

**ENERGY CONSERVATION AND CLIMATE  
Table of Contents**

<u>Item</u>	<u>Page</u>
16.0. ENERGY CONSERVATION AND CLIMATE .....	1
16.1 Introduction .....	1
16.2 Existing Impact of Energy Use Upon Climate Change and Global Warming .....	3
16.2.1 Energy Use .....	3
16.2.2 Global Warming .....	3
16.2.3 Climate Change .....	4
16.2.4 Responses to Climate Change and Global Warming .....	4
16.3 Existing County Actions .....	4
16.3.1 County Operations and Facilities .....	4
16.3.2 The Green Initiative Task Force .....	5
16.3.3 The Southeast Regional Climate Compact.....	6
16.3.4 Florida Energy and Climate Commission Grant Funds.....	7
16.3.5 Climate Change Advisory Committee.....	7
16.4 Existing Data on Energy Use and GHG Emissions .....	8
16.4.1 Energy Consumption Generally.....	8
16.4.2 Transportation .....	8
16.4.3 Land Use and Land Use Changes .....	9
16.4.4 Commercial and Residential Energy Use.....	9
16.4.5 Waste Management.....	10
16.5 Present and Projected Impacts from Climate Change: Land and Habitat.....	11
16.5.1 Sea Level Rise .....	11
16.5.2 Impacts on Property Loss.....	14
16.5.3 Impacts on Habitat .....	14
16.5.4 Hurricane Intensity and Frequency .....	15
16.5.5 Ocean Acidification and Coral Reef Degradations .....	16
16.6 Present and Projected Impacts from Climate Change: Infrastructure and Services .....	17
16.6.1 Water Supply Impacts.....	17
16.6.2 Wastewater Impacts.....	17
16.6.3 Stormwater Impacts .....	18
16.6.4 Water Quality Impacts .....	18
16.6.5 Additional Infrastructure Considerations.....	18
16.6.6 Green Infrastructure Considerations .....	19
16.7 Needs, Goals and Opportunities .....	20
16.7.1 The Need for Baseline Data .....	20
16.7.2 Mitigating County and Community GHG Emissions.....	20
16.7.3 Evaluating County Infrastructure Assets.....	20
16.7.4 Opportunities to Develop Strategies and Regional Airports.....	21
16.7.5 The Need for Additional Monitoring Data.....	21

**List of Figures**

<u>Figure</u>	<u>Page</u>
Figure 16.1: Sea Level Rise Predictions, (SE Regional Climate Compact) .....	13
Figure 16.2: Unified Sea Level Rise Projections of the Southeast Regional Climate Compact.....	13

**List of Tables**

<u>Table</u>	<u>Page</u>
Table 16.1: Average Rates of Historical Sea Level Rise (Heimlich et al., 2009) .....	12

## **16.0 ENERGY CONSERVATION AND CLIMATE ELEMENT**

The Energy Conservation and Climate Element is an optional element developed pursuant to Section 163.3177(1) F.S. to address the unique issues and challenges facing Monroe County (the “County”) relating to energy conservation and climate impacts.

### **16.1 Introduction**

On a global level, the long-term weather patterns and global climate of the Earth has continually changed over its five billion year history, including periods of extreme cold with glacier advancement and warming where the oceans rose and covered much of the Earth. Traditionally, sea levels were much lower than today. While extreme, these changes have usually occurred over many thousands of years.

For over 200 years, the global need for energy has steadily increased. Much of the energy used for light, heat and vehicles comes from fossil fuels like coal and oil. Burning these fuels releases greenhouse gases (“GHGs”). The U.S. Environmental Protection Agency (EPA) defines “greenhouse gases” as any gas that absorbs infrared radiation in the atmosphere. Greenhouse gases include, but are not limited to water vapor, carbon dioxide (CO<sub>2</sub>), methane, nitrous oxide, chlorofluorocarbons, hydrochlorofluorocarbons, ozone, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

EPA defines “greenhouse effect” as a general warming effect felt on Earth’s surface produced by GHGs. This process occurs naturally and has kept the Earth’s temperature about 60 degrees Fahrenheit warmer than it would be otherwise. The greenhouse effect is important; without it, the Earth would not be warm enough for humans to live.

