American Planning Association

POLICY GUIDE ON PLANNING & CLIMATE CHANGE

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1.0 INTRODUCTION

Today, planners have the opportunity and obligation to address the challenge of global climate change. The planning profession and the process of planning are uniquely suited to help communities rise to this historic challenge. This Climate Change Policy Guide recommends a policy framework to assist communities in dealing with climate change and its implications. Success will require new policies and a bold new approach to planning, including the recognition that there will be enormous challenges to our political and economic institutions to address the myriad impacts of climate change.

The earth is getting warmer and it will continue to do so well into the future, creating a wide range of impacts that include sea-level rise, droughts, and heat waves. The key question is how fast and how severe the impacts will be and whether we can adopt policies for mitigating and adapting to these impacts. Climatologists reporting for the United Nations Intergovernmental Panel on Climate Change (IPCC) see human activities as almost certainly the major contributor to current global warming and express growing fears that such warming will accelerate in the coming years with potentially devastating impacts.

In recent years, new scientific findings and media coverage have brought the issue of climate change to the attention of planners, lawmakers and the public. Each of the last three decades has consecutively been the warmest on record, validating the IPCC contention that climate system warming is "unequivocal." Scientists anticipate climate change impacts that include accelerated sea-level rise, drier conditions in the Southwestern United States, higher amounts of precipitation in northern states, and more frequent heat waves in every region of the U.S. These conditions make it imperative than planners and policymakers work immediately to implement new policies to address climate change.

Scientists believe that the effects of human induced global warming cannot be eliminated because of the volume of greenhouse gases (GHG) already emitted into the atmosphere., The IPCC 2007 Summary for Policy Makers states that "(b)oth past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea-level rise for more than a millennium, due to the time scales required for removal of this gas from the atmosphere." Scientists also note that the rate and volume of future GHG emissions can be reduced, lessening the extent of dangerous impacts on ecosystems, communities and human health.

Consequently, responses to climate change can be put into one of two categories. Responses intended to address the "cause" of human-induced climate change (e.g., production of CO2 and other greenhouse gas emissions and deforestation) through reductions in vehicle-miles traveled, green building techniques, and reforestation are classified as *mitigation* measures. Efforts to address the "symptoms" of climate change (e.g., drought, intense precipitation, sea-level rise, and heat waves) through water resource management, stormwater control, coastal hardening, and providing shelters for at-risk populations can be considered measures of *adaptation*.

The built environment is a primary contributor to climate change and GHG emissions. Roughly 50 percent of human-caused GHG emissions result from heating and cooling buildings and from transporting people and goods. Planners have significant opportunities to reduce emissions from these sources through promotion of multimodal transportation alternatives, compact development patterns, energy-efficient building siting and design, urban forestry, local foods, conservation of natural areas and resources, sustainable capital investments and economic development, low impact development practices, and many other initiatives and activities.

Additionally, both the built and natural environments are at risk from climate change impacts that will occur regardless of the extent to which GHG emissions are mitigated. Flooding, drought, stronger storms, sea-level rise, and higher temperatures will challenge the resilience of built and natural systems. Planners have the opportunity to help their communities adapt to these impacts by identifying vulnerable populations and ecosystems and developing plans to enhance their resilience.

Consequently, it is incumbent on planners to work toward addressing both the mitigation and adaptation components of the climate change response. As the IPCC AR4 Synthesis Report puts it:

> There is *high confidence* that neither adaptation nor mitigation alone can avoid all climate change impacts. Adaptation is necessary both in the short term and longer term to address impacts resulting from the warming that would occur even for the lowest stabilization scenarios assessed. There are barriers, limits and costs that are not fully understood. Adaptation and mitigation can complement each other and together can significantly reduce the risks of climate change. (AR4 SYR; Topic 5; 2007)

The need for both mitigation and adaptation responses to climate change makes planning central to any policy solution. Planners must play a key role in promoting energy efficiency in the existing built environment and changing development patterns, transportation systems, and regulations in ways that reduce GHG emissions, while simultaneously enhancing the resilience of communities to unavoidable climate impacts through adaptative responses such as stormwater management, improved hazards planning, and efficient use of climate-sensitive resources like water.

Planners must also understand that there is a "***no regrets***" approach to much climate change work. Reducing GHG emissions also reduces pollution; further, if these emissions reductions are achieved through green building development and reductions in vehicle-miles-traveled, there are economically measurable savings in energy expenses and traveler convenience. A more compact urban form has the potential to reduce both GHG emissions and infrastructure costs. A public safety program that enhances climate resiliency can also protect property and persons from existing threats. Building a bridge with greater clearance above a coastal estuary accounts for both future sea-level rise and current storm surge potential and may have environmental benefits as well. If these sorts of actions are undertaken to address potential climate change impacts or to reduce its effects, they will have collateral benefits regardless of the future state of the climate.

This policy guide provides planners, engaged citizens and elected officials with strategies to slow the pace of climate change and to adapt to its impacts.

1.1 The Role of Planners

Planners have been involved in activities that have had positive climate change impacts for a long time. Efforts to combat sprawl through promotion of a more compact land use pattern, for instance, result in fewer vehicle-miles traveled, reducing the amount of greenhouse gases going into the atmosphere. Virtually every community has a natural disaster response plan that can be modified to help citizens adapt to climate change effects. However, these different efforts have seldom been placed under the umbrella of climate change. As a result, there are few comprehensive efforts to address climate change at the local government level.

This is starting to change.

For the last decade, planners have rightly focused on smart growth and sustainability but have not always seen them as directly connected to climate change. The American Planning Association ratified policy guides on both topics, in addition to this one for climate change. Innovation in these areas has been important; however, the growing climate crisis and the emerging policies to address it make it essential for planners to respond to climate change issues now. Policy action on climate change is happening across the nation. More than 500 cities have pledged to significantly lower their emissions and, the majority of states now have special commissions or adopted action plans on climate change. Nearly half have already set overall GHG emission or vehicle-based GHG emission targets. Many have developed adaptation plans. The American Planning Association maintains a resource database on energy and climate change issues on its webpage that chronicles the work many communities are doing in this area. Planners will be called upon to implement many aspects of these new programs and craft plans that meet new emission targets and address adaptation concerns.

Planning can play an important role in influencing societal actions that can slow the pace of climate change, mitigate the effects that do occur and allow adaptation to the ultimate impacts of global warming. The planner's role will be extremely important because it will deal with such basic issues as community design, transportation networks and use and increasing development density. Elected leaders and citizens will rely on plans, direct investment, design, and development strategies that are efficient and sustainable and which comport with other community priorities. Planners will also have to address the potential costs imposed on households by climate change and the policies adopted to address it. The climate challenge will require the comprehensive, long-term perspective that planning is uniquely qualified to provide.

Four ideas form a framework for this guide. First, the policy responses to climate change need to be based on the best possible science. Because climate change is bringing about previously unrecorded conditions, projections based on new scientific modeling are the best way to anticipate and respond. Planners must have access to vital data, information and resources to help them interpret these unprecedented changes

Second, the specific impacts of climate change are highly regional and even local in nature. Therefore, climate change policies cannot be based on a one-size-fits-all approach. Planners must be aware of what the future holds for their particular geographic region and formulate their strategies accordingly. While plans and policies must reflect the individual needs of local areas, any successful mitigation effort will require a national, and indeed international, framework for addressing GHG emission.

Third, adapting to climate change is just as important as mitigating it. Planners can have a significant effect on climate change mitigation through a variety of actions, including encouraging higher density development, reducing vehicle-miles-traveled (VMT), using green building techniques, and supporting alternative energy sources. However, due to the extent of potential impacts projected under even the most aggressive mitigation scenarios, planners will also need to address the effects of climate change including rising sea levels, greater drought conditions and flood control in planning for adaptation.

Finally, planners need to communicate about climate change in new and different ways. Policies that we develop now will have a long-range timeframe. Given that it is often hard to keep people engaged over even the short-term, planners will need new communication tools to explain climate change issues and maintain the focus on long-term adaptation and mitigation responses. Citizen participation and engagement is vital to the success of climate change efforts.

Planning is vital because of its comprehensive approach to the built environment, but traditional approaches are not enough to mitigate and adapt to climate change.. A dramatic new response to climate change is required. Business as usual or small, marginal reforms will not suffice. The nation and our communities must commit to incorporating climate change considerations in a thorough, comprehensive new approach to physical, social and

economic planning. Planners must promote this major shift in the public policies that drive development decisions, growth and infrastructure investment.

1.2 Smart Growth, Sustainability and Climate Change Responses

Many communities have invested considerable effort in producing smart growth and sustainability plans to encourage a more effective and efficient use of resources, to promote sound fiscal policy, and to achieve infrastructure, economic development, social equity, and environmental objectives. Virtually all of these initiatives have positive outcomes for climate change responses. For example, a more compact, interconnected development pattern reduces vehicle emissions (a climate change goal) while promoting efficient use of infrastructure, public health and environmental stewardship (all smart growth/sustainability goals).

Consequently, it is important for planners to recognize that many climate change responses are ones that can be undertaken for a variety of other important reasons. There is a demonstrated synergy between reducing GHG emissions and fiscal and environmental sustainability, or between improving community resilience to climate change impacts and smart growth infrastructure decisions. Decision makers may be more inclined to reduce commuter costs than to reduce GHG emissions, for example, allowing planners to make progress in climate change responses in an indirect fashion.

By promoting the synergy between smart growth, sustainability and climate change mitigation and adaptation, planners can effect positive outcomes through a so-called "no regrets" approach, whereby actions taken to adapt to or mitigate climate change are ones that should be taken anyway for other reasons related to smart growth and sustainability.

1.3 Social Equity and Climate Change

Planners are required to address social equity in their work as part of APA's *AICP Code of Ethics and Professional Conduct*. As Hurricane Katrina and heat wave mortality figures teach us, lower income and elderly populations are more at risk and will bear the brunt of many climate change impacts. Additionally, indigenous populations, particularly American Indians subsisting in traditional ways in the Pacific Northwest and Alaska, will also face significant difficulties disproportionate to other populations as a result of climate change.

As a consequence, planners need to ensure that the responses they develop to address the impacts of climate change take into account the varied needs of all sectors of the community in order to equitably meet the significant challenges facing us.

2.0 Climate Change Science

Climate change science is complicated by the tremendous number of variables associated with climate that result from the complex interaction of the atmosphere, the oceans, ecosystems, and land forms. Developing scientific models that accurately simulate past trends and project future circumstances is difficult. Lack of a significant history of quantifiable measurements from instruments creates the need to understand the global climate history through the geologic record, glacial ice cores, tree ring analysis, and a variety of other less exact methods.

As a result, there is always a level of uncertainty associated with climate change predictions, just as there is in most other areas of intense scientific inquiry. This is to be expected, and scientists compensate for uncertainty by expressing predictive assessments in ranges of expected results. Opponents may attack such ranges as a reflection of weak evidence or of poor analysis, but it is instead a standard application of the scientific method.

One of the most important organizations working on interpreting state-of-the-art science on climate change is the Intergovernmental Panel on Climate Change (IPCC). The IPCC was formed by the World Meteorological Organization (WMO) and by the United Nations Environment Programme (UNEP) in 1988 and has been meeting periodically to discuss atmospheric and meteorological data, climate scenarios, projections, and models as well as scenarios of a different sort - anticipated trends in human population growth, energy usage, and economic development patterns.

In April 2007, the IPCC concluded that there is a significant human-induced contribution to climate change and that this human component is currently the single greatest contributor to worldwide climate change. The IPCC also concluded that climate change impacts are going to be extensive and will continue to occur for hundreds of years regardless of the scale and expedience of human intervention. According to the IPCC, these climate impacts will manifest themselves in regionally variable droughts, flooding, thawing permafrost, stronger storms, sea-level rise, wildfires, heat waves, and other weather and climate effects on the natural and built environments.

These conclusions are a measure of the substantial amount of scientific evidence supporting global warming theories. Despite the abundance of this evidence, there remains no single, universally accepted climate change scenario that specifically projects the extent of global temperature rise and the resulting consequences. This is certainly understandable given both the complexity of the issues and, just as importantly, the impossibility of knowing what economic development model will be followed by each of the world's countries. To what degree will industrialized nations reduce their production of greenhouse gases? Will industrializing countries agree to risk their economic growth by limiting their consumption of fossil fuels? To what extent will nations whose economies are built on agriculture and extraction (e.g., logging and mining) adopt sustainable practices?

These are political issues, not scientific ones. Consequently, the IPCC addresses this inherent uncertainty by developing a range of possible development scenarios that might emerge over the coming century and projecting likely climate impacts that result from each scenario.

Additionally, the IPCC projects that higher levels of warming will have significantly greater impacts than lower levels of warming, but, in all cases, many impacts will be irreversible. For example, approximately 20-30 percent of species assessed so far are likely to be at increased risk of extinction if increases in global average warming exceed 1.5-2.5°C (relative to 1980-1999). If global average temperature increase exceeds about 3.5°C, model projections suggest significant extinctions (40-70 percent of species assessed) around the globe.

A key distinction that planners must understand is the difference between climate change and climate variability. The U.S. may go through an unusually cold winter and measurements taken from that seasonal event will affect scientific assessment. However, a cold winter, by itself, does not constitute the end of global warming trends that have been occurring for decades. For example, a short period of cooler weather in the 1970s resulted in claims in popular literature and even some scientific papers that a new ice age was imminent. More thorough scientific analysis has shown that cold spell to be nothing more than an example of climate variability.

Our constantly variable weather will always result in short-term anomalies of heat and cold, flooding and drought, hurricanes and calm. These events must be put into perspective to create a picture of what the IPCC calls "average weather" in order to identify prolonged changes to that average which constitute actual climate change and are not just manifestations of climate variability.

> Climate in a narrow sense is usually defined as the "average weather" or more rigorously as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period is 30 years, as defined by the World Meteorological Organization (WMO). These relevant quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system.

2.1 The Greenhouse Effect and Carbon Dioxide

The greenhouse effect must be understood if planners are to be able to properly understand and explain the reason why greenhouse gases are so important to climate change. Solar radiation that reaches the Earth either penetrates the atmosphere or is reflected back into space. The radiation that penetrates the atmosphere is, for the most part, absorbed by the surface of the Earth (both land and water), warming the Earth and released as infrared radiation. The released infrared radiation either passes through the atmosphere and back into

space or is absorbed by greenhouse gases and re-emitted into the atmosphere where it contributes to warming the Earth's surface.

Greater concentrations of greenhouse gases in the atmosphere result in larger amounts of re-emitted infrared radiation and, therefore, greater warming of the Earth's surface. Due to greenhouse gas emissions from human sources, there are significantly more greenhouse gases in the atmosphere now than any time in the last 500,000 years.

Carbon dioxide (CO2) is the most prevalent greenhouse gas. Until the Industrial Revolution, there had been a long decline in the amount of CO2 in the atmosphere. This decline was due to the storage or "sequestering" of CO2 by plants and animals in living and fossilized forms and reduced volcanic activity that releases CO2 into the atmosphere. Fossilized forms of organic matter include oil, peat, natural gas, limestone, and coal.

Starting in the mid-1700s, the Industrial Revolution and modern agricultural practices reversed this trend. Fossilized organics were burned to create the energy needed for industrial processes, maintenance of indoor environments (heating and cooling), and transportation. Natural ecosystems were modified by agricultural practices, including forestry, and by sprawl development.

The growth in human population that has been supported by these practices now depends upon them for its maintenance and continued expansion, creating a self-perpetuating cycle. As a result, carbon dioxide concentration in the atmosphere has increased by over 30 percent, from 275 parts per million (ppm) in the early 1700s to about 390 ppm today, with annual increases of about two ppm. Projections of atmospheric CO2 concentration for the year 2100 range from approximately 550 ppm to over 800 ppm. At the current time, there is no scientific consensus about a "safe" level of atmospheric CO2 concentration, although the generally discussed safe CO2 concentration ranges from 350 ppm to 450 ppm. Unless significant reduction in emissions occurs on an international scale, the upper end of this range will be exceeded in approximately 30 years, underscoring the need for planners to expeditiously pursue effective climate change mitigation and adaptation actions.

2.2 Climate Change Impacts

Although there are some climate change impacts are anticipated to be common to every region of the United States, such as more intense weather events and negative effects on ecosystems and habitats, many impacts will vary by region. Planners must understand the regional effects of climate change in the communities they serve in order to develop and implement effective mitigation and adaptation strategies.

Some of the more significant regional impacts, identified in the 2009 U.S. Global Change Research Program publication *Global Climate Change Impacts in the United States,* include:

Northeast Region

- Shorter winters with fewer cold days and more precipitation; significant reductions in the winter snow season
- Under the higher emissions scenarios, 20 to 30 days in which the high temperature in cities exceeds 100°F; more frequent heat waves; and, on average, six weeks of longer summer conditions
- More frequent flooding as a result of sea-level rise and heavy precipitation events
- Economic effects including negative impacts on agricultural production, including dairy, fruit, and maple syrup, reduced snow cover adversely affecting winter recreation, and a northward shift of lobster fisheries and diminution of Georges Bank cod fisheries

Southeast Region

- Heat-related stresses for people, plants, and animals
- Decreased water availability due to increased temperature and longer periods between rainfall events
- Sea-level rise and the potential for increased hurricane intensity, significantly affecting coastal areas and ecosystems

Midwest Region

- In the summertime, increased heat waves and reduced air quality
- A longer growing season, potentially generating increased crop yields, provided challenges such as heat waves, floods, and greater numbers and varieties of pests can be managed
- Increased volatility in precipitation, resulting in more frequent flood and drought conditions
- Significant reduction in Great Lakes water levels as a result of higher temperatures that promote greater evaporation, affecting shipping, infrastructure, water-based tourism/recreation, and ecosystems

Great Plains

- Negative impacts on region's water resources resulting from increased temperature and evaporation and frequency of drought
- Stresses on agriculture, ranching, and natural lands management resulting from changes in precipitation and higher temperatures
- Negative effects on key habitats and ecosystems, especially wetland systems

Southwest Region

- Increasing scarcity of water supply, requiring policy decisions to prioritize allocation among competing uses such as urban populations and agriculture
- Increased temperature, drought, and wildfire, significantly affecting ecosystems
- Negative effects on tourism/recreation industries, including reduced snowpack in ski-resort areas and unique ecosystem degradation

Northwest Region

- Declining snowpack negatively affecting regional water supplies
- Higher temperatures increasing risks to forestry from wildfires and insect pests
- Negative impacts on coastal areas resulting from sea-level rise
- Decreasing habitat for cold-water fish, such as salmon

Alaska

- Higher temperatures increasing risks to forestry from wildfires and insect pests
- Longer growing season and longer periods for outdoor tourism due to increasing temperatures
- Damages to infrastructure due to thawing permafrost
- Negative effects on coastal areas from loss of sea-ice buffers, increasing frequency of strong storms, and thawing permafrost

Pacific and Caribbean Islands

- Reduction in availability of freshwater supplies due to changing rainfall patterns, including reduced precipitation in the Caribbean region and contaminated groundwater from flooding in the Pacific islands; sea level rise will threaten underground freshwater supplies
- Negative effects on marine ecosystems, creating problems for tourism and fisheries industries
- Greater frequency of coastal inundation resulting from sea-level rise and increased intensity of storms

In addition to the above *direct* impacts of climate change, migration represents a primary *indirect* impact simply due to its potential scale. Some direct climate change impacts may be quite severe and essentially permanent, such as inundation of coastal land areas resulting from sea-level rise and the constrained availability of potable water due to drought conditions or saltwater intrusion. Other impacts may be severe, event-oriented, and potentially repetitive, such as stronger hurricanes, floods, wildfires, and heat waves. Any one of these impacts has the potential to result in population migration to more favorable climate circumstances. For example, a significant part of the population of New Orleans has chosen not to return to that city after Hurricane Katrina. Planners need to be able to help their communities cope with increasing or declining populations which result from migration of people and businesses due to climate change impacts.

Simply put, people will migrate because of climate change. This migration may be due to physical, economic, or lifestyle reasons, such as property inundation due to sea-level rise, inability to affordably obtain water for industrial processes in a drier climate, or a desire for cooler weather. But that migration will occur.

Because some regions of the U.S. will experience less severe impacts than others, in a mobile society where people and industries can generally locate where they choose, some areas are bound to lose population and economic development due to climate change effects and

other less-affected areas will gain population and economic development through this relocation.

Rapid population growth may strain infrastructure, exacerbate NIMBYism, negatively impact community character, and create significant social services capacity issues. These effects can be compounded if there are humanitarian efforts to relocate non-U.S. populations from severely impacted areas of the world. Rapid population decline may create more affordable housing (assuming there is infrastructure to support such housing), less congestion, more open space, and similar circumstances that may not be perceived negatively by all persons residing in the affected areas.

Planners have the potential to positively affect migration impacts on their communities, regardless of whether there is extensive new investment or significant disinvestment as a result of climate change.

2.3 General Scientific Findings

Finding 1: Climate change largely results from a buildup of carbon dioxide and other GHG concentrations in the atmosphere. This buildup is principally caused by human activities, including fossil fuel burning for residential and industrial processes and for transportation, changes in development patterns, and deforestation. Global GHG emissions created by human activities have grown dramatically, with an increase of 70 percent between 1970 and 2004.

Finding 2: Warmer temperatures with related snow and ice melts in the arctic will create higher sea levels. The impacts of rising sea levels will be flooding in lowland areas and submersion of coastal beaches, marshes and estuaries. In addition, submersion will allow saltwater intrusion into groundwater and freshwater estuaries, as well as upstream from where rivers now empty into oceans. Longer droughts coupled with high temperatures may affect water supplies in many regions. Precipitation intensity is projected to increase in many areas, resulting in flooding and other stormwater runoff problems. The loss of habitat caused by these changes will affect many species of plants and animals. Because of increased urbanization and the speed with which climate changes are expected to occur, many, if not most, species will be adversely affected and threatened.

Finding 3: Advances in scientific analysis show that discernible human influences extend beyond average temperature to other aspects of climate such as: (1) sea-level rise; (2) changes in tropical and extra-tropical storm intensity; (3) increased heat waves; and (4) increased risk of both drought and heavy precipitation events.

Finding 4: Despite current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades. Human induced global warming and sea-level rise will continue due to the time

scales associated with climate processes. Even if GHG concentrations are stabilized, there will be increased global warming which is likely to create impacts that are abrupt or irreversible, such as the extinction of many plant and animal species.

