared to mitigate the wildfire danger to homes, the wood can be used to feed local pellet plants or biomass to energy projects.

Adaptive capacity:

The addition of a few days of above 85 degrees, additional precipitation, or days of above freezing in winter is something local businesses can readily adapt to. Due to overall drying, water use and demand are likely to increase for agricultural irrigation and Borough landscaping. It is possible that new species will be suited to the changing temperature and precipitation regime.

Mitigation: While not considered by the economic development group in the present study, there is potential for links between economic development and mitigation.

Suggested short-term actions (1 year):

- Based on the 2009 Fairbanks Energy Flex Plan consideration should be given to:
  A. Analyzing the potential in the economic development sector for opportunities in mitigation such as renewable energy development, job creation in weatherization and energy efficiency retrofit.
  B. Participating in and promote these opportunities as they are identified.
  C. Reducing the community's cost of energy through energy conservation and efficiency.

Suggested Mid-Term Actions (2-5 years):

- Continue to monitor the scientific results of climate projections and their implications and include in annual economic development strategic planning efforts.
- Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.
- Implement energy efficiency and renewable energy development based on cost saving models identified in year one.

Suggested Long-Term Actions (5-20 years):

- Continue to monitor the scientific result of climate projections and their implications and include it in annual economic development strategic planning efforts.

- Continue to implement energy efficiency and renewable energy development based on identified cost saving models.

Links to other sectors:
Air quality: wildfire concerns for quality of life and tourism
Forestry: wildfire concerns for quality of life and tourism
Hydrology: flooding/ground water changes Built *Environment:* energy efficiency, cost savings, renewable energy production

Outreach/ Education

The Education subcommittee met about 8 times over the spring, summer and fall of 2008. After consulting with UAF educators we concluded the most effective way we could help educate Fairbanks students about climate change, would be to work with the FNSB School District as they revised their Science Curriculum, a process repeated every 6 years. 2008 was the most recent revision.

We learned not to expect a whole new climate change strand to be added to the requirements already set for teachers to fulfill the State and Federal standards and goals. The best hope was to include climate change as a way to teach the current requirements.

- We reviewed the various drafts the FNSB Science Curriculum Rewrite team created in their established process. We found the term “climate change" had been added along with examples of how climate change meshed with existing topics.
- Currently, we are working on a Teacher’s Climate Change Kit, with specific lesson plans and materials gathered in one place, to make this subject as easy as possible for teachers to share in their classrooms.
- The Climate Change Task Force Reports will be shared with FNSB School District teachers to identify current, local data that is relevant for the students’ lives. FNSB School District Superintendent, curriculum administrators and science curriculum revision team were quite willing to consider our concerns.
- We agreed on the need to coordinate climate change educational efforts, so communities around the state could also benefit from our work.
- As part of our committee, UAF faculty endorse climate change requirements for education majors.
- The built environment group suggested making available an educational tool that utilized a simplified greenhouse gas and carbon footprint calculator for individual activities, consumer products, industrial activities, etc. This could be used by teachers and schools in curriculum development and by individuals to make more informed decisions.

Another area of work was contributing to Terry Chapin, UAF Climate Change researcher and Tom Paragai, ADF&G biologist, “Adaptation of Human Use of Natural Resources NS-8”report created for the Governor’s Climate Change Sub-Cabinet Adaptation Advisory Group. Here is the main gist of this work:

- Locally appropriate climate change adaptation plans are needed to launch adaptation steps by individual communities. Information-sharing would provide mechanism for communities to learn from approaches that have proven successful in other communities.
- Augment and coordinate existing outreach and education. Identify climate change as a high priority subject in the state science standards K-12. Increase support for and coordination among existing programs and entities that are addressing climate change education in Alaska’s schools. Develop lesson plans and activities that K-12 teachers can use easily to teach about climate change and provide training in climate-change education.
- Increase support at the University level for course development and delivery related to climate change, including climate-change courses targeted at teachers and natural resource managers.

- Support the development of outreach materials about climate change that are effective with the general public. There are many existing programs that are addressing this issue that should be augmented, including University of Alaska Cooperative Extension Service, Alaska Sea Grant Marine Advisory Program, Alaska Center for Ocean Science Education Excellence, Alaska Center for Climate Assessment and Policy and the Scenarios Network for Alaska Planning.