Most climate scientists think that human activity, such as burning fossil fuels, deforestation and certain changes to land use are causing an increase in GHGs in the Earth’s atmosphere. Earth’s climate has warmed by about 1 degree Fahrenheit over the past 100 years. Scientists are trying to fully understand why and how this is occurring. The increased GHGs lead to warming in general as well as greater variability and lower predictability of weather patterns in many places around the world.

The U.S. in general is struggling with the issue of GHG regulation and climate change preparedness. Approaches to these issues continue to evolve based on significant policy and regulatory debate. State level climate change and greenhouse gas management policy was first adopted in 2007 when the Governor of Florida hosted a climate change summit. Executive Orders (E.O.) were then signed that established a call to action and set targets for the reduction of greenhouse gas emissions within the State, and also established a Governor’s Action Team on Energy and Climate Change. This action team was charged with developing a Florida Energy and Climate Change Action Plan to meet statewide targets for greenhouse gas reductions. During the preparation of the action plan, the Florida Legislature passed House Bill (HB) 697, which amended portions of Chapter 163, F.S. and required GHG emissions

reduction strategies to be included in a local government’s Comprehensive Plan, among other mandates.

Although HB 7207, which became effective July 1, 2011, and revises requirements to address energy conservation, Monroe County desires to move forward in a proactive manner to address energy conservation and climate change in its role as a signatory to The Southeast Regional Climate Compact. For Monroe County, the “appropriate” and “professionally accepted” data required for Comprehensive Plans still requires some level of analysis related to energy conservation and climate change issues. See Section 163.3177(1)(f)1-2, F.S.

Additionally, among other requirements to address infrastructure planning, conservation and coastal management, Section 163.3177(6)(a)9.a., F.S. includes indicators for analysis that a plan or plan amendment does not discourage the proliferation of sprawl which include land use patterns or timing which disproportionately increase the cost in time, money, and energy of providing and maintaining facilities and services. Section 163.3177(6)(a)9.b., F.S. states that the future land use element or plan amendment shall be determined to discourage the proliferation of sprawl if it incorporates a development pattern or urban form that achieves four (4) or more criteria including whether or not the plan or plan amendment promotes conservation of water and energy.

Specifically the new legislation provided local governments the option of designating an “adaptation action area” and developing policies for areas experiencing coastal flooding and vulnerability to rising sea level. “Adaptation Action Areas” are defined in Chapter 163.3164 as:

*“A designation in the coastal management element of a local government’s comprehensive plan which identifies one or more areas that experience coastal flooding due to extreme high tides and storm surge, and that are vulnerable to the related impacts of rising sea levels for the purpose of prioritizing funding for infrastructure needs and adaptation planning.”*

Gaining an understanding of the relationships, effects and impacts related to energy conservation and climate change will necessitate implementing the critical policies and practices that will reduce GHG emissions and prepare for some of the unavoidable impacts of climate change. Simultaneously, the State and federal regulatory landscape is constantly evolving to address energy use and climate change. While GHGs produced within the County constitute only a small fraction of national and global quantities, because of its unique vulnerabilities to sea-level rise<sup>1</sup> and its status as a premier tourist destination the County has a vested interest in demonstrating leadership on these critical issues.

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<sup>1</sup> “Most of Monroe County has natural elevations of about 4 to 7 feet above mean sea level. This makes the area vulnerable to coastal flooding.” Monroe County and Incorporated Municipalities Key West, Marathon, Key Colony Beach, Layton, and Islamorada Village of Islands, “Local Mitigation Strategy”, 2010 Update.

**16.2 Existing Impact of Energy Use Upon Climate Change and Global Warming**

*16.2.1 Energy Use*

Within the U.S., fossil fuel combustion accounts for the majority of carbon dioxide (CO<sub>2</sub>) emissions. Fossil fuels are generally combusted for the purpose of producing energy for useful heat and work (U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2008). The five major fuel consuming sectors contributing to CO<sub>2</sub> emissions from fossil fuel combustion are electricity generation, transportation, industrial, residential, and commercial. Changes in land use and forestry practices can also emit CO<sub>2</sub> (e.g., through conversion of forest land to agricultural or urban use) or can act as a sink for CO<sub>2</sub> (e.g., through net additions to forest biomass). The term “sink” used in this context is any process, activity or mechanism which removes greenhouse gases from the atmosphere. Transportation and electricity generation are typically the largest contributors of CO<sub>2</sub> emissions from fossil fuel combustion.