Finding 5: The ability of populations to adapt to the effects of climate change is intimately connected to social and economic development but is unevenly distributed across and within societies with greater impacts on the poorer and more vulnerable.

Finding 6: Neither adaptation nor mitigation alone can eliminate all climate change impacts; however, they can complement each other and together can significantly reduce the risks of climate change. It is possible that some of the impacts of climate change can be reduced, delayed or avoided by aggressive implementation of mitigation strategies. Mitigation efforts and investments over the next two to three decades will have a significant impact on achieving lower GHG concentration levels.

Finding 7: Weather and climate on the Earth are quite variable. Consequently, no single weather event, such as a drought or a hurricane, can be unequivocally identified as a specific product of climate change. Climate is usually defined as the "average weather" over a thirty year period of time. Therefore, if there is a statistically significant increase in hurricane intensity, precipitation and sea-level over a thirty year period, such impacts can be considered to result from climate change.

Finding 8: Climate change impacts will vary by region. Generally, the northern parts of North America will see the greatest increases in overall temperature and precipitation. The Southwest region of the United States will become drier. Coastal areas not experiencing significant geological uplift will face sea-level rise. Glaciers, sea ice and permafrost areas will experience a greater extent and rate of melting or thawing. Tropical and extratropical storms will increase in strength, but not necessarily in number. Migration will be a major indirect impact of climate change.

Finding 9: Absolute certainty regarding climate change consequences is impossible to achieve. There are far too many variables in climate science and in future human political and economic development decisions to make 100 percent-certainty statements. Projections are typically scenario-based and are expressed in ranges.

2.4 Climate Change Policy Findings

Finding 1: Land use patterns play a significant role in reducing VMT and thus in reducing energy consumption and its associated GHG emissions. VMT can be reduced by promoting strategies such as compact development, high density development arranged to encourage pedestrians, bicycle and transit use, transit oriented development, and mixed-use development.

> "When viewed in total, the evidence on land use and driving shows that compact development will reduce the need to drive between 20 and 40 percent, as compared with development on the outer suburban edge with isolated homes, workplaces, and other destinations. It is realistic to assume a 30 percent cut in VMT with compact development. Making reasonable assumptions about growth rates, the market share of compact development and the relationship between CO_2 reduction and VMT reduction, smart growth could, by itself, reduce total transportation related CO_2 emissions from current trends by 7 to 10 percent as of 2050." (Ewing et al., *Growing Cooler*)

Finding 2: Transportation and parking policies can be employed to discourage private auto use and reduce VMT and its associated emissions. Current policies encourage auto use through a variety of direct and indirect subsidies. Programs such as congestion pricing, parking cash out, transit benefit equity, elimination of minimum parking requirement, and demand responsive parking pricing can be effective tools to reduce transportation-related GHG emissions and save energy costs.

Finding 3: Local programs that encourage the **preservation of historic buildings** and their adaptive reuse result in energy conservation. These buildings are typically closers to population centers and adaptive reuse generally involves lower impacts on natural resources than new construction. Technology exists to change and adapt the heating, cooling and ventilation systems of older structures so as to achieve the energy efficiency of modern construction. In addition the maintenance, restoration and adaptive reuse of existing urban areas (including their buildings, infrastructure and other assets) reduce energy use and VMT.

Finding 4: Use of **"green" building standards** result in energy conservation compared to conventional codes. About 75 percent of the electricity used in the country goes toward heating, cooling, and lighting buildings. Since over 70 percent of electrical energy is generated by conventional electrical power sources such as coal- and gas-fired generation plants, reducing the amount of power consumed by buildings is as important to addressing climate change as reduction of auto emissions. Research indicates that sufficient energy falls on the roof and south face of buildings to satisfy the power demands of those buildings.

Finding 5: Providing a **range of housing opportunities** within a community decreases commuting and its associated greenhouse gas emissions. It also reduces the need for private vehicle trips associated with job commutes.

Finding 6: Communities can encourage the production and use of **energy generated from renewable resources** by changing land use, building and site design standards. Changing the source of fuel used for electrical power generation to renewable energy will reduce GHG emissions. At the same time, technologies to cleanse emissions from traditional sources should also be expanded. Coal generation of electricity produces the bulk of GHG emissions. Policies should reduce reliance on coal fired plants, expand use of renewables, and promote

technologies to reduce emissions from coal fired power plants. Climate change planning must address the new opportunities and problems arising from increased use of renewable energy sources.

Finding 7: Communities can be made more resilient and defensible to the effects of climate change through land use policies that encourage **development in areas away from hazards** such as wildfires, land erosion and floods. Areas likely to experience floods and wildfires are expanding and threatening more populations due to a combination of the growth of new development into wilderness areas and changing weather patterns driven by climate change.

Finding 8: Protecting and enhancing green spaces in and near communities provides natural carbon sinks in soils, vegetation, and streambeds that can mitigate carbon emissions. Greenspace protection programs should not only be sensitive to natural ecological processes and habitat needs but also include an accurate calculation of GHG mitigation. The built environment and urban design should maximize natural areas and assets and incorporate indigenous plants or others appropriate to the community's climate to reduce energy and water consumption. These green spaces should also be designed to provide species migration corridors, particularly for species which need to migrate because of climate change sensitivity.

Finding 9: Promoting water conservation, and the use of nearby water sources reduces the amount of energy necessary to transport it, and therefore lowers greenhouse gas emissions.

Finding 10: Growing food for local consumption lowers transportation costs thereby lowering the use of fossil-based fuels. Climate change and its impact on arable land will reduce the amount of land available for **agriculture production** or future development of any kind.

Finding 11: Centralized facilities equipped with **communications technologies** such as videoconferencing allow community residents and businesses to conduct business and share information in ways that minimize travel thereby reducing VMT.

Finding 12: Planning and development policies to address climate change may vary based on size, economy, and ecosystem. While all of places can play a role in addressing climate change, the specific role may vary. Regardless of its specific variations, climate change planning must start at the local level.

Finding 13: Planning is a tool that must guide change, engage citizens, and **assist decision-makers,** including regional agencies and groups; local governments; neighborhood organizations; property owners; real estate and development professionals; insurance and finance companies; business leaders; hospitals, school boards, colleges and universities; and state and federal agencies to ensure better decisions and policies that address climate change.

Finding 14: The transportation sector is responsible for approximately one-third of GHG emissions, and if current trends continue, those emissions are projected to increase rapidly. The transportation sector's emissions are a function of vehicle efficiency, fuel content, and vehicle miles traveled. Significantly reducing emissions in the future requires improvements in all three areas. While improving vehicle and fuel efficiency are critically important, growth in VMT must be addressed in order to achieve overall reductions in GHG emissions. It is important to develop planning strategies to reduce and shift travel demand to modes that have the lowest carbon output and reduce VMT.

Findings 15: Economic strategies that reduce GHG emissions such as a nationwide and economy-wide **cap and trade system** for carbon emissions are needed to promote reduction in greenhouse gas emissions in an amount necessary to slow climate change.

Finding 16: Few communities **regulate and evaluate development** in a way that accounts for or reduces GHG emissions. Planning, regulations and development reviews should directly address climate factors. New or revised standards, regulations, practices and technologies are needed to reduce GHG and prepare communities to adapt to the effects of climate change.

Finding 17: Sea level is rising and the long-term impact of this phenomenon requires a systemic change in thinking. While difficult to predict, sea level rise will likely be nonlinear. Coastal ecosystems will likely be subjected to a combination of accelerating sea level rise rates punctuated by catastrophic flooding events. Traditional strategies that have been used and worked in the past will probably be inadequate. New options and adaptive management of coastal areas will be necessary to maintain the viability of many coastal areas Successful strategies will include planning for both natural succession and ecosystem management. The highest priority for new initiatives should be placed on those areas in which the most immediate and substantial risk exists and in which the impacts can be significantly reduced or avoided.

Finding 18: Climate models, impact models and data are important tools that help communities anticipate and respond to a wide range of possibilities resulting from climate change. Anticipating these changes is critical to developing appropriate responses unique the region.

3.0 Policy Guide Overview

The following climate change policy recommendations are organized around categories familiar to planners, including land use, transportation, natural resources, and similar areas of planning concentration. Some of these areas may be less familiar to planners, such as hazards management and public health, but all categories represent important responses to the problems posed by climate change.

Mitigation and adaptation techniques are provided within each category. Both mitigation and adaptation are vital policy responses and both must be addressed in any comprehensive approach to addressing climate change.

Additionally, policy recommendations are provided with regard to federal, state, and local roles in addressing climate change.

3.1 Federal, State and Local Roles

Introduction

It is important to clearly define the roles of various levels of government in addressing climate change issues. Role delineation not only avoids duplication of effort but recognizes the scale at which different categories of climate change responses should occur. For example, most efforts to adapt to climate change will primarily be implemented at the local level through retrofitting infrastructure, developing hazard management programs, facilitating urban agriculture, etc., while most mitigation efforts, including fuel efficiency standards, utility regulation and carbon pricing, will typically occur at the state or federal level. The following sections identify the primary roles of federal, state and local governments in developing climate change policies, regulations, and implementation measures.

Federal Roles

At the federal level, climate change is primarily addressed in four areas: research and development; standards, incentives and regulations; policy development and implementation; and national and international leadership.

Research and development is a critical federal role. Climate research and information-sharing by NOAA, EPA, and other federal agencies will form the basis for informed climate change action from the international level to the local level, as well as reduce uncertainties about scales of impacts and effectiveness of mitigation and adaptation measures. The newly created Climate Services program is intended to centralize federal climate information-sharing in formats that meet a wide variety of user needs through videos, visualizations, assessment reports, raw data access, and other media. Federal grants and agency research into alternative energy programs and practices help mitigate climate change through development of renewable energy sources. Identification of best carbon sequestration practices in the areas of agriculture and forestry, utility emissions, and green infrastructure will help mitigate

climate change, while identifying appropriate responses to climate change impacts through hazards management, public health, and infrastructure standards will assist with climate change adaptation. Federal grant funding of new technology supports eventual competitive pricing of such technology relative to fossil fuels whose development has been subsidized for generations by federal policies and research.

The federal government can play a key role in developing standards, and incentives and regulations. CAFE standards that address fuel efficiency will help minimize GHG admissions from vehicles. Treating greenhouse gases emissions as human health threats will improve public understanding of the issue as well as requiring industry responses to reduce emissions. Carbon pricing, whether through cap and trade, or a carbon tax, or some other mechanism, will provide incentives for emissions reduction practices and research. All of these efforts will assist in the mitigation of climate change.

A third area of concentration for the federal government involves policy development and implementation. Transportation policies which focus on multimodal transportation alternatives, congestion management, and "fix-it-first" maintenance practices will reduce emissions by creating a more efficient transportation system. Energy policies which focus on renewable energy, improved energy transmission and storage systems, and carbon-free energy sources will assist with climate change mitigation. Environmental protection policies which promote conservation of natural areas, implementation of green infrastructure practices, and internalizing of carbon emissions costs by generators of these emissions will help sequester carbon emissions or reduce their production. Housing policies which facilitate more energy- and resource-efficient construction and lending practices, including programs like LEED design, installation of Energy Star-rated appliances, and energy-efficient mortgages, will promote emissions reductions from the built environment. Agriculture and forestry practices which favor sustainability, food security, and carbon sequestration will help mitigate climate change. Policies relating to federal procurement activities involving buildings and vehicles can promote more efficient energy use by federal facilities both directly (more fuel-efficient fleets, more energy efficient building design, etc.) and indirectly (location of federal offices and facilities on transit lines, specification of locally produced foods for purchase by federal food vendors, etc.).

A final federal role addressed in this policy guide is involves national and international leadership. Climate change effects will not respect political boundaries and every state and nation will be impacted to some degree. The federal government must lead in helping develop international responses to climate change, ranging from humanitarian aid to severely impacted nations and regions to worldwide efforts to reduce GHG emissions. The United States is a major direct generator of greenhouse gases, and, through its consumption of products made in other nations, it is a major indirect generator of greenhouse gases. The United States is also a leader in the development of information and technology which can assist in addressing climate change issues. These factors strongly support the need for a federal leadership role in climate change responsibility.

State Roles

In many ways, state roles concerning climate change are similar to federal roles. Research and development, establishment of standards, incentives and regulations, and policy development and implementation are also key state level climate change roles. However, these roles must vary from state to state based on the specific climate change circumstances that each state faces. States having to contend with drier conditions have very different R&D, regulatory and policy issues than states facing generally wetter conditions; coastal states have sea-level rise concerns which are not necessarily shared by inland states.

This variability is largely in the area of climate change adaptation, however; mitigation roles are not substantially different from one state to another, and all center on the reduction of greenhouse gas emissions. State climate action plans will typically cover energy efficiency in procuring and operating vehicles and buildings, promotion of land use patterns which reduce vehicle miles traveled, promotion of multimodal transportation systems, and regulation of utilities to require efficiency, carbon sequestration, and peak load reduction strategies, for instance. Additionally, in the area of climate change adaptation, state climate plans will cover hazards management issues which are of specific concern, such as permafrost thawing in Alaska and saltwater intrusion in Florida.

In the area of leadership involving climate change issues, regional and interstate cooperation is essential to address water supply and drought response concerns, for example. Failure to achieve cooperation can result in legal actions, such as the recent lawsuits between Georgia, Tennessee and Florida concerning access to potable water in river systems. Leadership at the state level can also fill voids created by federal inaction on climate change or serve to complement positive federal actions.

Local Roles

It is at the local level of government where most climate change impacts occur. Local jurisdictions are where streets and homes are flooded, where infrastructure is installed, where potable water is supplied, and were building permits are issued. When storms and droughts occur, citizens look to their local governments for answers and solutions, as well as for protection. When citizens desire more energy-efficient buildings and development patterns, local plans, incentives and regulations help make these desires a reality. As a result, “Main Street” is the nexus for climate change action.

While some communities have adopted climate change mitigation and/or adaptation plans, virtually every community has some land use, capital improvement and hazards management planning activities or programs. These plans and programs can form the basis for responses to climate change at the local level, provided they are adjusted to address anticipated local and regional impacts from climate change. Furthermore, these plans and programs can be viewed by decision-makers as “no regrets” responses to climate change; that is, even if there is limited local support for direct climate change action due to political or economic concerns, significant progress can be made through relatively minor adjustments to other plans and programs. For example it is only marginally more expensive to install a larger stormwater

collection system to accommodate higher volumes of runoff, only good fiscal planning to install energy-efficient streetlights that are cheaper to operate in the long run, and only common sense to identify and protect population concentrations that are vulnerable to strong storms. Finally, local climate change leadership can help compensate for inaction at the state and federal level or complement actions taken by higher levels of government.

Federal, State, and Local Roles in Climate Change Mitigation and Adaptation General Policy A: The American Planning Association, its Chapters and Divisions, and planners support the clear delineation of roles for and aggressive, proactive action by various levels of government concerning climate change mitigation and adaptation.

Federal Role Policy 1: National Leadership on Climate Change

Planners support strong leadership by the federal government in establishing policies, programs, national standards, and funding prioritization that mitigate greenhouse gas emissions and prepare communities to adapt to climate change.

Reasons to support:

The federal government can provide funding, produce research and establish baseline regulation and policy on many topics related to climate change, such as motor vehicle fuel efficiency standards and energy policy. Also, action at the federal level can establish larger and more predictable markets for emissions reduction systems than can state or regional actions. Providing for such action at the federal level will result in a consistent approach nationwide and greater potential for successfully achieving emission reduction goals.

Federal Role Policy 2: U.S. International Leadership on Climate Change

Planners support stronger U.S. leadership in international efforts to create and adopt an international framework for achieving appropriate greenhouse gas emissions reductions.

Reasons to support:

Since the United States is and will remain one of the world's top greenhouse gas emitters, it should participate in creating and implementing an international framework for reducing greenhouse gas emissions in all nations. International agreements are critical to the protection of climate-endangered natural assets, ecosystems and communities. U.S. involvement also brings extensive scientific expertise and other resources to this effort. U.S. leadership is vital to bringing emerging economies, especially China and India, into an international climate change agreement.

Federal Role Policy 3: Federal Support for Climate Change Planning

Establish and fund federal assistance programs for planning for climate change and expand eligible activities under existing federal community development, transportation and energy programs to promote the integration of climate change and greenhouse gas emissions into local and regional planning. Fully fund the federal energy efficiency block grant program.

Reasons to support:

Among the best ways to address climate change at the local and regional level is by adapting and improving planning, policy priorities and capital funding that already direct public and private investment and development. Changing this planning to address climate change will require new analysis and implementation techniques that many communities have not undertaken or used in the past. Federal funding, such as a 'climate change planning grant' administered by the Environmental Protection Agency, the Department of Energy, and/or the Department of Housing and Urban Development, could provide needed resources to help communities adopt plans and policies changes to address the issue. In addition to direct funding of local and regional comprehensive planning, these resources could also fund pilot programs and research into best practices. Expanding existing grant, research and pilot programs to include new discretionary funding and policies that support investments to address climate change would further enhance the ability of local communities to confront climate impacts in planning and development.

If a separate categorical federal planning assistance for climate change program is not possible, then amendments to the federal Surface Transportation Act might allow such planning to occur through Metropolitan Planning Organizations and through Community Development Block Grant programs. Finally, regardless of how these funds are delivered, the White House Council on Environmental Quality might provide an overall policy framework for the evolvement of climate change planning as related to other related climate change considerations such as energy security and economic globalization.

Federal Role Policy 4: Climate Data and Information

Continue to develop and fund the Climate Services program as a central source of data and information concerning climate change. Support the development and dissemination of climate data and information by other agencies as needed for specialized purposes under the "umbrella" of the Climate Services program. Additionally, climate and weather monitoring technology, such as satellites and terrestrially based weather stations, must be continuously modernized to ensure their ability to accurately capture critical data.

Reasons to support:
Development and dissemination of climate change data and information from a central federal source reduces duplication of effort and provides a more effective method of getting the full range of information to user groups and the general public. The Climate Services

program has been created to serve these functions and should be supported by planners at all levels of government and in private practice. Climate and weather monitoring instruments and technology are essential tools in ascertaining climate change trends; as such, federal investment in maintaining and modernizing these instruments and technology is critical to ensuring effective mitigation of and adaptation to climate change.

Federal Role Policy 5: Research and Development

Establish and fund research and development programs to support alternative energy and fuel production, development of carbon capture and sequestration technologies, production of energy-efficient and climate-resilient building and construction materials such as "cool roofs" and heat-resistant pavement, development of effective storm surge barriers to protect ports and other coastal infrastructure, climate mitigating and adaptive agricultural practices, and other technologies, materials and measures that are effective in climate change mitigation and adaptation.

Reasons to support:
The federal government has been a leader in R&D projects and programs in many areas; for example, military R&D in the 1960s intended to produce a large-scale, distributed computer network eventually resulted in the internet. Federal finding of R&D is essential to reduce development risks and achieve cross-disciplinary research cooperation in order to create new climate technologies at the pace necessitated by the global warming problem.

Federal Role Policy 6: Carbon Pricing or Incentives

Federal legislation should achieve at least an 80 percent reduction in greenhouse gas emissions below 1990 levels by 2050 through carbon pricing or incentives. Some of the funds generated from such action should be used to support local, regional, or state efforts related to planning and implementation measures that reduce greenhouse gas emissions. Import duties should be added to products imported into the US at a rate that effectively is higher than taxes applied domestically in order to prevent carbon production from simply being moved off-shore.

Reasons to support:

Pricing carbon would reduce distortions in existing consumer spending and industrial investment patterns that result from market failure to capture the externalized costs associated with carbon emissions. Funds generated from a carbon tax or a cap and trade system could be used to support the development and implementation of low-carbon technologies and sequestration measures, phase out higher greenhouse gas emitting technologies and facilities, fund local, regional and state planning initiatives, and other similar actions that serve to reduce greenhouse gas emissions.

Federal Role Policy 7: Regulation of Greenhouse Gases

Support the regulation of greenhouse gases as hazardous by-products of industrial processes, energy generation and use, agricultural practices, and waste-disposal processes. Import duties should be added to products imported into the US at a rate that provides cost equivalency to complying with domestic GHG regulation in order to prevent the production of goods from being moved off-shore.

Reasons to Support:

Regulation of the production of greenhouse gases as hazardous by-products would recognize the role of these chemicals in posing health and safety hazards to persons, communities, ecosystems and the built environment. In addition to providing a mechanism for reducing their production, such actions would clearly signal the hazards these chemical pose to the general public.

Federal Role Policy 8: Regulation of Products

Use regulation to reduce the use of products with high energy use or production of greenhouse gases, including fluorocarbons, when viable alternatives exist**.**

Reasons to support:

Many energy-inefficient or high-carbon products, such as incandescent light bulbs, will continue to be used indefinitely unless they are banned or otherwise regulated. In such cases, voluntary action or market mechanisms by themselves are insufficient to bring about change, and regulation is needed. Many fluorocarbons, including CFCs, HCFCs, and HFCs, are potent greenhouse gas chemicals many times stronger on a per unit basis than CO2, although CO2 is a more significant contributor to global warming due to the volumes produced. Substitutes for many of these products are readily and affordably available.

Federal Role Policy 9: Federal Assistance to State and Local Mitigation and Adaptation Activities

Increase federal funding for technical assistance and critical planning data to state and local governments from federal agencies responsible for climate, weather, and hazard mitigation. Support improved climate model results that provide more localized information and predictions. Support standardized monitoring and reporting GHG emissions.

Reasons to support:

Many federal agencies have developed significant expertise and information regarding future climate change scenarios and potential measures to mitigate the effects of climate change. State and local governments are in need of these resources as they develop responses.

State and Local Role Policy 1: Climate Change Planning

State and local governments should pursue climate action plans, regulatory measures, incentives, technical standards and specifications, integration of climate change mitigation and adaption measures into comprehensive, neighborhood and regional plans, and other plans and programs in a regionally and/or locally appropriate fashion.

Reasons to support:
Given the regional nature of climate change impacts, state and local governments are often the most appropriate levels of government to develop plans, incentives, standards, and regulations to address climate change mitigation and adaptation. The American Planning Association has identified five "strategic points of intervention" for planners with regard to energy and climate challenges (PAS Report 558), all of which should be pursued at the state and local levels:

- Long-Range Community Visioning and Goal Setting
- Plan Making
- Standards, Policies and Incentives
- Development Work
- Public Investment

State and Local Role Policy 2: State, Regional and Local Action on Climate Change

Planners support collaboration and coordination by state, regional and local governments and governmental agencies to set greenhouse gas emission goals; develop and implement plans to address climate change; and incorporate climate impacts, indicators, benchmarks and targets in plans and development reviews.