Suggested short-term actions (1 year):

- Develop kits for teachers that will have all the materials necessary to teach various "Mastery Core Objectives" and "Suggested Activities" sited in the new Revised Science Curriculum focusing on Climate Change.
- Included will be an extensive reference section. The reports from our Climate Change Task Force Committees will be found there to give teachers local data that will be most relevant to the students.
- Public meetings to disseminate locally-appropriate climate change adaptation plans are needed to launch adaptation steps by individual communities. Information-sharing would provide mechanism for communities to learn from approaches that have proven successful in other communities.
- Increase support at the University level for course development and delivery related to climate change, including climate-change courses targeted at teachers and natural resource managers.
- FNSB should acknowledge and continue to support the work of the superintendent, the school district curriculum administrators, and the science curriculum re-write team.

Suggested mid-term actions (2-5 years):

- Augment and coordinate existing outreach and education centers.
- Support the development of outreach materials about climate change that are effective with the general public.

A. SUMMARY

Climate change will cost everyone and, to some degree already does. The rising price of energy will in a perverse way help bring about a need to reduce energy consumption and thus carbon reduction, our most fundamental goal in mitigating climate change. However, it will also continue to put a strain on all sectors of the economy everywhere, including Interior Alaska.

Inasmuch as there are probably unknown impacts to climate change and others that we can only surmise, our recommendations are essentially our best educated assumptions, based upon available knowledge and common sense. Even so, acting upon these assumptions will lead to more of an improved and sustainable human and natural environment than if we do nothing. That was true 20 years ago and remains true today.

The biggest challenge is for us as individuals to realize that we must invest a considerable amount of effort as a society to save ourselves from even more costly adaptation efforts in the longer term.

The built environment is where we have put our economic resources. Aspects of the built environment are seriously at risk with climate change. To preserve our ability to survive, we must adapt this environment in such a way as to substantially reduce our energy consumption and flexibly adapt to climate changes.

B. GOVERNMENTAL COORDINATION

The problem

Climate change is already impacting us. Many groups, both governmental and non-governmental are scrambling to come up with mitigation and adaptation plans. Most recognize that there needs to be a coordinated effort to maximize the benefit from what will be an extraordinarily costly endeavor.

Recommendations

The FNSB should establish and fund an Office of Sustainability directly under the mayor. The mandate of this office is to coordinate efforts of FNSB departments toward greenhouse gas reduction policies and coordinate and collaborate with other local, state, and federal government agencies, local communities, and non-governmental groups in efforts to accomplish the same thing. This office is NOT responsible for implementing these policies – that is distributed to the relevant departments/agencies that are charged with implementation. Keyword: facilitate

C. TRANSPORTATION

The problem

Interior Alaska is susceptible to destabilization of frozen soils, upon which transportation corridors are built. There are areas that are susceptible to flooding from increased precipitation and rapidly melting glaciers. (reference ISER 6/2007 Larsen et.al. study)

The FNSB population has developed in a sprawling manner. This is driven by a combination of factors such as a historical lack of or at least weak land use planning, distributed land use from homesteads, lack of building codes outside the City of Fairbanks, and many areas with unbuildable soils. *(some of this applies to constructed environment section)*

Recommendations

1. Find ways to reduce transportation needs.

2. Work with DOT to identify and develop plans to mitigate roads roads/airports/other infrastructure susceptible to melting permafrost.
3. Work with DOT to identify and develop plans to mitigate roads/airports/flood control projects/other infrastructure susceptible to flooding.
4. Encourage DOT to prepare for more road icing incidents.
5. Bike paths are equally or even more at risk from permafrost melting, so DOT needs to fund for regular rehabilitation.
6. Reduce idling at intersections by requiring DOT to install right turn pockets wherever possible.
7. DOT must expedite alternate route into Bentley Trust development bounded by the Steese Hwy, Johansen Expressway and the Alaska Railroad to reduce traffic congestion and idling.
8. All entities that provide parking shall do so as to encourage smaller cars, provide plug-ins (and somehow get it generated from carbon-free energy).
9. Keep bike paths clear to encourage more usage. They are often unusable during winter.
10. Continue to construct bike paths with new roadways and major rehab efforts.
11. Educate driving and cycling public on commuter bicycle rules of the road.
12. Continue to expand and support and expand mass transit to provide alternative to private vehicles.
    A. FNSB buses should seek to be as carbon neutral as possible.
    B. Bus fleet could be expanded with smaller buses and fueled as efficiently as possible. Hybrids and hybrid-electric may become feasible.
    C. Allow for flag stops on rural routes.
    D. Bus routes between Interior communities and Anchorage area should be explored for non-governmental investment.
    E. To encourage bus use, the FNSB bus fleet should utilize GPS to broadcast their locations at major bus stops and on the internet.
    F. Re-investigate feasibility of allowing adults on school busses.
    G. Continue reduced cost or free use of public bus system
13. Unnecessary idling of vehicles should be stopped. The price of gas doesn't appear to have had an impact on SUVs from casual observation. Recommend a student run study of parking lots, including interview of idling drivers to establish behavior patterns.
14. Establish policies that encourage smaller and more fuel efficient cars and transportation technologies – *what are some of those policies? Tax rebates on hybrids/electric cars,*
15. Air quality issues (blends into human health).
16. Street and highway lighting – consider LED lighting and maximize lighting on area that needs lighting and reduce light pollution otherwise.
17. Non-transportation lighting (commercial, yard lights, recreational lighting (ski trails, etc.) – reduce consumption and through planning or building requirements. Insure that vendors stock most efficient lighting. Rebates for most efficient lighting could be offered. Incorporate into GVEA program.