*16.2.2 Global Warming*

Global warming is the gradual rise of the Earth’s surface temperature. The Earth’s average temperature has increased by about 1°F (0.5°C) over the past century. An increase in global warming has occurred in the distant past as the result of natural influences, but today, the term is most often used to refer to the warming as a result of increased emissions of GHGs. There are six GHGs regulated under the Kyoto Protocol. These GHGs are: carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF<sub>6</sub>). Although the direct GHGs CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations.

Much of the sunlight that reaches the Earth’s surface is reflected upward again as infrared radiation. The heat caused by infrared radiation is absorbed by gases such as water vapor, carbon dioxide, ozone and methane, thus retaining some of that heat in the Earth’s atmosphere. This action regulates the Earth’s climate. The increased accumulation of GHGs results in more infrared radiation trapped and held in the Earth’s atmosphere. It is this warming trend that causes other climate change impacts.

*16.2.3 Climate Change*

Anthropogenic (human induced) activity is now widely accepted by the overwhelming majority of the world’s scientists as the major cause of recent and predicted future global climate change (Karl et al., 2009; IARU, 2009). Climate change is not only driven by the accumulation in the atmosphere of GHGs from the burning of fossil fuels, but also deforestation, land use, and agricultural practices (Heimlich et al., 2009). These influences on GHG emissions result in changes to regional climate characteristics, including atmospheric and ocean temperatures, humidity, precipitation, wind, and severe weather events. The changes are occurring at different rates and levels across the world.

16.2.4 Responses to Climate Change and Global Warming

Historically, societies and ecosystems have responded to climate change by adjusting and adapting to the natural variability of climate conditions, but the rate that climate change has been occurring in the last century has begun outpacing the conditions of the past. Our ability to mitigate<sup>2</sup> GHG emissions will affect the magnitude of the climate change impacts to which we will need to adapt.<sup>3</sup> “Vulnerability” to climate change refers to the exposure, sensitivity, and adaptive capacity of systems to climate change (Intergovernmental Panel on Climate Change).<sup>4</sup> Mitigation of GHG emissions and adaptation to climate change are inextricably linked, and both are required to reduce the impacts we have been, and will be, seeing.<sup>5</sup> Resilience to climate change is the capability to anticipate, prepare for, respond to, and recover from significant multi-hazard threats with minimum damage to social well-being, the economy and the environment (Council on Environmental Quality “CEQ” 2010). It is this final response of “resilience” that the County seeks to achieve with this Energy Conservation and Climate Element.

16.3 Existing County Actions

The County is on the front lines of climate change impacts such as sea level rise and increased hurricane intensity. Recognizing the need to simultaneously mitigate GHGs attributable to energy use and prepare for the gradual but accelerating impacts of climate change, the County has already proactively taken several actions.

16.3.1 County Operations and Facilities

The County has adopted a GHG target for county operations (Resolution 067-2010), including a reduction of countywide GHGs of 20 percent by 2020 as measured from a 2005 baseline inventory. The County has adopted green building standards for County Facilities with Resolution 147-2010; building upon the energy requirements in the Florida Building Code by incorporating the Florida Green Building Coalition’s green commercial building standard for county buildings, as the standard to be used for construction of all public buildings. Finally, the County established the “Employee Green Team” in December 2009 to develop a government operations climate action plan.

<sup>2</sup> Mitigation is an intervention to reduce the causes of changes in climate, such as through reducing emissions of greenhouse gases in the atmosphere. The White House Council on Environmental Quality, “Progress Report of the Interagency Climate Change Adaptation Task Force: Recommended Actions in Support of a National Climate Change Adaptation Strategy” (October 5, 2010).

<sup>3</sup> Adaptation is the adjustment in natural or human systems to a new or changing environment that exploits beneficial opportunities or moderates negative effects. *Id.*

<sup>4</sup> Differences in geological, oceanographic and biological processes can also lead to substantially different impacts on a single coastal system at different locations. Some global patterns and obvious areas of vulnerability are clear, however, estuaries, coral reefs, and ice-dominated coasts appear most vulnerable to either climate change or associated sea-level rise and changes. Low-lying coastal wetlands, small islands, sand and gravel beaches and soft rock cliffs may also experience significant changes (IPCC, 2001).