Reasons to support:

Regardless of federal policy on climate change, there is a need to act at the state, regional and local level. Impacts of climate change will be felt in different ways in different parts of the U.S., so local, state or regional plans are necessary to provide the appropriate guidance for specific areas and communities. In addition, decisions about development patterns and infrastructure investments will have an important impact on the nation's ability to reach greenhouse gas emission goals. These decisions are usually the responsibility of local governments so they should play an active role in planning for, and taking action on climate change.

State and Local Role Policy 3: Regional Coordination

Encourage coordination and collaboration in multi-jurisdictional planning initiatives to address climate change and its implications at a regional level, including adopting new requirements and structures for collective action on climate-related planning and projects.

Reasons to support:

Action to address climate change involves decisions at all levels, including choices made by individual local jurisdictions. However, collaborations among jurisdictions can make it easier for each community to act because research, programs and facilities can be shared. Regional coordination will be necessary in order to meet aggressive targets for reduction of GHG emissions or for adapting to many wide-reaching impacts such as droughts. In addition, action that affects regional investments or assets will be more effective if it is the result of regional initiatives and partnerships. Regional visioning programs and blueprint plans create excellent opportunities to build action agreements to address climate change and to set goals in conjunction with coordinated planning for regional development and infrastructure investment. Regional governance structures and agencies can be very valuable in developing and implementing integrated approaches to climate change mitigation and adaptation.

All Levels of Government Role Policy 1: Education and coordinated information resources for Planners, the Community and for Decision-Makers

Support updating planning school curricula to specifically address and prepare students for new approaches to planning associated with climate change adaptation and mitigation. Support ongoing professional development for professional planners dealing with tools and techniques associated with climate change planning. Accurately and explicitly recognize and discuss climate impacts and considerations in public participation processes related to long-range community visioning and goal setting, plan making, standards, policies and incentives, development work, and public investment. Support and encourage updates to primary and secondary curricula to educate and the next generation residents; planners and decision makers.

Reasons to support:

Planners have a professional obligation to educate themselves about climate change issues. In addition, they share an obligation to include education about climate change in community outreach efforts in all planning programs aimed at the public and local policymakers. Success in addressing climate change requires different choices in the way communities are planned, developed and maintained. Yet many public and private sector decision-makers are not informed about the current status of climate change research and the potential that communities have to affect this global issue. Members of the general public may have even less information about what their daily choices mean for the future of the planet. Most planning processes include public involvement, interaction and education. Whenever appropriate, information about climate change and strategies for mitigation and adaptation should be incorporated into these public outreach campaigns. The effort to create a community climate change action plan will clearly include this educational component but it should be included in all areas of planning, from visioning to development review to capital investments.

All Levels of Government Role Policy 2: Communities and Climate Change Research

Support research that improves the ability of communities to reduce their carbon footprint by quantifying their impacts on climate change and the effect of their actions to address this issue. Support the research and development of new modeling and scenario planning techniques that incorporate climate change impact measurement. Support research into areas where communities can act proactively to adapt to climate change.

Reasons to support:

Global research on climate change is rapidly increasing scientific knowledge about this issue and making more specific connections between climate change and human activities. As this research builds the knowledge base, it is important that people gain information about the ways they affect climate change. Communities need to know what current human actions are contributing the most GHG, so they can target those actions. Continuing research is needed so communities, neighborhoods and individual residents or businesses can take action in ways that will help to mitigate or adapt to climate change.

All Levels of Government Role Policy 3: Effects on the Local Communities and Conditions

Support research to better understand the effects of global warming on regions, communities, natural systems, and the built environment. Expand and fund state and federal programs that supply vital data related to climate change and its impacts to local and regional planning agencies. Require new reporting and measurement of climate impacts in planning and development processes and reviews. Evaluate the wisdom of past land use decisions in light of climate change vulnerability and adaptation considerations to determine future areas of growth and capital investment.

Reasons to support:

Changes in climate due to global warming ultimately will be local in their effects. Changes can occur in the availability of arable land, length of the growing season, amounts of rainfall, temperature changes, levels of disruptive weather, and ecological balance, just to name a few. In addition to research about the implications of climate change for communities and urban areas in general, research is needed that will enable specific places to develop appropriate plans for action to mitigate and adapt to climate change. This research will help regions and communities plan for future urban development locations and patterns, identify and protect natural assets, and develop strategies to support local agriculture as it deals with changing climate.

All Levels of Government Role Policy 4: Planning to Address Time Frames and

Uncertainty

Planners support policies requiring climate change plans that provide a framework for decision-making and actions which prepare communities to mitigate and adapt to climate change, but which are flexible enough to address the continuing complexities and uncertainties of pace and degree of change. New planning and stakeholder participation methods are needed to help communities embrace and address this complexity and uncertainty, including longer planning horizons and the generation and consideration of multiple scenarios, indicators and triggers to guide action.

Reasons to support:

Planning to address climate change is particularly subject to time frames and levels of uncertainty that are unfamiliar to planners, policy makers and the general public. There may be a long time horizon before impacts are felt, there is some uncertainty about the extent of changes occurring in the global systems, and there are many unknowns about the costs and benefits of local action. However, this is also an issue where action must begin now. Consequently, the planning processes for climate change mitigation and adaptation must build consensus on direction and on ways to respond to future uncertainties while taking action in the short run based on the best available information.

All Levels of Government Role Policy 5: Identifying Greenhouse Gas Impacts

All levels of government should seek to identify and quantify estimated greenhouse gas emissions for various courses of action. Where emissions cannot be precisely quantified, plans should discuss the impacts of recommendations on greenhouse gas emissions on a qualitative basis. Climate planning elements should be incorporated in comprehensive plans, public investments, regulations and incentives, and environmental and development review processes.

Reasons to support:

Understanding the impacts of plan recommendations and development proposals on greenhouse gas emissions is an important step in determining the appropriate course of action. Allowing planners, elected officials and the public to judge the impact of a plan, project or regulation on emissions will help them evaluate the extent to which it contributes to greenhouse gas reduction goals.

All Levels of Government Role Policy 6: Inter-Disciplinary Approach

Establish opportunities for collaboration among design professionals (e.g., planners, architects, engineers), scientists, social scientists, economists, academics, and other key professions to develop and carry out plans that address climate change mitigation and adaptation. Increase coordination with other organizations and utilization of collective

data, benchmarks and regulatory standards.

Reasons to support:

Effective action to address climate change will rely on expertise, analysis and recommendations from many different disciplines. Since planners often are responsible for programs that engage stakeholders from diverse backgrounds, they are particularly well-positioned for leadership in convening and conducting the interdisciplinary processes needed to address various aspects of climate change. APA can play a leadership role in building a coalition that brings these interests and professional perspectives together to address climate change.

All Levels of Government Role Policy 7: Address Stakeholder Involvement in Plans and Actions for Climate Change Mitigation and Adaptation.
Engage all affected stakeholder groups in initiatives to create and implement climate change plans to ensure that no group is isolated from the process.

Reasons to support:

Success in addressing climate change will require many groups to change their current behaviors, business practices and investment decisions. These stakeholders should be part of the processes that create climate change goals, plans and implementation measures. An inclusive process allows diverse concerns (economic, environmental and equity) to be considered and increases the potential that these stakeholders will support the plans and actions that result. In particular, constituencies likely to experience disproportionate impacts should be proactively engaged in the climate planning process.

Climate change plans should reflect the adage that one should think globally and act locally. As with many environmental issues small incremental impacts may have broad cumulative impacts. Local initiatives and participation encourage a greater sense of ownership and consequently greater buy in to responsibility. The work of planners should encourage personal responsibility in the daily actions of local communities and the individuals who live in them.

All Levels of Government Role Policy 8: Social Equity and Environmental Justice

Support plans, standards, regulation, incentives, and investments to reduce the impacts of climate change on those populations most vulnerable to the impacts of climate change, including those dependent on subsistence agriculture and fishing.

Reasons to support:

Like other environmental justice issues, climate change is likely to hit hardest the populations who are least able to adapt, such as low-income communities in flood prone areas or families

who cannot afford adequate home insurance or higher energy prices if GHG mitigation measures substantially raise those prices. Action to address climate change should seek to reduce these sorts of impacts on these communities.

Many policy and regulatory responses to climate change adaptation and mitigation pose the potential for initial disproportionate impacts and costs on low-income communities. These impacts on low-income households and communities should be addressed and, to the greatest degree possible, off-set as part of any comprehensive federal, state or local approach to climate change.

All Levels of Government Role Policy 9: Evaluate tax, fee and other fiscal policies, including a land value tax, at all levels of government that have the impact of encouraging sprawl; change such policies where feasible.

Reasons to support:

Various fiscal policies at all levels of government may contribute to a sprawling pattern of development that contributes to GHG production, VMT increases and increased cost of service delivery, both fiscally and in carbon produced. It may be that the fiscal policies of a single entity taken alone do not have such an impact, but when overlaid with all other policies at different levels, the net effect is a preference for sprawling suburban and exurban types of development. Examples include excessive reliance on a single revenue source (e.g. real property taxes) may impact the type of development planned for and zoned for in a community.

3.2 Land Use

Introduction

Population growth in the United States has never been evenly distributed. From the country's infancy throughout most of its early history, settlement patterns occurred along coasts and rivers for transportation purposes. Later, towns formed around areas of natural resource extraction, from coal and iron ore mines in Pennsylvania and West Virginia to gold and copper mines in the West. Still later, railroad expansion opened the interior of the country to development, providing ready access to the agricultural abundance of the Great Plains. In the late 1800s, the great industrial expansion created cities where transportation resources, natural resources, and energy resources converged. In the 20th century, networks of roads crisscrossed the country, reducing in many ways the influence of ports, rivers and railroads on the movement of goods and services and the location of industries. Finally, communication advances combined with the globalization of labor and transportation largely freed the American economy from its prior geographic-based constraints.

As a result, the U.S. population is highly mobile, able to quickly transition from place-to-place to take advantage of economic opportunities, desired lifestyles, and favorable climate

conditions. This mobility creates the first great climate change/land use challenge - what to do when people migrate to your community because of favorable climate and what to do when they leave your community because of unfavorable climate? This movement of population and the need to accommodate the consequent effects represent the major climate change *adaptation* challenge for local land use programs and policies in the United States.

Land use planning offers a significant climate change *mitigation* opportunity. Through sustainability, smart growth and New Urbanism, planners have recognized the many advantages of a more compact urban form. Compact development can be served with many modes of transportation, offers a wider variety of housing choices than the suburban model, and is more efficient to provide with public services and infrastructure. Whether "compact" meant replicating or rediscovering small-town America, developing nodes of transit oriented development, creating public amenities to support and attract dense downtown development, or establishing communities designed around form-based codes, planners realized that this form of development had the potential to reduce pollution and congestion, enhance social interaction, improve the efficiency and effectiveness of public service delivery, and create vitality in once-abandoned urban areas.

Just as importantly, this compact form has proven to be supported by housing consumers, businesses, financial institutions and, consequently, developers as more and more people make decisions to reside in urban areas. As a result, the potential offered by a more compact urban form is being realized nationwide in downtown development and redevelopment, in urban villages, in infill buildings and projects, and in transit-oriented developments (TODs).

Providentially, the major climate change mitigation response for local and regional land use decisions involves the creation of a more compact urban form. The significance of such a development pattern on the mitigation of climate change is both complex and comprehensive. A more compact urban form has characteristics that allow for significant reductions in the amount of greenhouse gas emissions associated with buildings and the transportation, utility and service networks that support those buildings. These characteristics include:

- Sufficient residential density to support multiple modes of transportation
- Proximity of land uses that encourage walking and bicycling
- More energy-efficient building types and unit sizes
- Provision of public open space that substitutes for more energy intensive private open space, such as lawns
- Less land consumed for development
- More efficient (and more energy-efficient) provision of public services, such as streets and utilities

When a development pattern combines reductions in VMT through complementary land use proximity and street network connectivity with greater energy efficiency in building type, the

synergy of such a land use arrangement has the potential to yield substantial dividends in climate change mitigation, in addition to benefits planners may be more familiar with, such as: pollution reduction, improved public health through promotion of pedestrian activity, enhanced tax base, greater service efficiency, housing affordability, and conservation of natural resources.

There are complications that result from creating a more compact land use pattern, such as the need for high-quality urban design standards, the potential for such concentrated land uses to contribute to the urban heat island effect, the need for public investment in infrastructure (parking garages, transit, streetscape, urban parks, etc.) to support more dense development, and the need for public investment/education in addressing the real or perceived concerns people may have with regard to urban living (quality of schools, crime, etc.). Planners must be conscious of all of these factors as they create regulatory requirements and incentives, land use and capital improvement plans, economic development incentives, and other implementation measures that encourage a more urban form. Failure to think holistically about dense development, particularly if such development is not commonplace in a community or region, can create unnecessary obstacles to and unintended consequences from the implementation of a compact development pattern.

Marketing the benefits of this type of development to the public and to the development community is also essential to the success of such a program. Outreach efforts explaining the purpose and benefits of a more compact urban form are often necessary to convince the public to accept what, in many cases, may be a new pattern of development.

General Policy A: The American Planning Association, its Chapters and Divisions, and planners support development patterns that minimize the emission of greenhouse gases.

Land Use Policy 1: Create a More Compact Urban Form
Adopt plans, regulations, and incentives that encourage a more compact urban form while preserving non-urban land for agricultural and forestry uses and for environmental purposes. Utilize public investments to support a more compact urban form and to preserve agricultural and environmentally sensitive lands.

Reasons to Support:
Significant climate change mitigation can occur from efforts to establish a more compact urban form. As described in more detail in the introduction to this section of the Policy Guide, a compact urban form, and its corollary - a rural/agricultural countryside - greatly reduce greenhouse gas emissions and provide for carbon sequestration and enhanced management of greenhouse gas emissions.

Land Use Policy 2: Integrate Land Use and Transportation
Integrate spatial planning and transportation planning so that the development patterns support mobility choices and reduced trip lengths to meet basic needs thereby allowing the

transportation facilities to help achieve community climate change goals.

Reasons to support:
A community's ability to achieve climate change goals will depend on whether its residents can make choices that reduce greenhouse gas emissions. Since trip choices and lengths – whether to travel in a single -occupancy auto or take transit, whether to walk or drive to local shopping and restaurant areas, how long a route is required from home to work – all affect transportation-related greenhouse gas emission, it is important that residents be able to choose trips that lower these impacts. By closely integrating the planning for land uses and all forms of transportation, communities can make these choices more realistic and desirable for their residents.

Land Use Policy 3: Mixed Use Development
Plan for development patterns that mix land uses so jobs, services, schools, shopping and other destinations are near residents' homes and neighborhoods. Adopt specific incentives and requirements that promote mixed-use development, including removing regulatory and financing barriers to mixed use project development. Federal and state housing, transportation and infrastructure programs should incorporate specific standards for mixed-use development.

Reasons to support:
Mixed-use development reduces climate change impacts in several ways. By locating diverse uses close to one another, it reduces the volume of daily vehicle trips, as well the need for private vehicles and parking facilities. Reducing travel distances reduces greenhouse gas emissions, even if the trips are taken in gasoline-powered vehicles. Shorter distances also make alternative travel modes – such as biking or walking – more feasible and likely, further reducing the emission of greenhouse gases.

Land Use Policy 4: Development Centers with Higher Density
Plan for local and regional development with higher density mixed- use development centers near transit stops and stations, and in other key locations such as historic town squares. Regulatory and other incentives should be adopted to encourage higher density development, particularly near transit. Development reviews policies and processes should acknowledge the GHG emission reduction impacts of higher density development and the negative climate impacts of sprawling, low density projects.

Reasons to support:
Pollution generated from transportation constitutes a major portion of GHG emissions worldwide. Development patterns that reduce the number and length of trips in single - occupant motor vehicles will reduce these emissions. Higher intensity centers accomplish this objective in several ways. Higher intensity development itself means that more desired destinations are close by, making walking or biking feasible choices, and making it easier to take care of several tasks in a single trip. Town centers, historic or newly created, illustrate these advantages. If these higher intensity centers are located near transit stops and stations,

then more people will be able to use transit for more trips**.**

Land Use Policy 5: Transit-Ready Locations
Use comprehensive planning efforts and policy incentives to create and encourage 'transit-ready' development patterns in major metropolitan regions (or parts of metropolitan regions) that do not yet have public transit. Change federal transit investment review criteria to better acknowledge climate impacts, economic development impacts, and supportive comprehensive planning.

Reasons to support:
It is very difficult to justify transit in areas that have already developed at very low densities. At the same time, many growing communities are not served by transit, so they are reluctant to plan for a development pattern that may never be served or have market support. 'Transit-ready' development patterns create centers with more intense, mixed use development compared to their surrounding development pattern. Before public transportation (bus, BRT, or fixed rail) is available, these areas can give residents the ability to reduce VMT by allowing each vehicle trip to serve multiple purposes, or by making trips on foot or by bicycle easier. If or when the community or region decides to invest in public transportation, those facilities will serve a development pattern that has already been designed to support public transportation.

Land Use Policy 6: Jobs-Housing Proximity
Plan for jobs and appropriately priced housing located close to one other so people at all income levels can live near their places of work. Adopt policies that incentivize mixed-income development near job centers and recognize the positive fiscal impacts on households in transit-accessible, high density locations.

Reasons to support:
In many places, the cost of housing prevents people from living in the community where they work. These workers must find more affordable housing in locations that are distant from their jobs and may be accessible only by automobile. This development pattern results in increased vehicle miles traveled and increases in greenhouse gas emissions. One of the means of identifying positive fiscal impacts would be research and measurement of housing/transportation affordability impacts, including combined housing cost/commute expense, dual household commute costs, and drive to school versus walk to school factors.

Land Use Policy 7: Compact Regions
Use planning policies regarding infrastructure investments, extension of urban services and utilities and preservation of natural or agricultural areas to create compact regional development patterns that reduce vehicle miles traveled within the region.

Reasons to support:
Compact development patterns, particularly when in close proximity to existing development, encourage the use of alternative transportation modes by reducing the

distance between uses. Compact regions can support lower levels of motor vehicle use and resource consumption than lower density, sprawling development. Policy tools that can support compact regional development include establishment of urban growth boundaries, decisions to invest infrastructure funds in already-developed areas, policies regarding extension of urban services, such as adequate public facilities ordinances, and initiatives that create greenbelts around urban development. There are various planning approaches and tools which might be used to bring about such compact, dense regions, one of the most promising being that of transfer of development rights at the local, or even state, level.

Land Use Policy 8: Infill Development and Redevelopment
Promote infill development, redevelopment of existing neighborhoods, preservation of historic structures and the adaptive reuse of buildings within the currently developed areas of communities and regions. Create incentive and policies that promote infill development, redevelopment of existing neighborhoods, preservation of historic structures and the adaptive reuse of buildings. Prioritize infill development in state and federal housing, transportation and infrastructure programs. Tax credits and other incentives and assistance should target the reuse and rehab of vacant properties.

Reasons to support:
Existing neighborhoods and communities are an important asset in efforts to address climate change. Public and private sector investments have created infrastructure and amenities to serve homes and businesses in these areas. Reinvestment in these sites allows a community (or a region) to accommodate new residents and businesses within its existing fabric. Such reinvestment maximizes the use of existing infrastructure, encourages the preservation and continued use of historic buildings and supports existing businesses and services. It reduces the need for new roads and infrastructure, and can encourage walking, biking and use of transit. It preserves open space and Greenfields, thus reducing sprawl and retaining areas that serve as carbon sinks.

Land Use Policy 9: Brownfields
Advocate the reuse of remediated brownfield and "Grayfield" sites to reduce distances between destinations and relieve pressures for Greenfield development. Expand and improve current state and federal brownfields programs to further encourage development, continue addressing liability issues, increase project funding, and improve coordination with comprehensive planning.

Reasons to support:
Open, undeveloped land provides valuable resources and ecosystem services such as the local provision of food and fiber, carbon sequestration, habitat, and flood protection. The use of remediated brownfield sites returns land to productive use and increases the supply of land necessary to meet the demands of growing populations. This, in turn, reduces the demands on undeveloped open lands. Brownfield sites are typically within developed areas connected to existing infrastructure networks, reducing demands on communities to provide new infrastructure and reducing the need for travel outside of the community to

equivalent Greenfield sites. It helps address climate change because it reduces vehicle miles traveled and retains land for vegetation that can serve as a carbon sink.

Land Use Policy 10: Zoning and Development Standards Reform
Implement zoning and development standards that promote significant changes in zoning and development standards. New policies and regulations should be developed that promote a more compact urban form through mixed use development, transit-oriented design, and greater development intensity to create communities that reduce energy consumption, vehicle miles traveled and greenhouse gases. New zoning and development standards should incorporate climate change impacts and implications in required environmental reviews and decision-making.

Reasons to support:
Zoning and other development standards should be made more flexible to allow for the creation of developments, neighborhoods, and communities that allow for more pedestrian, bicycle, and transit use, thereby lowering transportation energy consumption Changes need to be made from traditional zoning laws that are based on separating land uses and creating single-use communities. If designed improperly, standards such as parking requirements, building height limits and building setbacks may impede compact, mixed use development that reduces sprawl and facilitates transit use. For example, the elimination of minimum parking requirements reduces the incentive to drive, while concurrently reducing the amount of impervious surface necessary for auto storage.

Land Use Policy 11: Developer Incentives
Create development permitting processes with developer incentives, including tax credits and regulatory mechanisms for Greenfield, in-fill and redevelopment projects, which encourage the fast-tracking of development that reduces energy consumption and lowers greenhouse gas emissions**.** Encourage demonstration projects with evaluation mechanisms.

Reasons to support:
Development incentives give developers a direct benefit for some concession on their parts. New regulations and standards should be paired with developer incentives. This is among the most effective, fiscally neutral strategies that can be used. Specific development incentives can include, among others, density bonuses, one-stop permitting, expedited zoning procedures and permitting, fee reductions and waivers, and reduced parking requirements.

Land Use Policy 12: Location of Public Facilities
Ensure that schools and public facilities are accessible by walking, biking or transit; these facilities should be jointly located whenever appropriate. GHG emission impacts, particularly through potential for VMT reduction, should be considered in all location and investment decisions for public facilities.