18. As we reduce the number of transportation trips, the pollution during inversions can help us stay below the EPA new minimums.
19. Work harder with the Alaska Railroad to establish a commuter link between Fairbanks North Pole and Eielson.
20. Strongly encourage the Alaska Railroad to evaluate their infrastructure susceptibility to climate changes and how they plan to mitigate.
21. Work with agencies and businesses to encourage telecommuting. Suggestion to encourage downtown development might be a wireless mesh internet network as a combination of free and subscribed access.

D. CONSTRUCTED ENVIRONMENT

The problem

Not only has Interior Alaska developed with little forward land use planning, the absence of building codes, not even mentioning energy efficiency building codes, and the short term nature of speculative real estate development and building construction, the housing and commercial building stock is, by and large, extremely energy inefficient.

While climate change might bring about warmer winters, we are by no means heading for stable tropical weather in Interior Alaska. We can expect more precipitation, warmer summers, more frequent and protracted above freezing temperatures in the middle of winter. This makes us susceptible to freezing gutters, drainage and icing issues.

We also will likely experience flooding in some areas from more frequent precipitation and melting glaciers.

The constructed environment has perhaps the most opportunity for making fundamental changes in both adapting to climate change and reducing our carbon load on the environment. We all live and work in a constructed environment. We can't live without it. The bigger challenge is that we need to move away from the individualistic view of "it's mine, I can do whatever I want with it" to a community based view that we have a common problem and need to work as a group to adapt to future climate driven challenges. This isn't an easy shift in our society, and even harder to do in a short period of time, but is necessary to survive.

(also reference Haines Climate Change Plan p. 16)

Recommendations

1. Coordinate with the State of Alaska to revitalize the home weatherization program and major energy retrofits.
2. Coordinate with the State of Alaska to establish a commercial sector weatherization program.
3. Seek to build for and with sustainable building practices.
4. Establish building codes that stress energy efficiency for both heating AND cooling.
5. Identify those areas susceptible to flooding and drainage issues.
6. Establish building codes that address those areas of flooding.
7. Modify the property tax assessment system to reward more efficient and carbon reducing building practices for residential AND commercial construction.

8. Modify the property tax assessment system to encourage values other than development of every parcel as the highest and best use. Utilize assessing and tax policy to preserve areas that might be better suited to agriculture, greenspace, or watershed.
9. Coordinate with the State of Alaska and the building trades to educate the workforce and the design professionals to implement efficient and carbon reducing building practices.
10. As homes and businesses utilize tighter building techniques and pollution from summer forest fires increase, management of air quality needs to be addressed. Use of non-poisonous products in building products should be strongly encouraged (formaldehyde in carpets, etc.). Better microparticulate/VOC filtration systems to be built into occupied structures and users educated to maintain those systems.
11. Strengthen and focus landscaping ordinance, balancing requirements in rural areas with recommended defensible space. Establish a guideline for carbon mitigation by climate change survivable tree planting.
12. Encourage infill residential construction in already developed areas so as to provide affordable living to those who are economically challenged by increasing energy costs from FNSB area (climate change refugees) and other regional communities and villages.
13. Encourage GVEA to continue to pursue conservation over new generation.
14. **Modify the FNSB Comprehensive Plan, Platting and Zoning codes to** *(fill in here to summarize all applicable policies)**. Seek green infrastructure policies elsewhere for template. Suggested Bob Henzie's resources.*

E. ENERGY USE

The problem

We now generate, distribute and consume energy without any tie to the carbon cost. This failure to account for the cost of carbon now brings us the instability of our environment from climate change that bring with them substantial costs and unknown impacts. This is changing at a national and international level and is also driven by various communities and states who have taken a lead.