<sup>5</sup> *Id.*

Although not traditionally considered a strategy to address energy conservation and climate change, State and federal guidance and regulations pertaining to mitigation planning already require the identification of mitigation goals that are consistent with other goals, mission statements and vision statements (a Local Mitigation Strategy “LMS”). The previous Comprehensive Plan included Goal 217: “Monroe County shall develop and implement a program of hazard mitigation and post-disaster redevelopment to increase public safety and reduce damages and public expenditures.” The LMS Working Group first developed a set of goals as part of the 1999 LMS. These goals were reviewed and confirmed for the LMS revision in 2005, with one minor addition. The goals were discussed and reconfirmed for the 2010 Update. Monroe County Local Mitigation Strategy Goals include<sup>6</sup>:

- Preservation of sustainability of life, health, safety and welfare;
- Preservation of infrastructure, including power, water, sewer and communications;
- Maintenance and protection of roads and bridges, including traffic signals and street signs;
- Protection of critical facilities, including public schools and public buildings;
- Preservation of property and assets;
- Preservation of economy during and after disaster, including business viability; and
- Preservation and protection of the environment, including natural and historic resources.

Much of the LMS can provide baseline information in terms of what the County vulnerabilities are related to storm events, and additionally, projected impacts from climate change.

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<sup>6</sup> Monroe County and Incorporated Municipalities Key West, Marathon, Key Colony Beach, Layton, and Islamorada Village of Islands, “Local Mitigation Strategy”, 2010 Update.

16.3.2 *The Green Initiative Task Force*

The Green Initiative Task Force was created on June 18, 2008 (Resolution 177-2008) by the Board of County Commissioners (“BOCC”.) Originally called the Green Building Code Task Force, the name and mission, was officially changed with the adoption of Resolution 121-2009 on April 15, 2009. Membership of the task force consisted of two appointments made by each Commissioner (the BOCC had the discretion to nominate one member from their own district and one member from the County at large), and one member from each of the municipalities, utilities and the Navy (Resolution 024-2010). The task force was sunsetted on October 1, 2010 (Resolution 345-2008). The task force was coordinated by the Extension Services under the office of the County Administrator (Resolution 446-2009). The scope of the task force was to provide recommendations to the BOCC on environmentally sound practices and techniques to protect the environment as well as address climate change mitigation and adaptation needs. The task force also provided recommendations on green standards for implementation to improve quality of life and create more efficiency in County government.

The Green Initiatives Task Force completed a *Sustainable Vision Statement* in September 2010 with several key recommendations to address energy conservation and climate change. In the development of *Sustainable Vision Statement*, the Green Initiatives Task Force reviewed much of the data shaping energy and climate policy and management approaches in Florida. This data included recent analysis by the South Florida Water Management District, the U.S. Army Corps of Engineers, other local government energy/climate change initiatives and State and federal laws. That best available data serves as the basis for this Energy Conservation and Climate Element.

In relation to the Comprehensive Plan, the task force made the following recommendation: “The Monroe County Comprehensive Plan should include strategies to address the impacts of climate change. Adaptive management principles should be used to continually review and revise climate mitigation and adaptation policies, objectives, and Land Development Regulations. Revisions to the Plan may include:

- Create a Climate Change Element or Sub-Element within the Monroe County Comprehensive Plan which can be a model to other local government efforts;
- Address greenhouse gas reduction and energy conservation strategies that promote compact, bicycle and pedestrian-friendly development; increase public transportation; reduce reliance on automobiles, the construction of energy efficient buildings; and address the potential effects of rising sea levels, tropical storms, storm surge, and other climate change issues; and
- Consider climate change impacts as a factor in determining whether or not to permit additional intensity or density in land use plan changes.”

An additional recommendation was also made:

*Monroe County should continue to support the livable communities concept which promotes functional, walk-able mixed use development designs and projects by providing flexibility in development review for these projects, revising the zoning and land development codes to allow and encourage these projects, establishing incentives for this type of development, and adopting specific goals in the Comprehensive Plan to support and establish sustainable development patterns.*

Because the *Sustainable Vision Statement* was accepted by the BOCC on September 15, 2010, those recommendations also provide a basis for the development of this Element.