Reasons to support:
Schools and other public facilities are major trip generators, and planners have great influence over their siting. Planners should seek to locate schools in areas with good transit, pedestrian and bicycle connections to their attendance areas, helping to make Safe Routes to School programs feasible and reducing the emissions from dedicated school transportation and parents driving children to school. Similarly, public facilities with significant customer traffic should be located where there is good transit, pedestrian or bike access. Co-location of public facilities such as schools and parks, and location near town centers, further helps to reduce greenhouse gas emissions by reducing the number and length of trips needed to use public services.

Land Use Policy 13: Agricultural Land Uses and Practices
Support agricultural land uses, including forestry, through agricultural zoning regulations, preservation easements, and incentives. Support local food and local biofuel production initiatives. Assist farmers with implementation of best management practices for CO2 and other greenhouse gas sequestration and management.

Reasons to Support:
Agricultural land uses (from crops to forestry) represent important carbon sequestration resources, including afforestation, forest preservation, conservation tillage practices, managing livestock waste to reduce CH_4 and N_2O emissions, and biofuel production from crops such as switchgrass.

Additionally, agricultural land uses for local consumption, whether it be local foods, local fuels, or urban gardening, reduces transport distances and thus GHG emissions. Consequently, the preservation or establishment of such land uses, along with sound management practices, have the potential for substantial climate change mitigation effects.

General Land Use Policy B: The American Planning Association, its Chapters and Divisions, and planners support planning for climate change-induced migration by communities and regions.

Land Use Policy 14: Managing Climate Change In-Migration.
Utilize growth management tools and techniques to manage population in-migration resulting from climate change. Such tools and techniques should include the full range of practices which promote a compact urban form and preserve critical agricultural and environmental resources. Recognize that climate change migrants may have unique needs, such as the need for social services to address the effects of traumatic climate migration or acculturation.

Reasons to Support:
Adapting to population gains associated with climate change is just another form of growth management, with some subtle distinctions. People and businesses relocating as a result of climate change will be relatively more attracted to communities that demonstrate climate

change resilience; in general, they will not want to substitute one type of climate vulnerability for another. Consequently, communities interested in attracting and accommodating climate change-related growth will want to create mitigation and adaptation plans and programs that respond to their local and regional climate change issues, including addressing water supply, floodplain management, disaster preparedness, and effective growth management issues, as applicable to their climate change circumstances. Additionally, such communities may want to consider customized social services outreach to these new residents, especially if there are substantial numbers of people relocating due to traumatic events (hurricanes, wildfires, inundation, etc.). In some cases, in-migration may be the result of humanitarian efforts to relocate threatened populations from other regions and nations, in which case such outreach programs become both more complicated and more necessary.

Land Use Policy 15: Managing Climate Change Out-Migration.
Where not precluded by physical constraints, such as community inundation due to sea-level rise or limited availability of potable water, adopt strategies to minimize the negative effects of climate-induced out-migration on communities. Such strategies should include community engagement about the shared vision for the future while objectively identifying challenges and opportunities for positive local action.

Reasons to Support:
Out-migration effects are generally less familiar to planners since most of our training and professional practice has been related to addressing the effects of expansion rather than contraction. Some individual large cities have seen significant population losses (such as Philadelphia and Richmond) but even these cities are located in growing metropolitan regions. Still, we can learn from these cities' experiences in adapting to declining populations.

While out-migration creates a number of challenges (declining tax base, constraints on economic development, public safety issues associated with property abandonment, etc.), it also offers opportunities to improve housing affordability, adaptively reuse abandoned buildings and sites, address traffic congestion, introduce new open space and parkland into urban areas, create partnerships with businesses and institutions that remain in the community, and unite the human capital of the community in positive ways.

Planners can learn from neighborhood planning initiatives that maintained neighborhood quality in the face of disinvestment and vacancy. Examples from Philadelphia's struggles with chronic population decline include:

- *Prevent* future vacancy by promoting the local real estate market, assisting first-time homebuyers with housing counseling and down payment or settlement grants, to reduce the possibility that houses for sale will remain vacant for extended periods and eventually be abandoned.
- *Preserve* existing owner-occupied housing through creating or expanding city-funded repair programs with capability to repair or replace major systems on an "on-call," year-round basis.

- *Plan* for the neighborhood's future by making strategic decisions about where to demolish and where to rehabilitate vacant housing, how to improve vacant lots, and how to use city and state development funding to address community priorities for vacant-property development.
- *Repair* recently vacated houses in reasonably good condition, using rehabilitation loan financing supplemented by modest city subsidies . . . .
- *Mothball* other vacant houses in good condition through low-cost "encapsulation," to protect the structures against further damage and save them for future rehabilitation.
- *Plant* grass and vegetables on vacant lots, with technical assistance provided through the state Department of Agriculture extension service with the local horticultural society.
- *Leverage* development financing for affordable rental housing ventures . . . .
- *Collaborate* with city agencies and the local public housing authority to establish consensus on plans for the improvement or disposition of publicly owned property in the community.
- *Spread out* new housing development, in recognition of the declining population of older cities, to build houses on larger lots with generous yard space.
- *Demolish* vacant houses too expensive to rehabilitate, and plan for new development on the resulting vacant lots.

(from Kromer, John, *Neighborhood Recovery: Reinvestment Policy for the New Hometown*; Piscataway, N.J.: Rutgers University Press; 2000; pp. 40-41)

Extended disinvestment scenarios resulting from climate-induced out-migration will require planners to secure the assets of a community or neighborhood in a way that maintains or potentially enhances the overall quality of life as determined by the residents.

3.3 Transportation

Introduction. More energy-efficient transportation - infrastructure, vehicles, modes - can play a significant role in reducing carbon emissions in the United States, helping mitigate climate change. Additionally, a great deal of transportation infrastructure is vulnerable to a variety of climate change impacts, including excessive heat, storm surge, flooding, and inundation resulting from sea-level rise and will consequently require adaptive measures.

Transportation strategies to mitigate climate change include: reducing vehicle-miles traveled (VMT) through more compact development patterns, mandating higher fuel efficiency through new CAFE standards, increasing multimodal transportation options such as enhanced transit funding and installation of "complete streets," improved interconnectivity of local street networks, and the provision of fees and incentives that promote the manufacture and purchase of alternative-fuel vehicles. Additionally, "fix-it-first" infrastructure prioritization,

congestion management, travel demand management, congestion pricing, transit-oriented development, and similar actions constitute significant climate change mitigation opportunities.

Transportation-related climate change adaptation responses include risk-based transportation infrastructure decision-making, "grey streets to green streets" initiatives, adaptive infrastructure design and maintenance standards (including longer airport runways, heat-resistant paving materials, bridge elevations that take into account stronger storms, "fix-it-first" programs, etc.), adjusting road maintenance programs to reflect the needs created by new weather patterns, and retrofitting ports to adapt to higher sea levels in coastal areas and lower water levels in areas like the Great Lakes, among others.

General Transportation Policy A: The American Planning Association, its Chapters and Divisions, and planners support the planning and development of multi-modal regional and local transportation systems that reduce greenhouse gas emissions by reducing vehicle miles traveled, increasing pedestrian and bicycle facilities, increasing alternative fuels infrastructure and alternative modes of transportation, increasing fuel-efficiency of vehicles, improving connectivity of the transportation network, reducing congestion, and improving cooperation and coordination between all levels of government.

Transportation Policy 1: Federal Surface Transportation Authorization
Support new authorization of the federal surface transportation programs with increased priority for funding public transit and non-motorized travel and integrated regional and metropolitan planning as means to reduce the greenhouse gas emissions from the transportation sector. The federal program needs to explicitly incorporate climate change and shift priorities toward programs that encourage reinvestment in existing infrastructure and communities ("fix-it-first" programs), support public transportation and transit-oriented development, and address congestion management.

Reasons to support:
The reauthorization of the federal surface transportation program presents an opportunity to direct federal funding decisions and priorities to address climate change. The reauthorization should establish goals for reduction of transportation-related greenhouse gas emissions. Coordination of transportation networks with comprehensive planning and urban design is critical to this effort, and should be a top priority in the way funding is allocated. Funding for public transit and for alternatives (such as walking and biking) that reduce the need for automobile travel within metropolitan areas should receive high priority. Restructuring of the program is needed so metropolitan areas can set their own investment priorities and allocate funds across all transportation modes. Congestion management and "fix-it-first" programs should receive strong support.

Transportation Policy 2: Reform Transportation Models and Enhance NEPA Processes:
To recognize when shifts are taking place in the true costs of road and transit, the surface

transportation authorization legislation should encourage the development of up-to-date models and tools that measure the relative shifts in auto and transit costs, both up-front and on an operating basis as well as costs related to climate impacts and performance. Further, the U.S. Department of Transportation should be directed to develop ways and means to enhance the NEPA process in this regard as NEPA is central to all highway and transit project investment analysis.

Reasons to Support:
In transportation modeling and the NEPA process, the implicit assumption for the last 50 years has been that the relative costs of highway and transit are the same. However, this may now be changing, especially with the rapidly escalating costs of oil which may well prove to be a permanent change. Further, existing models do not adequately take into account performance-based savings over time or climate-specific impacts. Therefore, a new methodology and process is needed which indicates when cost shifts take place. One of the most important places to do this is in the NEPA process as it remains the central evaluation tool for all significant transportation capital investment.

Transportation Policy 3: Climate-Related Performance and Location Efficiency Standards for Federal Infrastructure and Community Assistance
Establish evaluation criteria and requirements for new and existing federal and state grant, loan, and tax credit programs supporting infrastructure investment and community development that take into account performance standards and measures of efficiency supporting key climate goals, including reduction of greenhouse gas emissions and adaptation to the impacts of climate change. These requirements and criteria should take into account and infrastructure lifespan relative to climate risks, degree of greenhouse gas reduction, and similar factors.

Reasons to Support:
Federal funding is one of the single most important catalysts for and determinants of key infrastructure investments and development decisions. Federal policy should recognize this role and incorporate climate-related criteria into decisions about the allocation of federal assistance. In addition, infrastructure and community development programs should explicitly expand eligibility to cover climate and energy efficiency activities. As noted elsewhere in this guide, available funding for such programs should be increased. These necessary increases in funding should be linked to specific standards of adaptive performance and carbon-reducing outcomes.

Transportation Policy 4: Increase CAFE Standards
Establish stronger Corporate Average Fuel Economy (CAFE) Standards and enforce their adoption.

Reasons to support: Increasing fuel economy is one of the fastest, cleanest and lowest cost options for immediate reduction in greenhouse gas emissions and oil dependence. The National Academy of Sciences found that improved fuel economy benefits the nation's

economy and trade, reduces dependence on oil (much of which comes from unstable regions and decreases our national security), and reduces carbon dioxide emissions. CAFE standards were increased for the first time since the 1970s when Congress passed the 2007 Energy Bill. Several states have urged even stronger regulation. APA supported the recent increase and encourages Congress to further strengthen fuel efficiency standards.

Transportation Policy 5: Promote Clean Fuel Technology and Standards
Establish low carbon fuel standards for autos, light trucks, heavy trucks, rail, air, buses, school buses, water, and off-road transportation modes and encourage research into clean fuel options and system-wide implementation**.**

Reasons to support: Today, planning focuses significant attention on reducing single-occupancy vehicle use, and increasing the use of non-auto transportation, including rail, air, bus, and water. However, since fuel-efficiency standards are sometimes weaker, sporadically enforced, or non-existent for these modes, clean fuel standards for all transportation modes are vital to a comprehensive transportation solution. Federal policy should actively promote new research into the development of cleaner fuels and the ability to make new fuels readily available to consumers.

Transportation Policy 6: Federal Action on Vehicle Emissions
Pass federal legislation setting standards for greenhouse gas emissions from vehicles at levels consistent with nationwide and economy-wide greenhouse gas reduction targets.

Reasons to support:
Reducing greenhouse gas emissions from vehicles is one of the largest steps the U.S. can take to reduce overall greenhouse gas emissions. The transportation sector accounts for about 28 percent of gross U.S. greenhouse gas emissions. Standards for greenhouse gas emissions are more closely linked to global warming, and therefore are preferred to fuel economy standards, which are only indirectly linked to greenhouse gas emissions.

Transportation Policy 7: Economic Incentives for Fuel Efficient Vehicles
Support enacting a system of fees and incentives that encourages the purchase or manufacture of fuel-efficient vehicles and discourages the purchase or manufacture of fuel-inefficient vehicles.

Reasons to support:
Fees and incentives that encourage the purchase and manufacture of fuel-efficient vehicles are effective in modifying personal and corporate behavior. Fee and incentive systems can also be designed to be revenue-neutral, thus costing taxpayers little or nothing in the aggregate while conveying the benefits of reduced impacts of climate change.

Transportation Policy 8: Intergovernmental Transportation Planning
Develop improved systems for integrating transportation planning at the federal, state, regional and local levels to ensure a consistent approach towards developing transportation

systems that reduce vehicle miles traveled by ensuring transportation choice. This will likely include shifting funding into transit, promoting enhancements and "complete streets" that accommodate all users, ensuring the interconnection of local, regional and national transportation systems and discouraging single occupancy vehicles as the primary source of transportation. Project funding should be linked to GHG reduction metrics and performance standards.

Reasons to support:
Transportation represents a significant area of concern for professional planners as one of the largest and fastest growing sources of GHG emissions, and should be a major focus of interest in policy options to improve planning processes to address climate change.

Transportation Policy 9: Enabling State Action on Vehicle Emissions
With or without federal action on vehicle emissions, support individual state actions to establish more rigorous standards, such as the State of California's request to U.S. Environmental Protection Agency to implement vehicle emission standards that would reduce greenhouse gas emissions, and thereby encourage other states to do the same.

Reasons to support:
Allowing states to develop and implement alternative greenhouse gas emission standards encourages technological and regulatory innovation, and can reduce emissions and the impacts associated with global warming. Similar innovation at the state level, in particular the adoption of standards by states such as California that were stricter than federal standards, helped reduce local air pollution in the past. In the event of both a federal and state standard, the higher standard should supersede other, less stringent standards.

Transportation Policy 10: Transportation Investment Priorities
Give higher investment priority to transportation infrastructure, programs and services that will reduce greenhouse gas emissions. Performance standards should be incorporated into infrastructure assistance programs. Performance standards for climate and related metrics, such as reduced VMT, should be incorporated in federal and state transportation, and infrastructure programs should include measures to reduce in the amount of freight hauled by truck, prioritize transit investment, and encourage of shared parking programs.

Reasons to support:
Most communities do not have enough funding to build the transportation infrastructure they need. Their processes for establishing funding priorities consider a variety of factors, such as projected traffic volumes, connectivity to other facilities, safety enhancement and local support. Investments that support an appropriate land use pattern and alternative transportation modes will help the community reduce its greenhouse gas emissions. These factors should be considered when transportation funding priorities are being set. This policy would apply to capital investments and also to investment in programs and services (such as transportation demand management or operation of a joint parking district) that enable residents to reduce vehicles miles traveled.

Transportation Policy 11: Monitor Greenhouse Gas Emissions from Transportation
Secure federal funding to develop reliable methods to quantify greenhouse gas emissions from transportation to accurately monitor progress in meeting goals. Monitoring should include gasoline consumption, VMT and CO_2 emissions disaggregated to the local or regional level. These efforts should result in new models for use in planning and related environmental or development reviews and analysis.

Reasons to support:
There is a need to be able to demonstrate, tangibly and separately from other factors, the impacts of greenhouse gas emissions from transportation. Establishing baseline conditions and identifying the possible impacts of proposed improvements provides critical input to plan evaluation and the setting of priorities. There is a corresponding need to be able to monitor progress over time; show the co-benefits with air quality and other similar initiatives; and — potentially — establish quantifiable benefits for use in cap and trade or similar programs. One specific model that to be developed is that which shows specific per-unit reductions in VMT and truck travel for specific projected growth units in the economy.

Transportation Policy 12: Multi-Modal Transportation Corridor Improvements
Develop major transportation corridors for multi- modal operation to minimize transportation–related greenhouse gas emissions associated with travel in the corridor.

Reasons to support:
Historically transportation routes have served a single travel mode, and improvements over time generally replaced one mode with another instead of creating multi-modal corridors (as, for example, when trails for travel by horseback were replaced with train tracks, which were then replaced with interstate highways). Planning and construction of multi -modal transportation corridors create alternatives for travelers, allowing them more efficient use of their time and money resources and providing travel choices that have lower greenhouse gas emissions. For the region, multi-modal design builds in flexibility. Pricing and other tools can be used to encourage people to switch to modes that reduce congestion and greenhouse gas emissions. Over time, technological advances may lead to new, 'greener' travel choices. A multi-modal corridor design will be most able to take advantage of these changes while continuing to serve established travel routes.

Transportation Policy 13: Transition between Transportation Modes
Support coordination and seamless transitions between transportation modes to increase the use of modes with lower emissions for the movement of people and freight.

Reasons to support:
Transferring between modes of transport is often inconvenient and can be costly. For commuters, connections between buses, trains or airplanes can be disrupted by network congestion, weather or equipment failure. Frequently, schedules of different modes are not

coordinated. In other cases, physical distance between routes and stops make transfers impossible. If someone is not confident about simple things, like knowing when a bus will arrive at the stop near her home and whether she'll make the connection to the rail system, she may simply forego a mode choice that will emit lower levels of greenhouse gases. The use of bus circulators and shuttles can provide greater transit options, "door-to-door" mobility, and low-cost options to decrease automobile dependence.

In the realm of goods movement, transferring goods from one mode to another is currently time consuming and labor intensive, thus costly. Seamless inter-modality for freight means bringing a range of appropriate modes directly to transfer points, so that goods do not have to be transferred more than once. Efficient goods movement also involves providing adequate and appropriately located and equipped staging facilities for trucks near major facilities such as ports. Goods movement is a 24-hour activity and moving goods during off-peak hours provides considerable energy savings, but many facilities, especially at the retail end of the chain, are poorly equipped for 24-hour operation. By reducing congestion at transfer points, smooth goods transfer also reduces greenhouse gas emissions from idling motor vehicles.

Transportation Policy 14: Invest in Transit
Transportation programs and policies should support substantially increased investment in transit, including commuter rail, heavy rail, light rail, bus rapid transit, and bus service. Connections between modes should be coordinated within pedestrian, bicycle and other non-automotive infrastructure. Transit investment should be given greater priority in the allocation of funding. Transit has demonstrated significant GHG reduction capacity. Investment should support both the development of new systems and the expansion/maintenance of existing systems. Transit options that include alternative energy, renewables or low-emission systems should be encouraged.

Reasons to support:
Rail transit reduces greenhouse gas emissions because it is more energy-efficient on a per-unit basis than transportation by automobile. Providing transportation choice on a local and regional level allows growing metropolitan regions to shape their growth around transit stops, maximizing open space and multimodal connections to activity hubs. Congestion, an impediment to the flow of people and goods, is reduced via rail transit. BRT systems reduce emissions and can be less expensive to develop and implement in many cases than traditional rail transit. Local bus service fills network gaps by serving less densely populated neighborhoods, providing not only access to local destinations but connections to the larger transportation network. In smaller communities, local bus service is the only practical way to provide transit services throughout the community

Transportation Policy 15: Airport Planning and Air / Rail Network Planning
Support development of transit access to airports and long-distance rail networks to increase national connectivity and reduce vehicle use for freight and long-distance passenger trips.

Reasons to support:
Congestion and energy consumption can be reduced through a more integrated multimodal intercity transit system. Enhanced intercity rail service will take both passenger vehicles and heavy-duty trucks off the highway. Planning airports so that they connect with a variety of transit options including rail and bus networks will create alternatives to short-haul flights as well as reduce the number of vehicle trips to and from airports. Encourage alternatives to airplane transportation for trips less than 500 miles where rail infrastructure exists.

Transportation Policy 16: High Speed Rail & Intercity Rail Transit
Encourage the use of high speed rail to connect urban areas within 500 miles of each other, and create programs to foster implementation. Fully fund intercity rail and support the design, development and funding of regional rail initiatives. Establish a new national rail corridor initiative, while maintaining safety as well as concern for historic and cultural assets.

Reasons to support:
Mobility between major urban areas is vital to American society. Americans travel a total of 1.3 trillion person-miles of long distance trips a year or about 2.6 billion long-distance trips, or 7.2 million trips per day. Currently almost 90 percent of these long-distance trips are by personal vehicle. High speed rail offers an alternative that reduces vehicle miles traveled and greenhouse gas emissions.

Existing railroad routes provide an attractive, practical location for high speed rail service that meets present and future mobility demands in an environmentally sustainable manner. Planning should begin on the next generation of truly high-speed trains to serve U.S. travelers. For some communities, the development of new public transportation organizations should be encouraged and supported. To address climate change, new strategies of transit delivery will be necessary.

Transportation Policy 17: Goods Movement and Freight Systems Planning
Support integrated multi-modal goods movement that minimizes financial and environmental costs primarily focusing on non-highway oriented means such as rail, and where appropriate, short sea and river shipping, through operational methods and transportation modes that minimize greenhouse gas emissions and environmental impacts on the communities they traverse.

Reasons to support:
The U.S. is part of a vibrant global economy, with goods sourced, produced, and marketed around the globe. Goods movement is a complex issue and is comprised of several discrete but inter- related components. While it affects every community differently, every community faces some measure of each of these components:

- port, inter-modal and transfer facilities
- long-haul movements
- short-haul and local market movements
- transformation and value-added facilities
- end user distribution services, and
- support facilities such as weigh stations, inspection facilities and staging areas.

At each step in the process, choices about operational methods and transportation mode will affect the amount of greenhouse gas emission associated with the transport of a particular shipment. Local comprehensive and metropolitan transportation plans should support goods movement and operations that reduce greenhouse gas emissions.

Currently, tractor-trailers are not subject to federal fuel efficiency standards and their fuel economy has declined over the last decade. One estimate of federal fuel economy standards for heavy-duty trucks assumes that a 50 percent improvement in fuel economy could be achieved for those vehicles by 2020.

Transportation Policy 18: Integration with Land Use Planning
Incorporate planning for transit, bicycle and pedestrian networks within local and regional comprehensive planning. Encourage development patterns that support transit and multi-modal transportation networks. Restructure state and federal funding to incentivize projects that demonstrate coordination and provide demonstrable impacts on reducing GHG emissions through supportive land use-transportation decisions.

Reasons to support:
Transit, bicycle and pedestrian facilities give people the ability to choose non-automobile travel modes for their trips and thus reduce the amount of greenhouse gas emissions from cars. In areas where transit, pedestrian and bicycle networks have not yet been defined, identification of potential future networks through land use and comprehensive planning projects can help preserve the opportunity to create these travel options in the future.