As the price of some energy sources (oil) increase dramatically, the front end cheaper alternatives of wood and coal are harder to discourage without any carbon policies. Use of wood and coal as a heat source in areas of climate inversions such as Fairbanks can lead to unhealthy air.

Recommendations

1. The Cost of Energy Study prepared in 2007 under the Interior Issues Council offers a number of good recommendations. Its fundamental policy was to reduce energy use. We recommend focusing on reducing our carbon emissions to mitigate climate change to both meet the Cost of Energy Study AND reduce our climate change policy. Our recommendation is for a fundamental policy is to work toward carbon free energy. We may never achieve a zero carbon goal, but we should always strive toward it.

   For example, there are inconsistencies in the Cost of Energy Study, such as the highlighted recommendation for investing our efforts into synfuel from either coal or biomass. Neither of these sources are even close to carbon free. As with ethanol, they require a substantive amount of energy and water for conversion. Carbon sequestration and capture are at best experimental. We

recommend that these techniques are inappropriate to invest in at a local level while lower cost carbon reducing options are open to us.

2. The FNSB should encourage utilities to generate electricity from carbon-free sources, such as solar, wind and environmentally acceptable hydro. This does not include nuclear, as storage of long lived toxic waste remains unsolved.
3. To the maximum extent possible, the FNSB should encourage distributed/on site solar and wind production for electricity and heating.
4. Ban any electricity from new power plants that use coal as a fuel source unless it fully captures and sequesters carbon.
5. Prohibit commercial sales of low end cost inefficient appliances – refrigerators, freezers, etc. (this could be phrased/targeted better)
6. Encourage co-generation from waste heat – e.g. Fairbanks District Heating
7. Encourage GVEA to prepare for more power line icing outages/incidents.
8. Local governments should continue to actively pursue energy retrofits for all buildings in their jurisdictions.
9. Seek partnerships for creative ways to reduce commercial electrical consumption. *An example of a challenge might be electronics displays in stores like Sears, Fred Meyer.*

(See Constructed for others)
What are some of the creative ways of reducing energy not otherwise mentioned?

F. OTHER

1. Have the State of Alaska impose a handling fee to assess the cost of recycling fee on imported goods, based upon cost of handling packaging. It could be based upon net vs. gross weight. The tax collected is to be used to reimburse those who handle the waste stream and to do so in a sustainable manner.

2. Encourage the State of Alaska to fund/bond/otherwise facilitate building a chlorine free pulp mill to receive paper for recycling. It might be located where expertise exists and to provide a sustainable employment for areas such as Ketchikan. We'd have a recycled AND an Alaskan product. Paper pelletizing as a fuel source is a final use that should be considered only if not otherwise recyclable

3. Bottle/can bill – proceeds to pay for cost of recycling/reuse.

4. FNSB waste stream collection – more separation and recycling, suggest staffing the transfer stations (will address other issues of misdirection of hazardous waste, privacy concerns). Incorporate method for encouraging paper separation at household level. Idea: free disposal if items separated, charge for disposal if not.

5. Increased opportunities from agriculture can increase self-sufficiency and reduced product transportation costs.

6. For the natural systems workgroup: note that melting permafrost tundra releases methane, which is many times more effective greenhouse gas (GHG) than CO2.

7. For the education/outreach workgroup: Find a simplified GHG calculator for activities, products, etc. that folks can use to make more informed decisions.

G. Other thoughts:

1. Mention the jobs from new energy efficiency economies.
2. Discuss what appears to be politically possible
3. Discuss prioritizing goals – e.g. do we pick away at specifics or establish a strong mandate first?
4. Funding – some initiatives already suggest funding. Reference Homer plan for other suggestions.

RESOURCES

Larsen, Goldsmith, et.al. (2007) Estimating Future Costs for Alaska Public Infrastructure at Risk from Climate Change.

Interior Issues Council, Cost of Energy Taskforce Report.

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King County, Washington. (2007) Preparing for Climate Change: A Guidebook for Local, Regional and State Governments.

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City of Homer. (2007) Climate Action Plan.

Intergovernmental Panel on Climate Change. (2001, 2007) Assessment Reports. www.ipcc.ch/ipccreports/assessments-reports.htm, www.ipcc.ch/pdf/assessment-report/ar4/syr/ar4_syr_spm.pdf

Appendix 5: Full List of Recommended Actions

Recommended Actions in the Short – Term (1 year)

This section summarizes recommendations made by the natural, built, and socio-economic sector groups outlined above. In order to facilitate the next project phase of prioritization, the task force steering committee has made an initial estimate as to the relative importance and expense for each action. Recommendations are listed in order starting with the most important and least difficult/expensive and working down to the least important and most difficult/expensive. **This list was used as our starting point for discussion in the prioritization workshop held on June 8, 2009, in the Noel Wein Library in which we will collectively prioritized these recommendations. The results of that prioritization workshop are reported above in the section "Prioritized Recommendations (June 8, 2009)" on page 13.**

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These recommendations and cost estimates are based on the experience and insight of task force members and do not represent the result of specific sector or economic analyses.