### 16.3.3 *The Southeast Regional Climate Compact*

The Southeast Florida Regional Climate Change Compact (the “Compact”) is a joint commitment of Monroe, Broward, Miami-Dade and Palm Beach Counties to partner in mitigating the causes and adapting to the consequences of climate change. The Compact was formalized in 2009 following the Southeast Florida Climate Leadership Summit, when elected officials came together to discuss challenges and strategies for responding to the impacts of climate change. The Compact outlines a collaborative effort to participate in a Regional Climate Team toward the development of a Southeast Florida Regional Climate Change Action Plan. Specifically, the Compact includes seven commitments on the part of the participating counties:

- Each county shall work in close collaboration to develop a joint policy position urging the United States Congress to pass legislation that recognizes the unique vulnerabilities of Southeast Florida to the impacts of climate change and to further a joint policy position that includes specific recommendations regarding the allocation of federal climate change funding based on vulnerability to climate change impacts.
- Each county shall work in close collaboration with the other counties to develop additional legislative policy statements relating to global climate change and future legislation to be considered by Congress for transmittal to the local delegation members.
- Each county shall work in close collaboration to develop joint position statements on proposed State legislation and energy/climate policies.
- Each county shall work to develop joint position statements for future State legislation.
- Each county shall commit appropriate staff resources and expertise, within budget constraints, to participate in a Regional Climate Team with other counties toward the development of a Southeast Florida Regional Climate Change Action Plan.

- Each county shall work to develop a Southeast Florida Regional Climate Change Action Plan. The Action Plan could, at a minimum, include the following components:
  - A baseline of greenhouse gas emissions for Southeast Florida;
  - Strategies for coordinated emission reductions throughout the built environment to include the use of energy efficiency, energy conservation, and the use of demand-side renewable energy resources;
  - Strategies for coordinated emission reductions from the transportation sector to include increased reliance on public transit, emerging vehicle technologies, and advanced biofuels;
  - Strategies for coordinated emission reductions resulting from changes in local and regional land use;
  - Strategies for the coordinated regional preparation for and adaptation to a rapidly changing global environment based upon regional mapping of projected sea-level rise and any resulting amplification of localized impacts of tropical cyclone events. Such strategies shall incorporate climate preparation concerns for the regional economy, regional infrastructure and the built environment, social and cultural needs, and natural systems within the four counties party to this compact; and
  - Each county shall commit to participating with other counties party to this compact in hosting the Second Southeast Florida Regional Climate Change Summit in October 2010.

There are also several work groups and sub-groups compiling information to complete work products including a Greenhouse Gas Work Group, Vulnerability Work Group, Sea Level Rise Work Group. Finally, the Regional Climate Change Action Plan is being developed with a strategy of focusing on priority planning areas, narrowing that focus through vulnerability and risk analysis and integrating it with the concepts of mitigation and adaptation. The Focal Areas of the Plan include: Land and Natural Systems, Transportation and the Built Environment. A Draft document is anticipated for completion by December 2011.

#### *16.3.4 Florida Energy and Climate Commission Grant Funds*

In 2010, the County, along with the City of Marathon, City of Key West and Islamorada, Village of Islands, received a state grant from the Florida Energy and Climate Commission. The collective grant application known as the “Keys Energy Conservation Initiative” identified different projects for use of the grant funds. The County’s projects included: an Energy Efficiency and Conservation Strategy for County Operations and Facilities, energy retrofits at four buildings, and the purchase of five hybrid vehicles for its fleet. Across all jurisdictions, the Grant includes funds for a low-income solar hot water heating installation program and a public awareness and outreach strategy on energy conservation and climate mitigation strategies. The Grant activities will be concluded by 2012.

16.3.5 *Climate Change Advisory Committee*

In January 2011, the BOCC adopted Resolution No. 002 - 2011 forming the Climate Change Advisory Committee. The purpose of the Climate Change Advisory Committee is to make recommendations to the BOCC regarding appropriate mitigation and adaptation policies needed to address climate change issues and to provide input to staff regarding implementation of those components of a Florida Energy & Climate Commission Grant received by the County and multiple partners. The Grant includes funds for community input and intergovernmental coordination on energy and climate issues. The Committee will also provide input on climate action plans and other climate related draft reports as needed.