Transportation Policy 19: Transportation Facility Siting and Community Design
Use community design and development review processes to secure rights-of-way and require provision of facilities needed to provide highly connected street, transit, bicycle and pedestrian networks in neighborhoods, communities and regions.

Reasons to support:
If transit, bicycle and pedestrian routes are not available from a resident's neighborhood to a desired destination, travel to that destination will almost certainly involve a car. Routes for these alternative transportation modes should be located and provided for through the planning and subdivision processes in the same way as roadways are. Highly connected street patterns facilitate travel by all modes, but are especially beneficial for walking and biking, since they eliminate the need to walk or bike on a busy arterial or collector street.

Transportation Policy 20: Local Street Network and Design
Support local street network connectivity and complete streets designed to accommodate all users and multiple transportation modes. Adopt complete streets policies at the federal, state, regional, and local levels. Support continued training and research in new techniques for transportation design professionals.

Reasons to support:
Local street networks with easy connections to a variety of destinations enable transportation choice and increased mobility. Street design that includes right-of-way for existing or future transit options, pedestrian-friendly sidewalks, bicycle lanes and appropriate bike and pedestrian accommodation, and safe pedestrian and bicycle crossings encourages the reduced use of automobiles for short and long trips, and increases multimodal traffic capacity. Supportive land use decisions are essential to making complete streets policies successful. By reducing the number and length of automobile trips, greenhouse gas emissions are also reduced.

Transportation Policy 21: Transportation Demand Management and Systems Strategies
Create and implement local and regional Transportation Demand Management Strategies that result in more efficient use of transportation resources and reduce vehicle miles traveled (VMT). Support local and regional transportation systems management strategies that reduce greenhouse gas emissions associated with the use and operation of transportation systems.

Reasons to support:
Transportation demand management (TDM) strategies focus on changing travel behavior — trip rates, trip length, travel mode, time-of -day, etc. — to reduce the number of vehicle trips and increase mobility options. Most TDM projects and programs reduce emissions through trip or VMT reductions or by shifting trips from peak periods to less congested periods. TDM strategies can achieve public goals such as reduced traffic congestion, improved air quality, and decreased reliance on non-renewable energy consumption, in addition to reducing greenhouse gas emissions.

Transportation system management (TSM) improves vehicle flow on the roadway system by focusing on changing the operation of the transportation system. Tools to reduce traffic congestion include HOV lanes, synchronized signals, incident management, variable message signs, wayfinding signs, and other forms of intelligent transportation systems (ITS). Some strategies focus directly on encouraging changes in driving behavior through educational information, incentives, or restrictions on driving speeds, operating patterns, and idling. TSM techniques can help reduce greenhouse gas emissions by discouraging driving during peak periods, when congestion and slow traffic speeds reduce fuel efficiency and increase emissions.

Transportation Policy 22: Efficient Use of Existing Transportation Infrastructure
Promote low-carbon commute alternatives by ensuring that the cost of the daily commute

by individuals reflects the actual cost of the trip, including its environmental and greenhouse gas impacts. Support the expansion of congestion pricing systems for urban expressways, provided that there are adequate transportation alternatives, both existing and planned and particularly for transit, in a given metropolitan area and such systems are undertaken in the context of comprehensive planning and a balanced transportation network. Use the funds generated from such a system to advance low-carbon transportation technologies and to reform existing transportation taxes. Incorporate performance standards and GHG emission-related metrics into funding, budget and investment decisions.

Reasons to support:
The transportation sector accounts for roughly one-third of gross U.S. greenhouse gas emissions. Actions that prompt changes in behavior in the realm of transportation can have a commensurate impact on reducing greenhouse gas emissions. Congestion pricing allocates scarce infrastructure resources more efficiently than the first-come, first-serve system that prevails today. Actions such as mandatory parking cash-out programs, funding for transit incentives, congestion pricing and parking pricing are particularly useful because they help reveal the total environmental costs/benefits associated with particular modes of travel.

Transportation Policy 23: Congestion Management
States, regions and local governments are encouraged to develop effective strategies for the management of congestion. These strategies include: access management, traffic signal coordination, incident management, capacity increasing programs (such as targeted road building and lane shifting programs), public transportation, travel option programs (like HOV lanes), congestion pricing, and transportation demand management.

Reasons to support:
Congestion management can reduce overall vehicle emissions by reducing the length of time the vehicles are in use, as well as allowing vehicles to operate at more fuel-efficient speeds. Congestion management also enhances the capacity of the existing transportation network, allowing it to operate more efficiently. Consequently, congestion management represents an effective climate change mitigation technique.

General Transportation Policy B: The American Planning Association, its Chapters and Divisions, and planners support the development and retrofit of climate-resilient transportation infrastructure and establishment of maintenance practices that reflect new climate conditions.

Transportation Policy 24: Risk-Based Infrastructure Decision-Making
Federal, state, regional, and local governments should adopt a risk-based approach to infrastructure decision-making with regard to climate change impacts. The potential for climate change to shorten the lifespan of infrastructure or to affect the safety of infrastructure is considerable, particularly over the long run. Consequently, a risk-based approach that evaluates potential climate change related impacts for various types of transportation infrastructure should be implemented to protect capital investments and

ensure public safety, whether the infrastructure is new construction or retrofitting of existing facilities.

Reasons to Support:
Climate change will increase risks to transportation infrastructure. These risks vary considerably by region and include temporary or permanent inundation of infrastructure by sea-level rise, storm surge or floodwaters, damage to pavement and rail lines by excessive heat, reduced efficiency of airplane wing lift and engines that necessitates longer runways, thawing permafrost that damages the stability of roads and bridges, impacts on port accessibility due to sea-level rise, and similar impacts. Accounting for these risks in transportation infrastructure design methodology is prudent fiscal practice and important to achieve acceptable public safety standards.

Transportation Policy 25: Ports
Port planners should expect major climate-related impacts over both the short- and long-term. These impacts will be both physical and economic in nature. Plans and procedures will need to anticipate these impacts in order to enhance resilience and inform investment decisions.

Reasons to support:
The ports transportation sector faces particularly significant impacts from climate change. Sea-level rise will affect coastal port operations over both the short- and long-terms and port facilities themselves over the long-term, as rising water levels complicate docking and loading operations and inundate critical facilities, including ground transportation access. In the Great Lakes, water levels are projected to drop due to increased evaporation from higher temperatures, creating problems for navigation and dockage. Changes in sea transportation routes, such as the opening of Arctic routes like the Northwest Passage, will reduce shipping distances between Europe and Asia by thousands of miles, creating new opportunities for ports in northern latitudes and decreasing business activity in ports in southern latitudes. Stronger storms will increase potential damage from storm surge and delay shipments. These impacts require comprehensive assessment in port planning and investment initiatives.

Transportation Policy 26: Airplane Transportation
Airplane transportation, like other transportation sectors, will be impacted by climate change in both physical and operational ways. Planners will need to plan for these impacts in order to maximize the lifespan of existing and future airports and to reduce operational impacts.

Reasons to support:
Airplane transportation will be primarily impacted by climate change in three particular areas. First, rising temperatures will reduce the efficiency of wing lift and engines; this may create the need for longer runways and changes in airplane design. Planners will need to address the issues associated with this problem – e.g., reserving land for runway lengthening and planning for stronger (and potentially noisier) aircraft engines. Second, stronger storms will affect operations by creating delays and maintenance challenges. Third, some airports located in coastal regions will be impacted by sea-level rise, including

how they are accessed by ground transportation. Long-range airport planning will need to account for these new climate effects.

Transportation Policy 27: Ground Transportation
Ground transportation planning will be affected by the need to account for a wide variety of climate impacts. Plans should take both capital and operational issues into consideration, including the level of investment in climate-resilient infrastructure, public safety issues related to operation and maintenance of the ground transportation system, and routine maintenance activities.

Reasons to support:
Ground transportation will be affected by a wide range of climate conditions, from higher temperatures to flooding and inundation from sea-level rise and precipitation and storm surge from stronger storms. Technologies such as high-temperature resistant paving materials and incident warning signage may have to be employed in more locations. Bridge elevations may require adjustment to reflect sea-level rise or new flood levels. Operational adjustments will be necessary to account for changes in storm impacts, such as increased risk of ice storms in northern areas due to higher winter temperatures. Back-up plans for ensuring adequate food and energy supplies when storms delay delivery of these goods will need to be developed. Transportation planning in this sector will require comprehensive consideration of these new climate impacts.

Transportation Policy 28: Transportation Maintenance Practices
Transportation infrastructure and operational maintenance will require adjustment due to climate change. Funding for maintenance programs should take both positive and negative impacts into account.

Reasons to Support:
Rising temperatures have the potential to create pavement damage, buckling of rail lines, thawing of permafrost foundations for transportation facilities like roads and bridges, increased amounts of snow in some areas due to higher moisture levels, changes in location of ice storms, and other effects that create maintenance problems. However, not all effects from increasing temperatures will necessarily be negative for transportation system maintenance, particularly in the colder areas of the U.S. Warmer temperatures may reduce the amount of snow and ice required to be removed in winter season maintenance operations. Less cold weather may result in an extension of the time available for transportation-related maintenance operations. These different effects need to be accounted for in transportation maintenance programs and budgets.

3.4 Energy

Introduction
Planners can address climate change mitigation through plans, incentives, and regulations

which promote the efficient use of energy in buildings, transportation and industry; though the use of less carbon-intensive energy sources; and through the production and use of renewable energy, and through exploitation of local sources of energy, including methane from landfills. To succeed in this area, planners will need to become educated about renewable energy sources such as wind, solar, geothermal, and biofuels, as well as innovative energy generation techniques like combined heat and energy systems. Regulatory barriers to alternative energy generation, such as height limits which preclude wind turbines, must be removed in order to allow these sources of energy to be tapped. Planners must support federal and state policies that promote alternative energy use, such as renewable energy portfolio standards for utilities and tax credits for home owners installing small-scale renewable systems. Planners involved with public investments in buildings and facilities should take energy-efficiency, potential renewable energy sources, and innovative technologies into consideration.

General Energy Policy A: The American Planning Association, its Chapters and Divisions, and planners support efforts to reduce greenhouse gas emissions related to the production and use of energy in the built environment.

Energy Policy 1: Energy Sources to Reduce Climate Change
Encourage and prioritize through policy, regulation and investment decisions, the use of energy sources that emit less greenhouse gases through their production, distribution and consumption, and promote the efficient use of energy. Provide tax incentives for the development, distribution and implementation of renewable energy sources and use.

Reasons to support:
While coal is currently the cheapest energy source available for large-scale electricity generation, it also is the most damaging in its climate impacts. New coal-fired plants in particular, but also other power plants relying on non-renewable energy sources, will overwhelm any reductions in greenhouse gas emissions mandated by the various domestic and international programs to reduce global warming.

Some biofuel sources, notably cellulosic sources such as switchgrass, have shown promise in providing energy while not negatively affecting food production or land conservation. Research into these alternative sources should continue. Investment in the development of renewable energy and more efficient energy sources would reduce climate change impacts, minimize reliance on large energy-producing facilities, and drive new areas of economic development.

Planning for energy supply and consumption should evaluate greenhouse gas emissions of alternative sources, and should support those sources that lower greenhouse gas emissions.

Energy Policy 2: Support a Transition to Renewable Energy

Adopt state, regional, and national policies that accelerate the transition to renewable energy sources.

Reasons to support:
Greenhouse gas emissions from energy use (including transportation) amount to about 70 percent of worldwide greenhouse gas emissions. Policies such as feed-in tariffs (the minimum price a utility must pay to an independent renewable energy producer), tradable green energy certificates (proof that a unit of electricity was generated from an eligible renewable energy source to be sold to entities that produce too much greenhouse gas), and renewable energy portfolio standards (minimum annual amounts of electricity to be generated by renewable energy sources), and similar mechanisms have been shown to be effective in accelerating the transition to a low-carbon economy, though no single approach is appropriate for all situations.

Energy Policy 3: Incentives for the Small-Scale Use of Renewable Energy Systems
Establish incentives to encourage installation of renewable energy systems by homeowners and small business operators including the training and education of homeowners**.**

Reason to support:
Given the artificially low price of coal and other fossil fuels, since environmental externalities are not included, it is often not cost-effective for individual homeowners or small business operators to install alternative energy systems. Such installation may also require up-front investment. Incentives for installation of small-scale renewable energy may include a per-watt rebate for newly installed electric generation capacity, loans or grants for installation of renewable systems, and net metering in which the property owner is paid for electricity fed back into the grid.

Energy Policy 4: Local Energy Generation from Renewable Sources
Support initiatives that generate energy from local renewable sources as a part of economic development efforts.

Reasons to support:
Electricity generation is responsible for 32 percent of U.S. greenhouse gas emissions. Local generation of energy meets community needs without the costs – and greenhouse gas emissions – related to long-distance transmission. In addition, the use of local renewable sources reduces greenhouse gas emissions from carbon-based fuel sources. Not only does this approach help address climate change, it can also form the basis for new economic opportunities.

Energy Policy 5: Design for Alternative Sources of Energy
Support urban design strategies that maximize use of renewable, sustainable, active and passive sources of energy design in architecture. Increase and/or extend tax credits for the use of active energy generation in building design and construction practices.

Reasons to support:
Site planning and building design have a significant effect on the amount of energy needed to heat, cool and light buildings to meet the needs of their occupants. Site and building design techniques can reduce energy consumption on-site, thus reducing demand for energy generated elsewhere and its related greenhouse gas emissions. Planning and development review programs should encourage the use of passive solar energy and other on-site alternatives.

Energy Policy 6: Funding for Energy Efficiency and Conservation
Fully fund the federal Energy Efficiency and Conservation Block Grant Program (EECBG) to communities.

Reasons to support:
Even though energy conservation and the use of renewable energy may save money in the long term, higher up-front costs often prevent their use. Federal funding could provide resources to fiscally constrained localities (through block grants) that could be used to reduce or offset these initial costs. This funding can play an important role in reducing reliance on fossil-fuel based energy and the greenhouse gas emissions from these energy sources, as well as allowing local governments to lead by example and help develop the market for "green jobs" locally.

Energy Policy 7: Encourage Combined Heat and Power
Facilitate the installation of combined heat and power (CHP) systems in industrial and institutional applications and in homes and businesses through education, grants, and the adoption of net metering nationally.

Reasons to support:
The average efficiency of the fossil-fuel power plants in the U.S. is approximately 33 percent. This means that, in the process of generating electricity, two-thirds of the energy in the fuel is lost as heat; an average of 8 percent more is lost in the transmission and distribution of electricity to users.

CHP is the production of electricity and use of the heat created in that process. CHP systems use waste heat that would normally be released to the surroundings. In residential applications the heat can be used for domestic hot water, space heating, absorption cooling, or dehumidifying at the building where it is produced. CHP systems consist of a package of equipment with a prime mover (for apartment buildings, most often a reciprocating engine or microturbine) driving an electric generator. If all of the recoverable heat is used, they can achieve overall efficiencies of about 80 percent.

In addition to greater efficiency and the security of a distributed network, CHP reduces emissions of CO2 and other gases. The Intergovernmental Panel on Climate Change recognized Combined Heat and Energy as a "key mitigation technology currently

commercially available" as did the U.S. Congress in 2007.

Energy Policy 8: Energy Generation
When siting energy generation facilities, planners should encourage the power generation plant to become an anchor of an eco-industrial park.

Reasons to support:
By cascading energy resources through the combined production of electricity, heat and steam, energy generation facilities can be made more efficient. Co-locating industries which benefit from the use of these resources can make the industries more competitive in the world marketplace.

Energy Policy 9: Integration of Renewable Energy into Codes
Revise building codes and architectural design guidelines to allow for, encourage, or require integration of passive solar design, green roofs, active solar and other renewable energy sources**.**

Reasons to support:
In many climates solar design and on-site solar systems have been shown to be effective in lowering overall building energy use. Design standards might include southern orientation of structures, extensive southern fenestration for winter heating, shielding of windows to prevent summer overheating, thermal mass to retain heat and coolness, and design for maximum natural summer ventilation, solar hot water heaters and photovoltaic electricity.

Energy Policy 10: Eliminate Regulatory Barriers to the Use of Renewable Energy Systems
Examine existing zoning laws and development standards and revise or eliminate provisions that act as a barrier to the installation and use of renewable energy systems. Streamlining permitting processes for renewable energy systems, for example, is a technique that reduces installation costs, minimizing financial barriers for renewable energy systems.

Reasons to support:
Community resistance to large-scale wind turbines and solar energy "farms" is well-documented and has occurred for a variety of reasons, including aesthetic and wildlife safety concerns, among others.

Siting of alternative energy facilities is highly location-sensitive. Wind turbines must be erected in areas with sufficiently constant wind velocity; solar energy farms must be located in areas with significant amounts and frequency of sunshine; and solar panels must be oriented toward the sunlight that is available on a particular site. These locational constraints must be addressed or accommodated in local land use regulations designed to support these types of facilities.

Scale and design also present problems for these facilities. Even small-scale wind turbines are frequently taller than what many zoning ordinances will allow for either principal or accessory structures. Solar energy farms may violate the maximum height limits and impervious surface regulations in local codes. Solar panel placement may conflict with historic district regulations or other community design standards, including rooftop mechanical equipment standards in downtown settings. Landscaping on adjoining properties may create problems for solar access for residential solar panels.

Energy Policy 11: Renewable Energy Systems and Energy Efficiency in Public Facilities
Construct and renovate public facilities to serve as demonstrations of energy efficiency improvements and green building practices and include (where possible) renewable energy systems such as photovoltaic electricity or solar hot water panels**.**

Reasons to support:
Public facilities can be visible examples of the benefits of renewable energy systems and act as models for the private sector to follow. Greenhouse gas emissions can be reduced by use of renewable energy and energy-efficient systems in public facilities.

Energy Policy 12: Methane Emissions from Landfills and Sewer Treatment Plants
Support policies that result in the design, retrofitting, operation, and management of landfills (both existing and closed) and sewer treatment plants so that methane emissions are controlled and, where feasible, used for energy production.

Reasons to support:
Methane is the second most common GHG, after CO^2. Methane is produced in landfills as the result of the anaerobic decomposition of waste. Landfills are a major contributor of methane emissions, accounting for approximately 34 percent of all methane emission in the U.S. Methane is readily usable for the production of energy since it is a major component (95 percent) of natural gas. Land use planning and public facility siting policies should locate and design landfills so they provide energy resources and minimize methane emissions.

3.5 Green Development

Introduction
Emissions from the energy used for lighting and heating and cooling buildings represent a significant part of the total U.S. greenhouse gas emissions, with some estimates as high as 40-50 percent. Additionally, according to the American Institute of Architects, over 75 percent of the buildings that will exist in 2030 will be either new or renovated.

These facts create obvious and significant opportunities for planners. Since building operations create at least a quarter of U.S. greenhouse gas emissions and 75 percent of U.S. buildings will be newly constructed or significantly altered over the next 20 or so years,

improvements in the way that buildings and sites are designed constitute a major method by which planners can help mitigate climate change.

Mitigation of climate change through green development primarily involves improving energy efficiency in order to reduce greenhouse gas production. These improvements include building design and landscaping techniques that minimize energy consumption through the use of efficient design and maintenance practices, the provision of shade, and the use of alternative energy sources.

In addition to these mitigation techniques, green development can be used to assist with community adaptation to climate change. For example, with drought conditions being exacerbated by climate change, reducing water demand is an important adaptation technique. There are a variety of existing technologies for reducing water use in buildings. These technologies can be applied in both existing and new construction. Low-flow toilets, waterless urinals, graywater systems for toilet flushing, low-flow showerheads, thoughtful placement of water heaters near points of use to minimize water waste while waiting for hot water to be delivered to the faucet, and tankless/on-demand hot water heaters are all ways in which water demand for use inside buildings can be reduced. Reduction in water consumption also translates into reduced energy needs to treat and deliver the water, a mitigation benefit.

There are a number of ways planners can implement structure design standards, regulations and programs to help communities mitigate and adapt to climate change, including the following:

- **Public awareness** — In general, the public is quite supportive of energy efficiency for a wide variety of reasons, including financial benefit and social concern. Planners can initiate public awareness programs and campaigns to broaden awareness of the opportunities to achieve greater energy efficiency through structure design technology and alternative energy sources. Additionally, the public is becoming aware of the hazards associated with climate change and planners can effectively communicate how green development can sit and reducing the risks associated with these hazards.
- **Incentive programs** — Planners can develop incentive programs for green development, including regulatory incentives such as increased density or expedited development review and financial incentives such as tax, loan or grant programs.
- **Public construction specifications** — When public buildings are proposed, the use of energy- and water-saving products, appliances, technology, and installation techniques can be specified as part of the construction bid process. This not only saves water and energy but also sets an example for the private sector.
- **Regulatory requirements** — In many cases, it may be appropriate to establish regulatory requirements that implement green development goals and objectives. For instance, many communities mandate LEED certification, open space preservation, landscaping, water-saving fixtures, and the installation of cool roofs.

- **Regulatory reform** — Often, existing code requirements or design guidelines inhibit the use of certain energy-efficient technology. For example, lot width standards may preclude optimal passive solar structure orientation or historic preservation guidelines may prohibit roof-mounted solar collectors and skylights. Existing regulatory provisions, such as local flood damage mitigation standards, should be reevaluated to ascertain their continued validity in light of potential climate change effects. Planners should examine their codes' compatibility with existing and emerging technology and make adjustments where appropriate.
- **Retrofit programs** — Many communities target older neighborhoods for energy-efficiency retrofits or the free replacement of older toilets and showerheads with low-flow models.

General Green Development Policy A: The American Planning Association, its Chapters and Divisions, and planners support the implementation of green development design standards and incentives that reduce the carbon footprint and enhance the climate adaptive capabilities of new and existing buildings and developments.

Green Development Policy 1: Green Building Standards
Support the continued development and application of green building standards. Develop and promote the means and standards to reach carbon neutral buildings by 2030. Incorporate green building and energy efficiency standards in all public facilities.

Reasons to support:
A variety of organizations have developed green building standards. An example is the LEED (Leadership in Energy and Environmental Design) green building rating system of the U.S. Green Building Council. Such standards "raise the bar" on the energy efficiency of new building construction and renovation. These standards can be used as guidance to set local standards for new construction, improvement to existing buildings, or to specify the level of energy efficiency desired in new public facilities, at the local, state, or federal level.