- We recommend that the FNSB incorporate climate change mitigation and adaptation as part of all of its planning, operations, and decision-making.
- One way to accomplish this is to establish a new position on Borough staff as climate change advisors to serve as a resource to existing Borough programs and staff as they enfold planning for climate change. We recommend this person serve as advisor for mitigation and greenhouse gas reduction, which would dove-tail with work reducing cost of energy, energy conservation and reduction of PM2.5. This person could also be assigned as advisor to incorporating climate change adaptation into Borough planning and business, school district curriculum development, and community outreach. This position should coordinate closely with the state climate change adaptation efforts.

Mitigation Recommendations

- Emissions Target. We recommend that the Borough set a target for reducing emissions and review this target bi-annually to account for continuous improvements in technology and possible future federal legislation. A cost/benefit analysis on emissions reductions is advised to identify the most cost effective measures and to serve as a basis for review and revision of emissions targets. These efforts should be linked to the Cost of Energy Plan utilization charts and the Borough Greenhouse Gas inventory. Ultimately, we recommend that the Borough aim for a carbon neutral economy.
- Reduce energy use. Mitigation goals may be achieved through reductions in energy consumption. Consistent with the Cost of Energy Task Force reports, we recommend that reducing energy use is a win-win action that can simultaneously reduce cost of energy and greenhouse gas emissions.

1. Specific Recommendations for Reducing Energy Use

In most cases these will also be cost saving. In some cases these will also contribute to reducing PM2.5.

- Adapt and adopt Homer brochure for employees (See Appendix 2).
- Program all Borough computers and similar electronics to shut down after 20 minutes of non-use. The Municipality of Anchorage saves $40,000 annually with this practice (Randy Virgin, Economic and Community Development, Municipality of Anchorage).
- Conduct a GVEA electrical use assessment of every FNSB building and rectify all shortcomings. (GVEA estimates 10-15% average savings in electrical costs.)
- Replace street lights and traffic lights with LED fixtures. Evaluate which street lights can be safely powered off between midnight and 6am. Evaluate long-term cost savings of installing fixtures to reduce light pollution (from Randy Virgin).

- Install occupancy or motion sensor lights in all public buildings. Reduce unnecessary lights at night to the extent possible for safety.
- Replace aging borough vehicles with hybrid or electric plug in models.
- Equip public employee parking spaces with timed/interval electrical plug-ins.
- Adopt best practices green (preferably LEED) building code for all new borough buildings (For 5-10% increased upfront construction costs, expect 20-50% lower operating expenses over the life of the building. Also healthier work environments lead to fewer absences, and a more productive and pleasant work place (USGBC)
- Conduct an energy rating on every publicly owned or leased building; implement the advice gained, one building at a time; Local governments should actively pursue energy retrofits for all buildings in their jurisdictions to reduce energy consumption. (Expect to reduce energy use by 25-50%. Upfront costs are moderate to high, but in most cases will be repaid with the savings on energy consumption.)
- For non-transportation lighting (commercial, yard lights, recreational lighting (ski trails, etc.), reduce consumption through planning or building requirements. Rebates for most efficient lighting could be offered. Incorporate into GVEA program.
- Install interval timers on all public parking vehicle plug-in circuits.
- Create incentives for commercial sales of energy efficient appliances, such as refrigerators, freezers, wood stoves, and furnaces.
- Seek partnerships for creative ways to reduce commercial electrical consumption. An example of a challenge might be electronics displays in stores like Sears, Fred Meyer.
- Encourage co-generation from waste heat – e.g. Fairbanks District Heating

2. Related to Air Quality and PM 2.5

- Adopt regulations for new wood/pellet fired boilers to comply with PM2.5.
- Enforce no idling laws
- Provide enhanced year-round public transportation
  1. Create incentives for workplaces to offer public transportation incentives to their employees.
  2. Bus fleet could be expanded with smaller buses and fueled as efficiently as possible. Hybrids and hybrid-electric may become feasible.
  3. Allow for flag stops on rural routes.
  4. Bus routes between Interior communities and Anchorage area should be explored for non-governmental investment.
  5. To encourage bus use, the FNSB bus fleet could utilize GPS to broadcast their locations at major bus stops and on the internet.
  6. Re-investigate feasibility of allowing adults on school busses.
  7. Continue reduced cost or free use of public bus system
- Work with the Alaska Railroad to establish a commuter link between Fairbanks North Pole and Eielson
- Idling at intersections could be reduced by requesting DOT install right turn pockets and round abouts wherever possible.
- Educate the public on proper choice, installation, and use of, wood burning stoves and furnaces.

3. Related to public health and safety and quality of life

- Increase the extent of bike paths and walking routes, including construct bike paths with new roadways and existing and future major rehab efforts.
- Keep bike/walking paths clear to encourage more usage. They are often unusable during winter.
- Coordinate with State Division of Forestry for public education related to fire management plans for effective control of wildfires in protection zones near communities along with focus on removal of hazard fuels and emergency evacuation plans.

4. Energy Production

- We recommend that all consideration for local energy production, including coal to liquid technology, be evaluated for its potential to reduce greenhouse gas emissions and that this criteria be used in prioritizing future plans for energy production in the Borough.
- Encourage distributed/on-site solar and wind production for electricity and heating.
- Encourage utilities to generate electricity from carbon-free sources, such as solar, wind and environmentally acceptable hydro. (This does not include nuclear, as storage of long lived toxic waste remains unsolved.)

Adaptation Recommendations

See also planning recommendations in Table 1 of Appendix 3

Built Environment and Transportation

- Support revision of design climate standards for engineers working in the Borough. New construction should use these revised standards to account for changing temperature and precipitation.
- Work with DOT and ACCAP graduate student, Eunkyoung Hong, to identify and develop plans to mitigate roads roads/airports/bike paths and other infrastructure susceptible to permafrost thaw and flooding.
- Update Borough flood plans to accommodate more frequent floods and higher water levels.
- Evaluate the potential for climate change impacts on waste containment structures.
- Update and make available map of current permafrost sensitive areas. This map will need to be updated regularly to account for rapidly changing conditions.

Air Quality

- Prepare to provide public buildings as "clean-air" spaces for emergency air quality situations such as wildfire smoke.
- Education of the public about what they can do in their own homes and lives to improve air quality and reduce exposure to poor quality air.

Public Health

- Implement on-going water quality monitoring for rivers and sloughs
- Create, fund, and staff public education programs relating to:
    - Water pollutants and disease related to water borne vectors
    - Hazards from venomous and other insects
    - Winter travel advisories as needed for safe river travel
    - Forest fire awareness and control programs such as Fire Wise on individual, local and state levels.
    - Public information/education to prepare for expected transportation, air quality and insect hazards.

Public Education

- Develop kits for teachers that will have all the materials necessary to teach various "Master Core Objectives" and "Suggested Activities" sited in the new Revised Science Curriculum focusing on Climate Change. Included will be a vast reference section. The reports from our Climate Change Task Force Committees will be found there to give teachers local data that will be most relevant to the students.
- As part of public outreach and education, hold public meetings to develop locally-appropriate climate change adaptation plans. Information-sharing would provide mechanism for communities to learn from approaches that have proven successful in other communities.

- Support University public outreach in climate change impacts and adaptation, including climate-change courses targeted at teachers and natural resource managers. This could involve the Alaska Center for Climate Assessment and Policy, the Scenario Network for Alaska Planning, and the Co-Operative Extension.
- FNSB should acknowledge and continue to support the work of the superintendent, the school district curriculum administrators, and the science curriculum re-write team.

Wildlife and Fisheries

- Place extra protective efforts on critical spawning areas and nursery areas. But if an area is actually drying, or prone to disastrous events such as floods or wildfire, there is not much that we can do to protect these critical areas.

Economic Development Recommendations

- Analyze the potential in the economic development sector for opportunities in mitigation such as renewable energy development and job creation in weatherization and energy efficiency retrofit.
- Participate in and promote these opportunities as they are identified.
- Consider climate impacts in sustainable forest use plans and practice.
- Convert dead and dying trees into value added wood products, wood composite deck materials, fuel pellets, furniture and house or saw logs.
- Pursue the development of fuel breaks and reduction of spruce dominated stands in fuel control zones in possible conjunction with biomass harvest for energy production. The development of shaded fuel breaks dominated by hardwoods will serve to reduce fire risk.

General suggestions for sustainability

- Minimize paper waste.