Green Development Policy 2: State Adoption of Mandatory Building Energy Codes
Support and seek adoption and ensure enforcement of mandatory building energy codes for commercial and residential buildings at the state level. As an alternative, set minimum standards for energy efficiency in new buildings and ensure that all states are achieving them through adoption and enforcement of mandatory building energy codes.

Reasons to support:
Eleven states do not have residential building energy codes; 14 states have either no enforcement or voluntary enforcement. A like number of states do not have commercial building energy codes. This is a lost opportunity to set minimum expectations for energy efficiency in new buildings.

Green Development Policy 3: Minimum Standards for Building Energy Codes

Support raising building energy code requirements to be at least as stringent as the most recent International Energy Conservation Code (U.S. DOE), or the most recent ASHRAE 90.1 code (American Society of Heating, Refrigerating and Air-Conditioning Engineers), or equivalent.

Reasons to support:
Building heating, cooling, ventilation, and lighting account for a very large percentage of greenhouse gas emissions in the United States (building contributions to GHG emissions are not aggregated as such by the U.S. EPA but are estimated at up to 48 percent by architect Ed Mazria, originator of the Architecture 2030 Challenge).

Green Development Policy 4: Performance-Based Code Alternatives
Support the addition of performance-based alternatives to energy codes and appropriate sections of the building code.

Reasons to support:
Innovation in building techniques and construction is essential to raising the bar for energy efficiency standards. Unfortunately, prescriptive based building codes, which rely on tried-and-true measures, can stymie innovation. If it can be shown through energy modeling that a building using innovative techniques can achieve energy performance at least as good as an equivalent building using the prescriptive based measures, then that design should be allowed.

Green Development Policy 5: Ongoing Investment in Building Energy Efficiency
Support the adoption of standards requiring existing buildings larger than a certain size threshold to periodically invest in energy-efficiency improvements that have a reasonable payback period. Support incentives and standards that retrofit and redevelop existing buildings to improve energy efficiency while respecting the historic integrity of buildings and communities.

Reasons to support:
As building energy efficiency technology becomes more cost-effective, ensuring that it is incorporated into existing buildings will benefit not only the building owner but also the larger community through lower greenhouse gas emissions. Communities will not be able to meet their targets by addressing only new construction.

Green Development Policy 6: Green Roofs
Encourage and incentivize the use of green roofs in the development of landscaping and building regulations.

Reasons to support:
When intensifying infill development, green space within a community may be lost. By greening rooftops, the community itself can become an effective carbon sink. A significant amount of total GHG emissions come from the built environment. Green roofs can help

decrease building-connected emissions and are an important element of any strategy aimed at carbon neutral buildings.

Green Development Policy 7: Incentives and Education for Green Development
Support the creation of incentives, including appropriate tax credits and financing energy efficiency improvements with repayment through assessments on property tax bills, and education programs to encourage homeowners and developers to invest in green development improvements.

Reasons to support:
Many homeowners and developers want to improve the energy performance of their buildings, and may be concerned about climate change hazards. Education programs and incentives such as expedited permit review and fee waivers can encourage retrofit and voluntary compliance.

Green Development Policy 8: Performance Rating Standard
Support the adoption of a national building energy performance rating system.

Reasons to support:
Such a system would allow potential buyers and tenants to make informed choices about the energy costs associated with buildings. It could be similar to gas mileage ratings for vehicles and would improve market awareness of the energy performance of buildings.

Green Development Policy 9: Heat Island Effects
Design communities, neighborhoods and individual development projects using techniques that reduce heat absorption throughout the community and region**.**

Reasons to support:
Heat island effects traditionally take place in urban areas where natural ground cover has been replaced with pavement, buildings, or other materials that tend to absorb and retain heat. While the resulting warmer temperatures may be benign or even welcome during colder times of the year, any such benefits are greatly outweighed by the negative impacts during hotter summer months when heat island effects significantly contribute to increased human health risk and increased use of air conditioning, resulting in greater energy use and greenhouse gas emissions.

Green Development Policy 10: Housing and Infrastructure Programs
Federal, state and local housing and infrastructure programs should incorporate green development standards and requirements.

Reasons to support:
Public investment and grant programs offer an opportunity to implement green development techniques throughout the community, in addition to potentially saving money for clients and the public through greater efficiency.

Green Development Policy 11: Require the Use of Water Saving Fixtures
The use of water saving fixtures should be required in both new construction and in retrofit of existing structures.

Reasons to support:
Most building codes contain provisions for low-flow toilets. In areas where water supply is threatened by climate change, these codes should be examined to ensure that other water-saving alternatives are permitted. Plan review and inspections programs can promote water-saving technologies at the design level. Additionally, opportunities to retrofit older technology can be pursued through incentives or requirements.

Green Development Policy 12: Landscaping Requirements and Incentives
Landscaping standards should be designed to promote environmental benefits such as carbon sequestration with a preference for indigenous plants.

Reasons to support:
Many zoning or development codes contain provisions for parking lot landscaping, perimeter site buffering, and/or open space preservation. These code requirements present planners with opportunities to introduce or preserve carbon-sequestering vegetation as sites are developed. Planners should consider examining their code requirements with an eye to promoting tree canopy development, use of native species and xeriscaping practices, and integrating landscaping with stormwater management techniques such as raingardens. Larger trees sequester more carbon and native tree species combined with xeriscaping and integrated stormwater management are more likely to reach full maturity in urban environments.

Green Development Policy 13: Public Building and Infrastructure Investments
Specify the use of energy- and water-saving products, appliances, technology, and installation techniques can be specified as part of the construction bid process for all public building and infrastructure projects.

Reasons to support:
Public buildings and infrastructure represent opportunities to implement green development in a highly visible fashion throughout the community. This communicates the community's commitment to green development and sets an example for the private sector.

3.6 Natural Resources

Introduction. Climate change will modify natural systems. In many cases, these modifications will be significant. For example, rising sea levels will alter the salinity of low lying coastal marshes, drought will affect the habitat of many plant and animal species, and rising temperatures will extend the ranges of some species while contracting those of others. These

changes will affect food supply, species diversity, timber harvests, and many other important components of the human relationship to the natural world. As a consequence, management of natural resources will become increasingly important as the effects of climate change materialize and ecosystems react and are modified.

Natural systems sequester carbon, slowing or inhibiting its concentration in the atmosphere. Maintenance and enhancement of critical natural sequestration systems are highly important factors in climate change mitigation. Reducing greenhouse gas emissions alone is not going to "turn the tide" on global climate change. Sequestration of carbon and other greenhouse gases is essential. Even under the most optimistic scenarios for energy efficiency gains and the greater use of low- or no-carbon fuels, additional sequestration will be necessary if the world is to stabilize atmospheric concentrations of greenhouse gases at acceptable levels. Planners are likely to be involved in promoting natural sequestration through such activities as preserving forests and farmland, creating urban forestry programs, and similar actions.

Agricultural and forestry practices can assist with climate change mitigation through carbon sequestration. Properly managed, farmland has a high potential for carbon sequestration. Many sustainable agricultural practices significantly increase the amount of carbon that can be sequestered in soils. These include planting cover crops, using no-till farming techniques, adding organic material to soil (crop residues, biosolids, compost), planting more deep-rooted perennial crops, and limiting the use of chemical fertilizers which disrupt natural soil processes.

Forestry operations also provide significant opportunities for sequestration, through such practices as afforestation, reforestation, preservation of existing forests and forest management to enhance sequestration, including lengthening the harvest/regeneration cycle and adopting low impact logging methods.

Other ways to promote conservation of agricultural and forest areas and natural ecosystems include:

- **Transfers of development rights (TDR)** — TDR provisions can preserve property owner investment by allowing the development intensity associated with a particular property to be physically separated from that property. In effect, the allowable development that could potentially be put on an agricultural property or environmentally sensitive area is transferred to a less sensitive area for development purposes.
- **Soils-based zoning** — Zoning regulations can be imposed to limit the amount of development allowed on a range of soil types, such as prime agricultural soils or hydric soils. Such an approach may also need to take into account additional physical circumstances associated with the zoned property (proximity to urban development, access, etc.) in addition to soil types so that a wider range of public concerns are addressed through the imposition of the particular zoning requirements.

- **Cluster development** — Concentration of the development allowed on a property creates the opportunity to preserve the remainder of the property for agricultural, forestry or natural uses. While there are inherent incentives for such "clustering" (e.g., infrastructure expenses are reduced for more compact development and potential amenities are created for the residents of such developments), many communities utilizing this approach also provide associated density bonuses and other regulatory incentives because there are public benefits associated with maintaining property in open space, including carbon sequestration purposes.
- **Local foods** — The rapidly developing local food movement creates a strong market for local agricultural products, often high-value organic food products. Institutional purchasers of local food products, such as military bases, college campuses and hospitals, can enhance the viability of local agriculture.
- **Urban growth or urban service boundaries** — These policy or service-based boundaries demark urban areas from rural areas and support the preservation of agricultural, forestry and natural areas by making them unavailable or less palatable for development. Such approaches are especially effective in areas where certain urban services are necessary for virtually any kind of development, such as centralized potable water service in areas where individual wells are not feasible due to cost, availability of groundwater, or quality of groundwater.
- **Urban forests** — Planting trees and other vegetation in urban areas can have a significant impact on greenhouse gas sequestration and reducing energy use in cooling buildings.
- **Compact development pattern** — A compact development pattern in general has the potential to increase opportunities for conservation by simply reducing the amount of land needed for urban and suburban development.
- **Economic development** — Conservation efforts can be greatly enhanced by economic development programs that are designed to take advantage of conserved lands. Two examples:
    - Heritage tourism allows visitors to experience a rural lifestyle.
    - Ecotourism promotes the ecological uniqueness of conserved lands.

The above discussion has been targeted to climate change mitigation. Adapting natural systems to future climate change effects will require renewed emphasis on agricultural, natural resources, and ecosystem management techniques. Here, the issue is broader than carbon sequestration. It involves managing natural systems in ways that enhance sustainability of those systems, where sustainability is possible due to climate change effects. Where systems cannot be sustained, adaptation responses must include appropriate alternative responses, such as when a coastal freshwater marsh transitions to a saltwater ecosystem due to sea level rise or storm inundation.

Natural resources are threatened by climate change in many ways. Pests and diseases may become more prevalent due to higher temperatures and broader ranges, with exotic species displacing natural species in many cases. Droughts and floods may alter natural ecosystems and create challenges for agriculture and forestry uses. Sea-level rise will affect coastal

ecosystems and agriculture by inundating uplands and introducing salinity to freshwater wetland and riparian systems. In some cases, however, climate change may prove beneficial by expanding the range of some crops through warmer weather. Increase concentrations of CO2 in the atmosphere have been shown to have some beneficial effect on plant growth.

Planners will need to consult with experts and practitioners in ecosystem management, agriculture, and forestry in order to develop effective plans to assist natural resource adaptation to climate change effects. An interdisciplinary approach is necessary due to the scale and complexity of the issues.

General Natural Resources Policy A: The American Planning Association, its Chapters and Divisions, and planners support actions that preserve and manage natural assets, including agricultural and forestry lands and natural ecosystems, in such a way that the natural assets can be sustained despite climate change impacts and that the natural assets held reduce greenhouse gas emissions.

Natural Resources Policy 1: Natural Asset Protection
Protect important natural assets within communities and regions to maintain their roles as "carbon sinks" and to enhance their long-term resilience to climate change impacts. Government, businesses and institutions of higher learning should help communities identify and map and these assets and sustainably manage them.

Reasons to support:
Throughout much of the 20th century, urban development relied on engineering methods and construction to modify the natural environments surrounding growing communities. The need to reduce greenhouse gas emissions adds another reason to support a different approach to natural assets — one in which they provide valuable benefits to the community and the world.

Nature preserves and other areas that remain in a natural state — such as grasslands, wetlands , farms and forests — serve as carbon sinks, sequestering carbon and keeping it from reaching the atmosphere. Disturbance of these areas releases carbon into the atmosphere.

These areas are vulnerable to climate change impacts and require careful management in order to be sustained.

Natural Resources Policy 2: Reduce Greenhouse Gas Emissions through Agricultural Practices
Establish educational programs and incentives to promote agricultural cultivation and livestock best management practices that reduce greenhouse gas emissions and that allow the sequestration potential of agricultural activities to be realized. Local, state and federal standards and regulations should be reformed to support agricultural practices that reduce emissions and curtail practices that increase GHG emissions. Increased sequestration of

carbon agricultural land uses should be a primary goal of these efforts.

Reasons to support:
Today's agricultural practices contribute to climate change in several ways: through fossil fuel combustion by farm machinery and vehicles; through the use of nitrogen fertilizers; through the release of carbon stored in plants and soils; and through methane gas production in livestock and other operations. County and rural area plans that include agricultural preservation can include policies that promote sustainable agriculture. Development incentives (such as density bonuses for clustered development) can be increased for agricultural properties that meet greenhouse gas reduction or carbon sequestration targets. Plan implementation can include education and training programs.

Natural Resources Policy 3: Local Food and Energy Production
Include consideration of the local production of food and energy in comprehensive plans and local regulations. Reform federal agricultural policy to shift resources and funding priorities toward support of locally produced foods and assignable biofuels such as switchgrass. Remove regulatory barriers to the distribution, consumption and purchase of locally produced food and energy. Encourage institutional procurement local foods and biofuels.

Reasons to support:
Local food production can reduce "food miles" — the distance that food must travel – and consequently greenhouse gas emissions. Food in a grocery store typically travels 1,000 miles or more while the typical food in a farmers market travels less than 1/10th of that distance. Planning for land used for community farming can help protect and ensure the retention of these properties for local food production. The result will help minimize VMT by limiting food transport and avoiding regional imports of consumer goods that can be produced locally, helping the local economy. Environmentally sustainable biofuel production of crops like switchgrass can help preserve local agriculture and sequester carbon while providing a renewable energy source. Locally produced foods and fuels can enhance regional security in the event of shortages resulting from climate impacts such as drought, extreme weather incidents, or floods.

Natural Resources Policy 4: Protect Agricultural Lands from Urban and Suburban Encroachment
Establish strategies to promote redevelopment and compact new development that will minimize the conversion of farmland and woodland for urban and suburban use. Promote federal, state and local funding for preservation of open space, farm and forest land.

Reasons to support:
Reducing conversion of agricultural and woodlands to urban and suburban use enhances carbon sequestration, supports the local economy, and retains rural character.

Natural Resources Policy 5: Natural Resource Climate Change Adaptation

Utilize a multidisciplinary approach to address climate change adaptation challenges affecting natural ecosystems, agriculture and forestry. Identify and map areas of concern and develop plans for a sustainable transition to new climate conditions. Identify best practices management techniques to support system resilience in the face of anticipated climate change impacts.

Reasons to support:
Ecosystems, farms and forests face adaptive challenges to climate change. Preservation of these systems will require sophisticated management approaches that support transition to a new climate future. It is important to "buy time" to allow these systems to adjust to higher temperatures, new precipitation patterns, and, in coastal areas, increased salinity and/or inundation. Allowing systems to adjust slowly and more naturally reduces the problems that rapid transition can create, such as die-off of forests and wetlands from increases in salinity or inundation and reduced crop or forest yields.

3.7 Economic Development

Introduction
Economic development impacts resulting from climate change may well prove to be one of the most significant issues of concern for planners in the United States. The U.S. economy is extremely diverse, but, as our balance of trade deficit illustrates, it is extremely dependent on and supportive of the global economy. In many ways, the diversity of our economy will reduce our vulnerability to economic impacts from climate change, at least relative to the less diverse (and presumably less resilient) economies of many other nations. However, our dependence on global economic conditions increases our vulnerability to changing markets, resource limitations, social unrest, and other global factors that may be strongly influenced by climate change.

Additionally, the "new economy" is highly mobile. Industries will migrate because of climate just as people will. Water supply problems, difficulties in finding affordable insurance, availability of cheaper shipping, and other factors affected by climate change may cause businesses and industries to relocate to more advantageous places. Migration, therefore, has enormous implications for local economies, creating different issues depending upon whether business is moving in or is moving out. Planners will need to develop adaptation responses to assist their communities as these economic transitions occur.

A sample of climate change impacts on several economic sectors is provided below.

Agriculture. Higher temperatures may mean longer growing seasons in some areas, increasing yields. Temperature changes may also make increase the commercial range of certain crops, such as the ability to produce oranges in northern Florida. Higher CO2 concentrations may spur enhanced plant growth, also increasing yields. These geographically based gains may be offset by problems from increased heat-induced evaporation, greater

incidence of drought, more intense flooding, and increased pest activity. Issues for planners include addressing the following:

- Adjustments to crop type selection and management in response to new climate circumstances may result in new or different markets and the need for different or retrofitted machinery for planting and harvesting. Farmers may require assistance in making these adjustments.
- Balancing agricultural irrigation needs with the needs of other water users.
- New or more frequent pest management applications, including managing their effect on surrounding non-agricultural properties. As residential development into exurban areas increases, there is potential for increased conflicts with or concerns about agricultural practices.

Forestry. Drier conditions are expected to create more wildfires, reducing timber yields. Pests' ranges may increase along with their period of activity, also reducing yields; this is already occurring in many areas affected by the pine bark beetle, for instance. The need for enhanced fire management may limit forest production during and for some time after controlled burns. There may be declines or increases in the commercial yield potential for certain tree species as their historic ranges are altered by higher temperatures. Greater CO2 concentrations may spur increased growth which could enhance yields.

Fisheries. Higher temperatures and changes in the salinity and pH of ocean waters may negatively affect yields from certain species of fish and shellfish. Sea-level rise, drought, and flooding may impact the spawning runs of salmon and many kinds of estaurine fish and shellfish. Loss of wetlands due to sea-level rise, flooding, sedimentation, and erosion has the potential to negatively affect many commercially important species. Some fishing ports and processing facilities may be threatened by sea-level rise. Various studies note that thermal expansion of the oceans has the potential to affect major ocean currents, creating significant changes in fish populations and their migratory habits.

Shipping and freight. Major changes in shipping routes may occur as the Northwest Passage and the Northern Sea Route are able to be used more frequently as a result of declining Arctic sea ice. These new routes cut 5,000 or more miles off the distance traveled between Europe and China relative to the Panama and Suez Canals. They have the potential to greatly lower shipping costs and are able to support the much larger container ships currently being planned or constructed. These routes may generate new activity in northern ports while reducing activity in southern ports, a potentially significant change for local economies in these areas. Sea-level rise will increase the vulnerability of many ports to inundation and storm surge. Similarly, road and rail access to ports and to coastal areas in general may experience problems associated with sea-level rise. "Just-in-time" freight delivery practices have dramatically reduced the need for warehousing of goods, creating a reliance on timely material and product delivery. However, increased energy costs and weather-related delays may create greater demand for local products or more reliable and energy-efficient shipping practices.

Manufacturing. Water supply issues may affect manufacturing operations and costs. Other problems for this economic sector include flooding and/or inundation of manufacturing facilities located in vulnerable areas, weather-related raw material and finished product delivery issues, and the effect of higher temperatures on products and personnel, particularly outdoor storage and processing operations.

Insurance. The insurance industry will be significantly affected by climate change. The Global Business Network (GBN) notes that "{i}nsurance is enormously important, in part because without the socialization of risk, development becomes much more difficult." (Nils Gilman, Doug Randall, and Peter Schwartz, "Impacts of Climate Change: A System Vulnerability Approach to Consider the Potential Impacts to 2050 of a Mid-Upper Greenhouse Gas Emissions Scenario"; *Global Business Network*; January 2007; p. 13.)
In the same publication (pp. 13-14.), three major challenges are cited for this industry:

- "... insurance prices for events like floods, droughts, wind, hurricanes, and tornadoes are all based on historical data . ... Climate change makes this historical data much less useful." As a result, some markets may prove overly risky, resulting in insurers exiting the market. Government may be forced to step in to fill the gap in order to maintain both public and private investment, such as in the case of federal flood insurance. This step would, of course, expose the public sector to risks that the private sector is unwilling to endure.
- Regulators may hold the actual price of insurance to artificially low levels due to concerns about the effects of actuarially based pricing using climate projections on, for example, the real estate market in hurricane-prone areas. As with the uncertainty issue, this has the potential to affect the willingness of insurers to remain in higher-risk markets and to result in government action if private insurers demur.
- The potential for increased exposure to climate change liability lawsuits further complicate risks. For example, GBN postulates a class-action lawsuit against a corporation that produces one percent of the human-induced GHG in which the corporation is held accountable for one percent of the global damages associated with climate change.

Services and construction. Health care will see an increasing trend toward heat-related maladies, vector-borne diseases, and hazard response services. Outdoor-oriented businesses will have to adjust to warmer temperatures which may create heat-related delays in some areas and a prolonged outdoor work season in others. New markets for energy-efficient, green building products and construction techniques will open to address climate change issues such as water supply problems caused by drought or contamination and cooling costs caused by higher temperatures.

Tourism/recreation. Rising temperatures will affect cold-weather tourism and recreation by reducing amounts of snowfall and the length of the winter-weather season. In many areas, lake levels will be reduced by drought and evaporation, complicating such recreation activities as water sports and fishing. Beach resorts face problems that include beach erosion

from sea-level rise, reduced water quality and abundance of coral, and increases in vector-borne diseases .

Adaptation responses to climate change involving local economic development involve addressing vulnerabilities in the two main areas listed below and in adjusting to in-migration of industry and business in areas where such new economic activity can be expected.

Physical vulnerabilities - Industrial facilities, agricultural operations, ports and shipping facilities, and power generation and other support infrastructure may be located in areas prone to inundation due to sea-level rise, in areas made more flood prone due to changes in precipitation patterns and snowpack melting rates, and in areas of thawing permafrost. Consequently, there are physical threats to the local economy that must be addressed by relocation, renovation or innovation to eliminate the threats or minimize them to acceptable levels.

Physical vulnerabilities will create a range of economic development impacts:

- **Migration** — the use or economic activity can no longer effectively function in its current location and migrates from the locality or region in response to climate change.
- **Obsolescence/abandonment** — the use or economic activity can no longer effectively function in its current location and becomes obsolete or is abandoned in response to climate change.
- **Relocation** — the use or economic activity can no longer effectively function in its current location but can be relocated elsewhere in the community or region in response climate change.
- **On-site mitigation** — the use or economic activity can continue to function in its current location provided impact mitigation measures are taken in response to climate change.