Recommended Actions for the Mid-Term (3 – 5 Years)

Mitigation Recommendations

1. Specific Recommendations for Reducing Energy Use

- Modify the FNSB Comprehensive Plan, Platting and Zoning codes to strive for green infrastructure.
- Modify the property tax assessment system to reward more efficient and carbon reducing building practices for residential AND commercial construction (new and retrofit).
- Continue to employ energy conservation and efficiency techniques.
- Continue public education programs (K-12 and adult) related to the need for energy conservation and efficiency.
- Seek partnerships for creative ways to reduce commercial electrical consumption. An example might be creating competitive challenge to reduce electricity consumption in electronics displays in stores like Sears, Fred Meyer.

2. Related to Air Quality and PM 2.5

- Switch all aging vehicles in the Borough fleet to hybrid or full electric.
- Promote city and town planning to
    - car-pool and ride share
    - reduced levels of individual travel, either distance or frequency
    - encourage production, distribution and sales of local products that do not require shipping (agriculture, value added forest products, biomass for fuels, etc.)

- Stress infilling for businesses as well as housing to decrease the need for motorized travel.
- Expand broadband capacity and work with agencies and businesses to encourage telecommuting. Suggestion to encourage downtown development might be a wireless mesh internet network as a combination of free and subscribed access.
- Encourage co-generation from waste heat – e.g. Fairbanks District Heating.

3. Related to Building and Construction

- Coordinate with the State of Alaska and the building trades to educate the workforce and the design professionals to implement efficient and carbon reducing building practices.
- Adopt a "best practices" building code suitable to our environment. Identify those areas susceptible to flooding, permafrost and drainage issues; establish building codes that address those areas of concern.
- Design and construct new public buildings to green, energy efficient standards.

4. Related to Agriculture

- Promote increasing opportunities for agriculture with expanding growing season to increase self-sufficiency and reduce product transportation costs.

5. Related to Public Health and Safety and Quality of Life

- Promote city and town planning to;
    - encourage more foot and bicycle travel
    - increase utilization of non-motorized transportation (walk, bike)

6. Energy Production

- Encourage utilities to generate electricity from carbon-free sources, such as solar, wind and environmentally acceptable hydro. (This does not include nuclear, as storage of long lived toxic waste remains unsolved.)
- Create incentives for coal generating plants to reduce emissions based on best available technology.
- Encourage distributed/on-site solar and wind production for electricity and heating.

7. Related to Carbon Sequestration

- Investigate options for economic development through carbon sequestration.

Adaptation Recommendations

See also planning recommendations in Table 1 of Appendix 3.

Education

- Continue public education programs (K-12 and adults) related to climate change impacts and adaptation. and the need for energy conservation and efficiency.
- Support the development of outreach materials about climate change that are effective with the general public (There are many existing programs that are addressing this issue that should be augmented, including University of Alaska Cooperative Extension Service, Alaska Center for Climate Assessment and Policy, Scenarios Network for Alaska Planning).

Public Health

- Support research to increase our understanding of climate change impacts on public health in FNSB and Northern latitudes.

- Monitor public health conditions in the borough and create a public health strategy for the borough that incorporates expected impacts from continuing climate change.

Infrastructure

- Retrofit structures, including lift-foundations (See Built Environment Section)
- Installation of drainage systems and/or retaining walls to reduce landslide threat in highly vulnerable areas
- Monitor changing permafrost conditions in the Borough, especially in areas of new development.

Economic Development Recommendations

- Continue to monitor the scientific results of climate projections and their implications and include in annual economic development strategic planning efforts.
- Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.
- Implement energy efficiency and renewable energy development based on cost saving models identified in year one.
- Continue to identify economic opportunities that are synergistic with decreasing greenhouse gas emissions and adapting to climate changes in the Borough.
- Implement energy efficiency and renewable energy development based on cost saving models identified in year one.

General suggestions for sustainability

- Continue to monitor the scientific result of climate projections and their implications and include it in annual economic development strategic planning efforts.
- Encourage the legislature to adjust financial incentives to encourage values other than development of every parcel as the highest and best use. Utilize assessing revenues to preserve areas that might be better suited to agriculture, green space, or watershed protection.
- Encourage state, federal and local policies that will lead to waste reduction and recycling. Institute a comprehensive, sustainable recycling program.

Recommended Actions for the Long – Term (5-10 Years)

- Continue to monitor the scientific result of climate projections and their implications and include it in annual economic development strategic planning efforts.

Appendix 6: Summary of successful climate change planning process in New York City

In New York City climate change planning was embraced as a way to integrate ongoing plans focused on growth management, infrastructure, and environmental sustainability. This piggy backing of climate change planning on other ongoing initiatives moved the climate change planning process to an advanced stage very quickly and satisfied several goals, with both immediate and long-term benefits.