Sector vulnerabilities — Some sectors of the economy may be threatened by changes in resources available as products or for production or processes. For example, drought-related water supply issues may affect availability of water or use in industrial processes, for hydroelectric generation, or for irrigation. Certain types of agriculture may not be feasible in drought conditions. Drought may also affect tourism through reduced lake levels or wildfire-charred scenery. In these sector cases, planners may need to address vulnerabilities through innovations in processes, practices or energy use, land use conversions or adaptive reuse of existing facilities, specialized or time-sensitive marketing, and similar measures.

Sector vulnerability responses to climate change impacts are similar to those for physical vulnerabilities. However, there are typically more options for communities to pursue since buildings housing obsolete uses can be adaptively re-used or new crops can replace those which are no longer viable. The impact categories are listed below with some additional discussion relevant to sector vulnerability issues and opportunities.

- **Migration** — the use or economic activity can no longer effectively function in its current location and migrates from the locality or region in response to climate change. This may be the case of a water dependent use in a drought-prone location. In most cases, however, the facilities and infrastructure remain intact and available for re-use for another economic activity or use. The problem then becomes one of marketing the location to suitable alternative uses, rather than adjusting to a permanent loss of the resource as in physical vulnerability.
- **Obsolescence/abandonment** — the use or economic activity can no longer effectively function in its current location and becomes obsolete or is abandoned in response to climate change. In this case, the opportunity for adaptive re-use remains. There are numerous examples of abandoned wharves and similar facilities being converted to housing or mixed use developments. A word of caution is warranted, however – planners will need to evaluate the need to retain existing warehouse and industrial sites in the event of the re-emergence of a more decentralized model of freight distribution and local production due to rising energy costs and other factors.
- **Relocation** — the use or economic activity can no longer effectively function in its current location but can be relocated elsewhere in the community or region in response climate change. Relocation offers the opportunity to adaptively re-use the facility or property.
- **On-site mitigation** — the use or economic activity can continue to function in its current location provided impact mitigation measures are taken in response to climate change. Such measures may include switching to alternative crops or agricultural practices, floodproofing, hardening the water's edge, and modifying the support infrastructure to create climate change resilience.

General Economic Development Policy A: The American Planning Association, its Chapters and Divisions, and planners support planning efforts that diversify local economies, incorporate and promote new technologies and sustainable businesses, and reduce the physical and sector vulnerabilities of local economies to climate change.

Economic Development Policy 1: Diversification of Local Economies
Diversify economies to reduce risks that climate change impacts, including weather-related disasters, will overly impact particular economic sectors leaving communities without important services.

Reason to support:
In financial portfolio management we are often told to diversify to reduce risk to optimize returns. A parallel dictum could be applied to local and regional economic development sectors potentially impacted by climate change. Planners should adopt policies that anticipate potential climate and weather economic impacts and seek opportunities for self-reliance and economic resilience by developing local resources.

Economic Development Policy 2: Technology and Communications
Support technology and business practices that encourage telecommunities and enable people to reduce vehicle miles traveled from home to work. These include the use of home offices and technology such as wireless communications and videoconferencing, and the expansion of rural broadband.

Reasons to support:
Evolving communications and computer technology allow people to work together without being in the same physical location. These changes allow effective collaboration with fewer vehicle miles traveled, and thus lower greenhouse gas emissions. They provide for more efficient use of space (i.e. building materials, parking, roads) when home offices are combined with "hot desking" (one desk shared by many people at the main office). They also can provide social and economic benefits by offering more flexibility to accommodate full-time parents, the handicapped, and part-time workers.

Changes to development patterns that support these trends include increased flexibility for home office uses, the potential for satellite offices within residential neighborhoods with wireless communication to the main office when some collaboration is desirable, and business support centers in neighborhood commercial areas.

Economic Development Policy 3: Green-Collar Jobs
Use comprehensive planning and shift economic development and working training programs to support local jobs in sustainable businesses.

Reasons to support:
Businesses in 'green' industries (or businesses that use 'green' approaches to traditional industries) will become increasingly important to greenhouse gas reduction and to sustainable economies. As companies and individuals seek to reduce their 'carbon footprints', they will look for more sustainable materials, technologies and services. Support for the businesses that are using green practices will make it possible for local climate change goals to be met. These businesses can also form the foundation for 'green' economic growth that can reduce reliance on fossil- fuel-based economies. Green businesses can be a positive focus for economic development which supports a living wage, offers career ladders as well as robust training programs to increase income to help everyone adjust to increasing costs.

Economic Development Policy 4: Eco-Industrial Development
This concept utilizes a systems approach to siting industrial development, placing industries that use the by-products of other industries or that can share energy systems and other resources in close proximity, anticipating green construction and infrastructure in industrial park layout and design, and collaborating with the surrounding community for services or resources or to ensure compatibility, among other synergistic and environmentally friendly practices. The goal is to create a node of industrial sustainability that minimizes waste, enhances inter-industry cooperation, and more effectively and efficiently utilizes local resources.

Reasons to support:
Harmonizing economic development and climate change is crucial for a prosperous future for humanity. Integrating economic development opportunities into our future is important and encourages a shift toward a more efficient use of resources throughout society, in keeping with the goals of sustainability.

Economic Development Policy 5: Address Physical and Sector Vulnerabilities
Create and implement economic development plans and programs that address physical and sector vulnerabilities resulting from climate change utilizing a risk assessment practices. This risk assessment should be supplemented by a cost-benefit study or an opportunities analysis that evaluates both the costs and benefits associated with possible adaptation measures. Tourism, commercial fishing and recreational fishing may be enhanced by the removal of a hydroelectric dam made obsolete by climate change due to low water flows, for instance. Such studies also need to take into consideration uncertainties in climate change impacts at regional levels so that adaptive responses are balanced with potential for risk.

Reasons to support:
Addressing physical and sector vulnerabilities will require planners to clearly identify the specific risks faced by the local and regional economy from specific climate change impacts. Do stronger electrical storms pose particular threats to the broadband cable network that supports the new high-tech company in town? Will the proposed timing of a controlled burn affect the scheduling of a particular tourism event? Will lower lake levels cause the marina to close? If sea-level rise inundates the local port, what other businesses will be affected? And this baiting and answering these questions will build resilience into local economies.

3.8 Hazards Management

Introduction
Hazards management, as it is applied to climate change, represents primarily an adaptive response dealing with public safety threats from climate change impacts.

The costs associated with managing natural hazards and disasters continue to rise in the US and elsewhere. Many climate change impacts are manifested in stronger or more frequent natural hazards such as floods, wildfires, hurricanes and typhoons, droughts, and heat waves.

Despite this common problem, the climate change adaptation and hazards management communities have largely failed to acknowledge each other's work in reducing hazard impacts. This is even reflected in the language that each community uses; for example, the hazards management community refers to hazard impact reduction as *mitigation* while the climate change community refers to it as *adaptation*. Similarly, planners tend to think of *hazards* management as *disaster* management; although there are certainly hazards from disasters, the range of incidents that hazards management professionals contend with

include smaller-scale events as well as ones which could be classified as disasters. Consequently, one of the first challenges for planners attempting to address climate-related hazards management issues is to overcome this communication problem.

A second challenge is to recognize those climate change impacts which must be managed as hazards. There are five primary types of hazard incidents associated with climate change:

- Heat waves
- Strong storms, including tropical cyclones and extratropical storms like northeasters
- Flooding
- Drought
- Wildfires

Heat waves. Heat waves are the most deadly hazard events in the developed world. In 2003, an extended heat wave struck Western Europe, killing over 35,000 persons. The death toll from hurricane Katrina, by way of contrast, is estimated at 1,836. Since heat waves are expected to increase in frequency and intensity as a result of climate change, it is important for heat wave responses to be a significant part of any community's emergency preparedness planning. The key components for responses to heat waves include public awareness programs targeted to particularly vulnerable populations as well as the general population, provision of air-conditioned shelters, and enhanced law enforcement in crime-prone areas to deter burglary of homes vacated by persons seeking shelter.

Strong storms. As a consequence of changes in storm intensity and sea level resulting from climate change, the following public safety responses may require adjustment to address these new circumstances:

- Vulnerable area and flood elevation maps may be required to be re-drawn to reflect the geographic extent of the new intensity of storms.
- Evacuation order procedures and routes may require revision to address new evacuation route vulnerabilities.
- Building code standards, from sheathing materials to fastening procedures and materials to wind-ratings of doors and windows to base flood elevation heights, may require adjustment.
- Infrastructure located in vulnerable areas may require retrofit or replacement to provide continued service or withstand new conditions.
- Landslide and mudslide mapping and response procedures may require adjustment to account for the effects of heavier rainfall.
- Engineering solutions may be proposed and implemented, such as this enormous protective gate installed to protect the port and city of Rotterdam from storm surge as part of The Netherlands' "delta works" program.

Flooding. The more extensive flooding effects anticipated to result from climate change may require re-examination of local flood mapping, building codes, and other development standards. In many communities, maps prepared for FEMA's flood insurance rate program (FIRM maps) may be outdated due to new precipitation circumstances, as well as other factors such as changes in impervious surfaces in watersheds. Emergency services providers need to be aware of the potential extent of flooding events to determine what buildings and locations are vulnerable. These maps are the most commonly used source of information for what constitutes the 100-year flood, the typical extent of flooding that communities plan for; if the maps underestimate local flooding potential, public safety can be compromised.

Additionally, the prospect of increased flooding potential requires re-examination of emergency services logistical plans. New evacuation routes and procedures may have to be identified and implemented. Additional barricades may have to be acquired or installed for bridges, streets and roads that face new vulnerability. Additional flood response materials, such as sandbags, may need to be stockpiled to adequately respond to new flooding circumstances. These needs should be identified and included in local community hazards management plans.

Drought. Drought conditions may become more frequent as a result of climate change. The effects of drought conditions on public safety operations include insufficient potable water supplies and the potential for brownouts and blackouts as hydroelectric and nuclear electrical power generation is affected by low water flows or decreased availability of water for cooling. Examples of drought-related public safety problems include:

- In 2006, the Town of Las Vegas, New Mexico faced the potential of mandatory evacuation of the entire town due to a drought-related threat to adequate water supply.
- Record drought conditions in 2007-08 in North Carolina created concerns about the potential for nuclear power plant shutdowns due to low lake levels that could compromise cooling processes.

Water and electrical service supply availability is generally considered a universal problem – in the event of a shortage, all population sectors are impacted. That is not entirely the case, however. Persons in high crime areas may refuse to heed evacuation orders due to fears about property loss from theft or vandalism. Plant shutdowns can create exorbitantly high electricity costs since utilities are forced to purchase expensive peak power from other sources. These expenses are typically passed on to the customers and may cause lower income persons to cut back on or preclude their use of electricity, especially air conditioning. Since droughts are often associated with heat waves, such decisions can prove dangerous or even fatal for these higher-risk populations.

Public safety service providers need to take these drought-related problems into account in their planning and service delivery.

Wildfires. Wildfire damage potential increases as rural areas and areas with steep slopes are developed. Such development complicates the use of wildfire management techniques like prescribed burns due to proximity of homes and supporting infrastructure. Increased distance from fire protection services results in slower response times, although more residential development may result in earlier detection of wildfires (it should be noted, however, that direct human detection is becoming less necessary due to NOAA satellite detection techniques which can provide wildfire detection and monitoring on a half-hour basis). Drought conditions associated with climate change are likely to exacerbate conditions which result in wildfires. In addition, pest infestation such as the pine bark beetle that can kill large stands of trees, creating wildfire fuel sources, will become more commonplace as temperatures rise and beetle populations are better able to overwinter.

Adaptive land use responses for planners include placing limits on development in areas vulnerable to wildfires or establishing wildfire-resilience requirements for developments in such areas as part of the development approval process such as:

- Instituting property management requirements on subdivisions and other developments to burn or mechanically remove undergrowth and other fuel sources prior to development.
- Establishing wildfire management agreements that provide for professionally managed prescribed burning or mechanical removal of fuel sources.
- Requiring developments to prepare a Community Wildfire Protection Plan (CWPP) in accordance with the process developed by a consortium of agencies and organizations for such plans.
- Establishing exactions that enhance the capabilities of local fire suppression agencies to combat wildfires, including purchase of fire equipment, provision of fire stations, etc.
- Taking special care with cluster or conservation subdivisions to limit the potential for wildfire initiated house-to-house fire transmission by setting standards for exterior materials, requiring implementation of a CWPP, and/or placing requirements for maintenance and management of the conservation areas to minimize wildfire potential (e.g., mandating fuel reduction strategies such as prescribed burns or manual removal of brush and dead vegetation).

General Hazards Management Policy A: The American Planning Association, its Chapters and Divisions, and planners support the development of plans, strategies, and standards to better anticipate and prepare for the hazards impacts of climate change.

Hazards Management Policy 1: Incorporate Climate Change Adaptation into Hazards Management Planning

Develop a comprehensive approach to hazards management planning that integrates the variety of climate change scenarios and includes both pre-incident and post-incident

responses. Expand federal and state support for climate-related hazards management. Continue to coordinate and cooperate with the hazards management community.

Reasons to support:
Traditional hazards management planning is often separated by hazard type and uses a short planning time horizon. The cycle for most hazards management planning has normally been: event — warning — response — recovery — and back to event. It is only recently that the hazards management community and the planning community have begun effectively coordinate and cooperate. Planners should become more engaged in hazards management planning in a comprehensive way and should include climate change adaptation in hazards management mitigation plans, land use planning, natural resource conservation plans, development review, and community visioning.

Hazards Management Policy 2: Climate Change Scenarios
Integrate climate change scenarios into local, state and federal hazards management efforts. Increase funding for hazard mitigation planning that incorporates and addresses climate change-related scenarios and potential impacts.

Reasons to support:
Climate change will increase the risks associated with certain types of hazards. For example, more intense rainfall events will require adjustments to what are considered 100-year floods. Scenario planning can help put hazards heightened by climate change into perspective, allowing appropriate responses to be developed.

Hazards Management Policy 3: Building and Life Safety Codes
Update building and life safety codes to better address the variety of hazards that are likely to result from climate change.

Reasons to support:
Building and life safety codes should be updated for increased safety from hazards. For example, wind load standards should be re-evaluated in light of an increased potential for stronger tropical and extratropical storms.

Hazards Management Policy 4: Reducing Risk to Development
Improve the ability to identify areas prone to greater risk from climate change hazards and restrict development and redevelopment in those areas**.** Increase support for mapping and data collection of high risk areas.

Reasons to support:
Improvements in our predictive capabilities relative to the impact of climate change should be pursued. Areas prone to significant risk from climate change should not be developed or redeveloped to minimize future loss of human life and impacts to property**.** Communities should investigate and promote opportunities for these areas, such as floodplain restoration, groundwater recharge, and flood-compatible agriculture. Place development in low -risk, low

hazard areas. Restrict the development of buildings or infrastructure in flood-prone areas and low-lying coastal areas. Manage development in the urban/wildland interface area to minimize the risk from wildfire. Climate change is likely to bring increased risk of flooding to many areas, even those in which overall precipitation levels are less (due to greater storm severity, changes in the timing of precipitation, or changes in the proportion of precipitation that falls as rain versus snow).

Hazards Management Policy 5: Coastal Zone Management Act Review
Re-examine the Coastal Zone Management Act in light of risks due to sea- level rise and increasingly strong tropical and extratropical storms. Improve planning and risk assessment for development in coastal areas**.**

Reasons to support:
The national coastal zone management program should be re-evaluated based on new hazards associated with climate change. Storm surge associated with stronger storms will be compounded by sea-level rise, for instance.

Hazards Management Policy 6: Reconstruction
Encourage local governments to develop post-disaster redevelopment plans that discourage the reconstruction of buildings and infrastructure in hazard zones following climate related disasters.

Reasons to support:
After major disasters, restricting rebuilding in hazard zones should be seriously considered. Abandoning intensive land uses in the hazard zone should be strongly considered with the government looking at ways to mitigate the pain of relocation.

Hazards Management Policy 7: Security after Disasters
Develop strategies to maintain energy, water, and food security during and after climate related disasters, including coordination with appropriate state emergency management agencies.

Reasons to support:
Disasters tend to cut links to outside resources. Surpluses and supplies are needed to support the community until outside links are re-established. A dependable source of energy is necessary to support essential services for surviving extreme weather events. This could include distributed location of electricity generating facilities that could operate independent of the utility grid. This plan would be integrated with emergency food systems, medical services, police and fire protection, and infrastructure such as water, sewage and street lighting systems.

Hazards Management Policy 8: Risk Analysis and Event Impact Horizons
Develop scenarios to help the general public and decision-makers understand the potential

risks associated with climate change and to develop contingencies for catastrophic events. Expand the timeframe associated with hazards management mitigation related to climate change to 100 to 500 years.

Reasons to support:
Conventional planning horizons should be extended. FEMA Flood Insurance Rate Maps (FIRM) assesses flood potential into the 100-year and 500-year probability areas. Other hazard maps should also be extended into the 100 to 500 year frame. While the FIRMs are probability maps not time horizon maps, it is an easy shift to a time perspective for flooding and other hazards. As with the FIRMs, the zones in these maps are not no-build zones but zones where the development is constructed with conditions that address potential risk factors.

Hazards Management Policy 9: Action Strategy
When considering climate change impacts, first seek to avoid impacts altogether, then minimize them, and finally, adapt to the unavoidable impacts as much as possible.

Reason to support:
The first decision choice on development in potential hazard areas should be avoidance. If avoidance is not possible or other requirements dictate a need to develop, evaluation should then move to minimization. From a hazards management planning standpoint it is minimization of areas at risk. The final decision step is mitigation to protect against the risk.

Hazards Management Policy 10: Identify and Reach Out to Vulnerable Populations
Identify and map vulnerable population areas. Develop effective outreach programs to increase public awareness about hazards exacerbated by climate change.

Reasons to support:
Hazards affect different populations in different ways. Planners need to understand the public safety risks associated with various hazards and how they affect particular populations. Effective outreach to different populations requires different techniques in order to be successful; planners need to recognize these different approaches in outreach plans and programs.

3.9 Public Health

Introduction
Planners involved in the provision of social services, the design of buildings and infrastructure, the preparation of neighborhood and comprehensive plans, the creation of economic development strategies, the provision of affordable housing, the installation and design of recreational programs and amenities, the design of environmental management programs and systems, and the preparation of hazards management plans and strategies will all need to be aware of the implications of climate change on public health. Heat waves and storm-related disasters will create the need to adequately shelter vulnerable populations.

New infectious diseases and increased incidence of air pollution will complicate the design and management of ecosystems, the preparation of tourism-related marketing, the timing of recreational programs, and how emergency management services are delivered. Water supply management will face new health challenges from saltwater intrusion and algal pollution.

As we have seen from Hurricane Katrina, certain groups of people are disproportionately affected by both the event itself and the aftermath effects. Effective and ethical responses to these types of climate change effects require planners to understand their client populations'. Some examples:

- The elderly are less able to withstand stresses created by heat waves, air pollution and diseases, in addition to having greater potential mobility problems in avoiding storms and floods.
- Persons with disabilities and chronic illnesses are inordinately susceptible to problems associated with climate change impacts due to health and mobility issues.
- A number of population groups tend to be employed in outdoor settings, are more likely to be outdoors for recreation, or are homeless; this makes them more vulnerable to heat waves, air pollution, and various diseases.
- People living in high crime areas may refuse to open windows during heat waves or evacuate from their properties during storm events and floods due to crime concerns, enhancing their vulnerability.
- People living in substandard structures or mobile homes typically experience greater risk from storms and flooding and may have problems avoiding vector-borne diseases.
- Multifamily structures generally offer less opportunity for cross-ventilation than single-family dwellings, creating the potential for greater exposure to heat wave risk.

Spatial information about most of these population groups is available through the U.S. Census and other sources, allowing planners to create population vulnerability maps that can be used to identify areas with populations requiring particular types of services during heat waves, storms, floods, etc.

To understand how climate change impacts are interrelated with public health issues in complex ways, we can consider the case of air pollution. Air pollution is one of many public health issues that can be significantly exacerbated by climate change. Higher temperatures will increase ozone concentrations. Increased precipitation will add mold spores and other allergens to the air people breathe, while droughts will add dust. Consequently, a wide range of climate change impacts must be considered in air quality management initiatives undertaken by planners. In the area of public health, planners' adaptation responses will generally be in communicating hazardous air quality conditions to the public and, in the case of mold, providing inspections and remediation services. In developing a communications initiative, planners must be aware of and target population vulnerability in order to be able to effectively communicate to the public about air quality conditions and their potential to create health problems. Since air pollution is a more significant public health problem for the

elderly and very young, for persons with respiratory disabilities, for persons likely to be outdoors (socially isolated/homeless, linguistically isolated/ESL, and persons having below median incomes), and for persons less likely to have air conditioning (e.g., those living in substandard dwellings or in areas where past climate conditions did not require air conditioning), such communication programs need to focus on reaching these more vulnerable persons. Some examples are provided below:

- Promoting transit use on air quality alert days through free fares and other incentives (this raises awareness of air quality issues with persons using transit, many of whom may be members of the target populations).
- Using non-English language media to communicate the issue through advertisements, press releases and announcements.
- Communicating air quality issues and appropriate responses through formal and informal community leaders, such as priests, pastors and other religious leaders, prominent businesspeople, sports figures and celebrities, etc.
- Utilizing medical personnel having expertise in air quality-related health problems to communicate the importance of staying indoors to target populations; many people vulnerable to air quality health issues have particular respect for the opinions of medical personnel.
- Communicating with outdoor-labor employers about the health dangers associated with air quality problems.
- Making mold detection and remediation part of local code enforcement and affordable housing programs.

Climate-related public health effects are complicated and addressing their impacts requires planners to think creatively and utilize a multidisciplinary approach that may involve medical and emergency management personnel, community leaders and local celebrities that can effectively reach target populations, building code inspectors, and a multitude of others depending on the specific situations.

General Public Health Policy A: The American Planning Association, its Chapters and Divisions, and planners support efforts to effectively manage public health impacts resulting from climate change, including customization of efforts to address particularly vulnerable populations.

Public Health Policy 1: Address Population Vulnerability
Identify and map populations having particular vulnerability to climate change. Develop cross-disciplinary approaches to ensure that these populations receive services they need during and after hazard incidents. Plan and implement outreach efforts in coordination with appropriate federal, state and local public health agencies directed at particular populations to increase awareness of specific types of climate change hazards.

Reasons to support:
Certain populations will be more vulnerable to climate-related public health effects than

others. Effective delivery of public health services will require special efforts to ensure that these populations are reached with information and any necessary services/treatment.

Public Health Policy 2: Determine Regional and Local Vulnerabilities
Climate change will affect communities in specific ways with regard to public health issues. Vector-borne diseases are less likely in drier climates, for instance. Planner should identify impacts having the highest likelihood of occurrence and focus resources on addressing the consequences of these impacts.

Reasons to support:
Resources for addressing public health impacts are limited. It is prudent to concentrate on the most likely hazards and develop specific plans and programs for addressing them.

> **Public Health Policy 3: Conduct health impact assessments**
> Use health impact assessments (HIA), health checklists, and/or other tools to evaluate key climate change impacts to highlight the effects these will have on general well-being as well as upon the health of our most vulnerable populations.
>
> **Reasons to support:**
> By including a comprehensive health analysis during land use, transportation, and climate change planning, planners and public health professionals would have an opportunity to evaluate the health implications of important planning decision and suggest changes at an early stage. It would also elevate the importance of public health with the hope of making it as relevant to the policy-making process as economic or infrastructure concerns.

3.10 Public Infrastructure

Introduction
A significant amount of the public infrastructure in the United States is vulnerable to the effects of climate change. Increased flooding potential and sea-level rise may threaten sewage treatment facilities constructed at the water's edge for gravity collection and discharge purposes. Potable water reservoirs may have reduced supply due to drought and increased evaporation resulting from higher temperatures. Coastal area bridges, roads and highways face inundation threats resulting from sea-level rise and storm surge from stronger hurricanes and tropical storms. Airport runways may require lengthening due to higher temperatures and humidity which reduce air density, resulting lowered aircraft performance. Stormwater management systems may be overwhelmed by increased intensity in precipitation events. Road and utility maintenance procedures may require adjustment to account for damage potential from higher temperatures, increased intensity of precipitation, and new seasonal variations in precipitation type.

In addition to the need to adapt public infrastructure to climate change, the design and management of public infrastructure offer opportunities to help mitigate the severity of climate change. More energy-efficient operation of public utility systems, changes to street lighting programs, purchase and/or retrofit of fleet vehicles that use alternative fuels, and recycling of asphalt and other construction materials are some of the many ways public infrastructure can contribute to lowering greenhouse gas emissions.

Some key public infrastructure issues are discussed by category below.

Water supply and treatment. Adapting to climate change impacts that affect water supply and treatment will be one of the more significant challenges that many planners will face in the coming decades. Regional impacts that include drought, evaporation (a result of higher temperatures), saltwater intrusion, reduced recharge, and flooding have the potential to threaten ground and surface water supplies. As supply options become more limited, treatment challenges can occur; for example, more polluted water sources or saltwater sources may need to be pressed into service. Higher temperatures may result in algae and microbe growth that create other treatment challenges. Additionally, water treatment plants, transmission lines, pump stations, and other infrastructure may be located in areas vulnerable to flooding, temporary or permanent inundation, or other climate change-related risks.

Careful assessment of community vulnerability regarding water supply and treatment is essential to determine future capacity, not only for growth and development, but simply for meeting the supply needs of existing residents, industries, and agriculture. Constraints in water supply and treatment options may result in significant consequences, including establishing limits on future growth, an inability to meet the needs of industry, or even evacuation of existing residents, as almost happened in 2006 in Las Vegas, New Mexico. (Source: http://www.geosociety.org/news/pr/06-39.htm) Communities that want to grow — or even simply to maintain their current population — must secure stable future water supplies, a task that may be made more difficult due to climate change challenges. If they cannot, they must adapt to the effects of out-migration.

There are a variety of ways of securing stable future water supplies, all of which suffer from the inherent constraint that freshwater supply is ultimately finite. This constraint is immaterial in places where water supplies regenerate through abundant rainfall or which have sufficient groundwater storage. However, in areas where there is an imbalance between supply and demand, other solutions must be pursued. Examples of efforts to secure stable water supplies include:

- *Increasing access to water sources.* The state of Georgia is in a series of lawsuits with neighboring states (Florida and Tennessee) to either withdraw more water than currently allowed or to obtain access to new sources. One such initiative being pursued by Georgia is to redraw its boundaries with the state of Tennessee to allow access to the Tennessee River. Las Vegas, Nevada is constructing a $2 billion pipeline to eastern Nevada to access existing groundwater sources in the Snake Valley.

Interbasin transfers across watersheds, state boundaries and even national boundaries are being considered.

- *Underground storage*. Areas experiencing a sufficiency of water at times and drought at other times are considering underground storage of "excess" water in aquifers. Such underground storage avoids the problem of evaporation experienced by surface. Areas as diverse in climate as Greenville, North Carolina and Hays, Kansas are exploring this option. Las Vegas, Nevada will store its pumped water from the Snake Valley in an aquifer. It should be noted that this underground storage option is not available to all communities because of geologic constraints and it has its own risks, including pollution.
- *Diversion from other uses.* Diversion has the potential help communities meet potable water needs, provided that it can occur without unacceptable environmental and economic consequences. Some experts believe that inefficient use of subsidized water for agriculture in the Southwest offers the potential to provide a new "source" of potable water with minimal consequences to agriculture provided more water-efficient farming practices are established.
- *Intrabasin transfers.* Some areas, particularly Western states, have experience in negotiating equitable allocations of available water resources; a prime example of this is the recent agreement reached between the seven Colorado River Basin states (Arizona, California, Colorado, Nevada, New Mexico, Utah, and Wyoming) about the use of the Colorado River water resource. Agreements to equitably share water resources among jurisdictions and use sectors (agriculture, potable, industrial, etc.) may offer solutions to supply problems in some areas.
- *Conservation.* Many communities have experience with voluntary and even mandatory conservation efforts during times of drought. In most cases, such conservation efforts have been temporary measures, lasting only for the duration of the particular drought, but some communities are making them permanent. Las Vegas, Nevada, for instance, pays residential property owners to convert their landscaping from turf to xeriscape. Water pricing schedules which increase per unit costs for higher volume water users are another way to encourage the use of conservation measures.
- *Regional interconnectivity*. This measure involves the establishment of connections between separately managed water systems that allow water supplies to be shared. With regard to climate change, such system interconnectivity is particularly important if it increases the diversity of available water sources, such as connecting a surface water supply system with a groundwater supply system, since one supply source may be less affected by drought than another. In some cases, local differences in rainfall or storage capacity, even in the event of climate change, are significant enough for interconnectivity to create a desirable "hedge" situation. In others, a significant supply source available to one system may allow multiple systems to avoid future supply problems. Needless to say, interconnectivity is desirable even absent climate change circumstances in order to avoid problems created by an emergency treatment plant shutdown, for instance.
- *New technologies.* Use of graywater and treated wastewater for irrigation purposes, low impact landscaping, water-efficient appliances, cisterns, industrial water reuse and

recycling, and innovative agricultural practices are some of the technologies being explored to make more efficient use of water resources.

Ascertaining a community's vulnerability to climate change impacts affecting water supplies is a complex undertaking. EPA has issued a number of practical suggestions that should be part of the assessment of water supply availability and guide planners' responses. (Source: *Growing Toward More Efficient Water Use*; EPA; 2006) These suggestions are summarized below.

Development Patterns — Large residential lots increase water demand. Various local studies cited by EPA indicate that larger lots create 20-60 percent more water demand than smaller ones, largely due to differences in lawn care requirements. In addition to the pure demand costs, the service cost differential between large and small lot development was significant. Low density also means more leakage; all water systems experience leakage and the longer service lines required to serve low density development increases the potential for leakage, increasing the cost of service by reducing the efficiency of delivery. Finally, development on the fringe of urban areas (sprawl development) diverts water system resources away from maintenance of existing lines, resulting in continued operation of older, less efficient or obsolete water infrastructure. As a result of these findings, EPA recommends that communities concerned about water resources consider more compact development patterns.

Legal Considerations — Public utilities are typically governed by the "duty to serve" provisions of public utility law which require providing service to any and all customers within a utility's service area. EPA notes that "{t}he duty to serve can, and at times does, conflict with a utility's or a community's efforts to control water costs and ensure adequate quantities for existing customers. ... sometimes undermining other community goals, such as orderly growth and long-term, stable water provision." (p. 17) Essentially, this duty to serve requirement places the decision-making about service timing and extent in the hands of property owners and developers, rather than local governments and utility system managers. EPA notes that several Western states, specifically California, Idaho and Arizona, have enacted laws which subordinate duty to serve to comprehensive growth management considerations. As climate change creates new stresses on water supplies, communities should link water supply planning to their comprehensive growth management programs and plans and should encourage growth management considerations to become part of their state's overall water management strategy and legislation.

Operations and Pricing Policies — EPA suggests public utilities consider a "fix it first" policy that emphasizes maintenance of existing infrastructure rather than expansion into unserved areas, noting that credit-rating agencies reward

utility systems for effective asset management programs, resulting in lower financing costs for bonded improvements. Additionally, setting rates that fully recoup all system costs is recommended in order to discourage water consumption. EPA also recommends two pricing strategies for consideration: conservation pricing and zone pricing. Conservation pricing increases water rates for higher volume users; in some cases, conservation pricing is seasonal or drought-related in order to reflect short-term supply problems, but, in other cases, it is used on a year-round basis. Zone pricing establishes rates which reflect service cost differentials for situations like dispersed development, development at higher elevations, or large lot development, all of which have a relatively high service cost compared with more compact development and lower elevation development.

Finally, physical vulnerability of water sources and infrastructure needs to be considered and both capital and emergency planning situations. Climate change has the potential to create flooding and inundation problems that affect operations and viability of water systems on both a temporary and permanent basis. For example, storm surge or floods may create temporary interruptions of operation while permanent inundation due to sea-level rise may render some facilities no longer usable. Planners need to assess the risks that climate change poses to these facilities and incorporate that information in the planning process.

Sewage collection and treatment. Sewage collection and treatment systems will encounter many of the same physical threats that water systems will experience. Sewage treatment plants, collection lines, pump stations, and other infrastructure may be located in areas vulnerable to flooding, temporary or permanent inundation, or other climate change-related risks. Low water flow in discharge areas during droughts may require changes to treatment programs to avoid environmental damage.

In addition to system vulnerabilities, climate change adaptation may require innovations in the use of treated wastewater, such as for irrigation purposes. Such adaptation measures may require new treatment protocols and will certainly require new infrastructure.

Joint stormwater and sewage treatment systems (also known as combined wastewater systems) create special health and environmental problems in flood conditions. These systems are designed to divert wastewater exceeding plant treatment capacities back into natural systems during floods. This creates the potential for contamination of downstream water supplies with pollutants and water-borne diseases. Even sewage treatment facilities that are not combined with stormwater systems can become inundated during flood conditions or by storm surge, creating similar problems.

Transportation infrastructure. Transportation infrastructure such as bridges, roads, rail, airports and ports, have a variety of vulnerabilities to climate change impacts. Low-lying infrastructure has the potential to be inundated by sea-level rise or storm surge. More frequent or larger floods can damage transportation infrastructure. Bridges designed to

current flood level or sea level standards may become prematurely obsolete as a result of climate change impacts. Higher temperatures can buckle pavement in deform railroad tracks, as well as reduce airplane efficiency, requiring longer runways for safe takeoffs. Evaporation caused by higher temperatures, along with droughts, can lower water levels and negatively affect navigation and port operations.

Stormwater management. A significant impact area for climate change involves stormwater management. Many areas of the United States are projected to receive increased intensity of rainfall events, leading to additional runoff. In some ways, this circumstance mimics the effects of urbanization on stormwater. The impervious surfaces associated with urban development create a two-pronged effect on streams and other natural stormwater systems. First, runoff occurs in greater volumes over shorter durations, creating a higher "spike" than would happen in a natural system, resulting in greater flooding potential as well as negative effects on habitat and natural stream functions. Second, infiltration of precipitation into the ground is reduced by impervious surfaces, typically creating lower flow conditions for urban streams; the water that would have slowly flowed into the stream from the saturated ground of the adjoining watershed will have already run off.

As in the case of urbanization, higher intensity rainfall events create the "spike" of higher runoff and result in less infiltration since the volume of precipitation exceeds the capacity of the ground to absorb it. Snowfall melt can create similar runoff circumstances. Rapidly melting heavy snowfalls or snowpack due to warmer temperatures can result in erosion, flooding, and water quality impacts from spikes in runoff and reduced infiltration. Landslides and mudslides can result from increased stormwater runoff. In areas where groundwater recharge is necessary to maintain water supplies, lower infiltration may create water supply problems. Additional runoff can also result in additional flood events. With flood mapping in many areas based on outdated stream flow or precipitation/snow melt information, climate change impacts will further complicate already-compromised flood planning and adaptation measures.

Planners should consider the impacts of climate-exacerbated runoff in designing public stormwater management systems and infrastructure. Green infrastructure, discussed in the following section, may provide a positive response in some stormwater situations. Other regional approaches to stormwater management (as opposed to site-by-site solutions) may also have benefits for planners to evaluate. In such cases, implementation of green infrastructure or other regional management solutions can be funded through a stormwater fee-in-lieu regulatory provision that exacts the funds needed to construct on-site stormwater measures into a pool of funds to provide more regional solutions. Funding for such systems may also be available from programs implementing federal water quality regulations.

Green infrastructure. "Green infrastructure" refers to an interconnected network of open spaces and natural areas, such as greenways, wetlands, parks, conservation and preservation areas, and flood-prone areas. Often used to manage stormwater by controlling flooding and improving water quality, green infrastructure also maintains wildlife habitat and travel

corridors, provides recreational opportunities, preserves critical vegetation, and creates open space. Green infrastructure preserves native vegetation that sequesters carbon dioxide.

Fleet management. Effective fleet management can provide positive contributions to climate change mitigation while resulting in cost savings for federal, state and local governments. The City of Concord, North Carolina, is a leader in energy-efficient fleet management. Concord's garage superintendent David Nuckols offers the following practical ideas for fuel-efficient fleet management:

- Purchase hybrid cars and small pickup trucks for most normal use light vehicle situations.
- Equip full-size pickups with the smallest V-8 engine offered in the manufacturer's line.
- Purchase diesel engines for vehicles over three-quarters of a ton.
- Specify the most fuel-efficient diesel engine for large trucks; include in the specifications low horsepower ratings coupled with transmissions that provide adequate power at low speeds and, as necessary, the ability to reach highway speeds.
- Adopt idling policies that mandate turning vehicles off, while providing exceptions such as idling in traffic, to keep interiors cool for K-9 units, in extreme cold weather operations, etc.

  Source: Matt Lail, "By Saving Fuel, Cities and Towns Save Some 'Green' While Being Green"; *Southern City*; vol. LVII, no. 12; December, 2007.

Further fleet management opportunities include moving to electric and zero emissions vehicles in the future as they come online. As these different vehicle types come online, fleet managers can evaluate their suitability for inclusion in municipal fleets based on the government's needs at the time of technology availability.

Street lighting. Street lighting costs frequently represent a significant part of the local government energy use budget. A March 2008 report prepared for the American Chamber of Commerce Executives (ACCE) and the Ford Fellowship in Regionalism and Sustainable Development by Robert T. Grow noted that switching to an electronically managed street lighting system and energy-efficient lamps, as recently done by Oslo, Norway, has the potential to reduce street lighting energy consumption by 50 percent, resulting in a five-year return on investment. Grow notes the carbon footprint reduction benefits of such conversion in terms of the ten largest U.S. Metropolitan Statistical areas (MSAs):

> The 4,424,361 streetlights in our nation's ten largest metropolitan statistical areas use an estimated 2,988,500,000 kWh of electricity annually producing the equivalent of 2.3 million metric tons of CO2. A 50 percent reduction on kWh used amounts to a savings of 1,494,250,000 kWh or 1,161,716 metric tons of CO2.

Source: Robert T. Grow, *Energy Efficient Streetlights: Potentials for Reducing Greater Washington's Carbon Footprint*; March 8, 2008. (http://www.mwcog.org/uploads/committee-documents/lV5fWF9d20080320143921.pdf)

These are significant savings of energy; however, Grow found that they represent only one benefit of conversion to an electronically managed street lighting system. Reported additional benefits include opportunities to use street lighting as a traffic calming tool (reducing light output by only 5 percent can result in a tendency for drivers to slow down), complying with local "dark skies" initiatives to minimize urban area lighting to allow greater visibility of the night sky, and immediate identification of out-of-service lights.

Planners should recognize that such systems are in the relatively early stages of development and may not be compatible with the lighting systems (or even the electricity sales policies) used by individual municipalities or partner utilities. Potential difficulties include the fact that, for most utilities, street lighting represents an off-peak demand so there is limited incentive under most pricing schemes to implement conservation measures. There may be concerns about long-term reliability of the current generation of LED (light emitting diodes) lights and ballasts. However, it does seem that exploring the potential benefits of an electronically managed street lighting system has merit beyond simply helping mitigate climate change impacts. For instance, the timely replacement of a broken street light in a high crime area or the ability to reduce or increase lighting intensity during particular seasons or weather events are actions that have significant public safety benefits.

Alternatives to such managed systems include: Establishing local standards specifying more energy-efficient streetlight lamps and/or greater separation between streetlights, providing streetlights only at intersections, not requiring or providing streetlights in lower density neighborhoods, lighting sidewalks rather than streets, use of more directional street lighting through installation of cut-off fixtures, and establishing a street lighting policy that reduces lighting requirements in low crime areas or areas on the periphery of the city or town (i.e., a "sliding scale" that has brighter lighting at the city center and reduced lighting further away from the center based on street design and crime conditions analyses.)

General Public Infrastructure Policy A: The American Planning Association, its Chapters and Divisions, and planners support efforts to address climate resilience and reduce greenhouse gas emission related to design, construction and installation, and operation of public infrastructure.

Public Infrastructure Policy 1: Water Availability
Assess water resources demands and supply to determine long term environmental risks to ensure long-term availability to water for potable, industrial and agricultural purposes through techniques like underground storage, diversion from lower priority uses, negotiated intra- and inter-basin transfers, conservation, regional interconnectivity, reuse of treated wastewater or grey water, rain-water capture and similar measures. Give priority to measures

which improve water use and energy efficiency, such as conservation and reuse, as opposed to measures which would simply increase water supply. Establish compact development patterns that conserve water and minimize the costs of its distribution. Implement operations and pricing policies that reward conservation and accurately reflect distribution costs. Balance "duty to serve" requirements with other community goals, including growth management and water supply and rate stability.

Reasons to support:
Planners must take a comprehensive approach to water supply management. Since climate change will negatively affect water availability in many locations, it is critical for these communities to manage water availability in an effective and efficient fashion. Communities will need to establish priorities regarding water use and develop effective programs and practices which allow these priorities to be met.

Public Infrastructure Policy 2: Threats to Water Supply
Develop long-term assessments of potential water supply threats such as drought, saltwater intrusion, inundation, and evaporation, water-intensive industries, non-indigenous plants and plan to increase resilience to these threats.

Reasons to support:
Adapting to water supply threats brought on by climate change will be a critical undertaking for planners in many locations. Availability to water is essential for meeting potable, agricultural, and industrial needs. Failure to properly plan to address these threats can place communities at significant risk, with consequences ranging from emergency evacuation, out-migration, and disinvestment.

Public Infrastructure Policy 3: Sewage Collection and Treatment
Minimize the vulnerability of sewage collection and treatment facilities and systems to climate change effects. Eliminate joint stormwater and sewage treatment systems where feasible. Assess the potential for sewage collection and treatment systems to assist in addressing water supply issues, such as the use of treated wastewater for irrigation purposes.

Reasons to support:
Vulnerabilities to sewage collection and treatment systems that result from climate change include flood risks, collection line infiltration and outfall problems resulting from intense rainfall, temporary inundation occurring from storm surge, and permanent inundation problems from sea-level rise, as well as public health problems resulting from surface water contamination from untreated sewage. Reuse of treated wastewater can help address water supply issues by providing an alternate source of water for certain purposes.

Public Infrastructure Policy 4: Transportation Infrastructure
Minimize the vulnerability of transportation infrastructure to climate change effects, including threats from individual weather events like floods and permanent effects like sea-level rise.

Reasons to support:
As with water and sewer systems, transportation infrastructure is vulnerable to a wide variety climate change impacts, both permanent and temporary. Where possible, planners seek to enhance resilience of this infrastructure or locate it in areas where its vulnerability is reduced.

Public Infrastructure Policy 5: Stormwater Management
Account for the potential impacts of climate change effects on storm water runoff in designing management systems and infrastructure. Utilize green infrastructure and regional management solutions.

Reasons to support:
More intense precipitation events will create stormwater management problems in many communities. These problems include flash floods, erosion, and general flooding.

Public Infrastructure Policy 6: Green Infrastructure
Create, protect and manage systems of green infrastructure (i.e., urban forests, parks and open spaces, green roofs, natural drainage systems, low impact developments) in regions and communities. Fully fund programs that support the development, identification, and maintenance of green infrastructure. Support new research and training for design professionals on the development, incorporation and preservation of green infrastructure.

Reasons to support:
When a community uses and enhances its natural environmental assets as an integral part of its infrastructure, that community also reduces its impact on climate change and increases its ability to adapt to changes that may occur. For example, shade from the urban forest reduces the need for air conditioning in the summer, thus reducing electrical demand and the greenhouse gas emissions caused by electrical generation and transmission. Preservation of urban forests found in floodplain or other low-lying areas also enables a community to adapt should future changes in global climate increase the intensity of flooding or raise sea levels. Programs to plan new trees in urban areas, and other green systems provide similar opportunities.

These systems should form an important part of the infrastructure framework upon which a region's climate change planning is based. Since many green infrastructure systems extend beyond the boundaries of individual communities, they should be addressed at a watershed or other appropriate regional level. Smaller cities and towns should take this approach with natural systems that provide their green infrastructure as well. Green infrastructure should be incorporated and emphasized in planning and related policies across geographic scales from local to national. Green infrastructure also provides a framework for implementing adaptive ecosystem management and flood hazard mitigation strategies.

Public Infrastructure Policy 7: Energy-Efficient Public Infrastructure
Implement energy-efficient technologies and management in public infrastructure design, installation and operation.

Reasons to support:
Climate change mitigation plans can include a focus on public infrastructure to take advantage of energy-efficient technologies and management practices. Street lighting and fleet management programs can improve energy-efficiency and reduce overall energy consumption. Compact development patterns can reduce utility service delivery costs. Public buildings and facilities can be designed to maximize energy efficiency. In addition to helping reduce greenhouse gas emissions, these efforts are generally cost-effective, saving taxpayer dollars.

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