Future climate change is a direct threat to New York City with its 600 miles of shoreline and a water supply network that extends through hundreds of miles of tunnels to upstate reservoirs. However, in many ways climate change will exacerbate problems that have already emerged. Heat waves, for example, have been a chronic health hazard and have strained the city's electrical power system. Its transportation infrastructure has already proven vulnerable to the moderately intense storms that are forecast to become more common as climate changes. Coastal wetland losses are accelerating.

As the largest metropolitan population (22 million) in the U.S., the New York City area had been the focus of a special regional study by the U.S. Global Change Research Program (USGCRP 2000). That report focused on water supply, coasts, public health, infrastructure, energy, and institutional decision-making sectors. This Metro East Coast report stimulated thinking about the city's vulnerabilities and brought together key players and constituencies under the banner of climate change. New York has recognized the need to plan and act to increase the sustainability of its urban structure and to diminish its vulnerability to future changes. Its strategies employ both mitigation and adaptation elements.

PlaNYC was announced in December 2006 as a sustainability and growth management initiative (plan page 10) to answer the question of what kind of city New York should be. The city's iconic slogan was repurposed as a motivating question when stakeholders were specifically asked "Will you still love New York in 2030?" Further, the plan is specifically intended to establish New York City as a model for other 21st-century cities to emulate (plan page 11).

After PlaNYC was announced, a top-to-bottom outreach effort began to receive input on goals for 2030. Hundreds of community leaders were invited to meetings in January 2007 and more than 300 attended (http://www.nyc.gov/html/planyc2030/html/home/home.shtml). In February and March another 5,000 community representatives were invited to borough town hall meetings and hundreds attended. Another 3,000 emails with suggestions were received. This input was synthesized into "10 goals for 2030" which became the basis for the plan.

The plan's scope was expanded beyond growth management when the challenges were recognized as too narrow and the issues too interlocked with other environmental problems to be addressed in isolation. In developing a model for what a city could be in the 21st century it was necessary to consider climate change as a major threat to sustainability. The ten goals of PlaNYC are distributed among three challenges areas (growth, infrastructure, and the environment) and six planning elements that correspond to the city's environment: land, water, transportation, energy, and air. The climate change strategy is seen as a cross-cutting element that integrates the other five elements (http://www.nyc.gov/html/planyc2030/html/plan/plan.shtml).

Sustainability is a unifying theme throughout the reports and is used to identify how each of the plan's initiatives can achieve multiple benefits. Dozens of initiatives are cross-referenced with the 10 goals. Most of the initiatives (e.g., reclaim waterfronts, increase tree plantings) work toward several of the goals. The plan becomes action-oriented by identifying a lead agency for each initiative as well as milestones for 2009 and 2015 (plan p. 142–155).

In August 2008, Mayor Bloomberg convened a panel of experts, modeled on the IPCC process, to advise New York about issues related to climate change and adaptation. This panel is chaired and constituted by several key players from the USGCRP's Metro East Coast study (NYPCC, p 4–5). The panel has baseline information about climate parameters of the recent past and uniform planning projections of how climate might be in the 2020s, 2050s, and 2080s. Impacts for various climate-related stresses are identified in the communications, energy, transportation, and water infrastructure sectors (NYPCC, Appendix D).

Also in August 2008, a public-private task force made up of approximately 40 city, state, and federal agencies, and corporations that maintain critical infrastructure (PlaNYC 2009 progress report, p. 38) began work. In Fall 2009 the panel is expected to release a report on what critical infrastructure is at risk and adaptation recommendations (PlaNYC 2009 progress report, p. 39)

In summary, in New York City climate change planning was embraced as a way to integrate ongoing plans focused on growth management, infrastructure, and environmental sustainability. Planning for climate change adaptation appears promising because it builds on a previous climate change assessment of the region, engages climate change scientists and representatives of key agencies, utility providers, and businesses, and is vigorously promoted by the Mayor's office. This piggy backing of climate change planning on other ongoing initiatives moved the planning process to an advanced stage very quickly. This allowed initiatives to be selected that satisfied several goals, with both immediate and long-term benefits. The public-private initiative that was developed provides for a coordinated approach and helps each group identify vulnerabilities and pathways to solutions.

References for New York City Planning Process

- http://www.nyc.gov/html/dep/html/home/home.shtml
- http://www.nyc.gov/html/dep/html/news/climate_change_report_05-08.shtml
- http://www.nyc.gov/html/dcp/home.html
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