**16.4 Existing Data on Energy Use and GHG Emissions**

16.4.1 *Energy Consumption Generally*

Trends in CO<sub>2</sub> emissions from fossil fuel combustion are influenced by many long-term and short-term factors. Year in and year out, the overall demand for fossil fuels generally shifts in response to changes in general economic conditions, energy prices, weather, and the availability of non-fossil alternatives. Longer-term changes in energy consumption patterns, however, tend to be more a function of aggregate societal trends that affect the scale of consumption (e.g., population, number of cars, size of houses, and number of houses), the efficiency with which energy is used in equipment (e.g., cars, power plants, steel mills, and light bulbs), and social planning and consumer behavior (e.g., walking, bicycling, or telecommuting to work instead of driving) (U.S. EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2008). Direct GHG emissions are emissions from sources that are owned or controlled by the reporting entity such as energy use for the electricity generation by utilities. Indirect GHG emissions are emissions that are a consequence of the activities of the reporting entity, but occur at sources owned or controlled by another entity. The residential and commercial end-use sectors are reliant on electricity consumption for lighting, heating, air conditioning, and operating appliances and as such are indirect emissions sources. Direct emissions, used in industrial, commercial and residential sectors, represent the greatest share of U.S. GHG emissions.

16.4.2 *Transportation*

Energy use from the transportation sector is approximately 32 percent of CO<sub>2</sub> emissions, 24 percent of CH<sub>4</sub> emissions, and 65 percent of N<sub>2</sub>O emissions from fossil fuel combustion, respectively. Among domestic transportation sources, light duty vehicles (including passenger cars and light-duty trucks) represents 62 percent of CO<sub>2</sub> emissions, medium-duty and heavy-duty trucks 22 percent, commercial aircraft seven percent, and other sources nine percent. From 1990 to 2008, transportation GHG emissions rose due to increased demand for travel and the stagnation of fuel efficiency across the U.S. vehicle fleet.

Over the 1990s through early this decade, growth in vehicle travel substantially outweighed improvements in vehicle fuel economy; however, the rate of Vehicle Miles Traveled growth slowed considerably starting in 2005 (and declined rapidly in 2008) while average vehicle fuel economy increased. The number of vehicle miles traveled by light-duty motor vehicles (passenger cars and light-duty trucks) increased 37 percent from 1990 to 2008, as a result of a confluence of factors including population growth, economic growth, urban sprawl, and low fuel prices over much of this period. A similar set of social and economic trends has led to a significant increase in air travel and freight transportation. But, with EPA and the National Highway Traffic Safety Administration (NHTSA) taking regulatory steps toward mandating reductions in GHG emissions, and fuel use from cars and light trucks, coupled with future regulatory steps related to fuel economy standards, transportation related emissions could see future decreases.

#### 16.4.3 *Land Use and Land Use Changes*

The Intergovernmental Panel on Climate Change *2006 Guidelines for National Greenhouse Gas Inventories* (IPCC 2006) recommends consideration of the effects on changes within, and conversions between, certain land-use types such as undeveloped or forest land to development. The impact of considering these changes is significant. Land use, land-use change, and forestry activities in 2008 resulted in a net carbon sequestration offset of approximately 13.5 percent of total U.S. CO<sub>2</sub> emissions.

Alternative development scenarios demonstrate that location, density, proximity, connectivity, diversity of land uses and other concepts can be important in reducing GHG emissions. The overall composition of development patterns, housing and buildings types such as single-family, multi-unit and multi-story also have an influence over energy use. Transit Oriented Development and Transit Ready Development and transit served neighborhoods are all strategies that have been used in other communities to reduce vehicles miles traveled. When considering GHG emissions from land use, a land-use or management trend factor estimates the rate at which land-use or management changes are occurring within the geographic area during a specific timeframe. The land-use trend factor is then applied to the baseline to reflect the changing land-use or management practices in an area.

#### 16.4.4 *Commercial and Residential Energy Use*

Energy use in homes and businesses is typically a large sector of GHG emissions. The U.S. Energy Information Administration (EIA) indicates total energy use from these sectors at 7 percent of electricity sales.<sup>7</sup> In homes, several factors influence energy use: the physical characteristics of the housing units, the appliances utilized including space heating and cooling equipment, demographic characteristics of the household, the types of fuels used, and other information that relates to energy use.

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<sup>7</sup> Electric Power Monthly, Table 5.1, April 22, 2009.

According to the EIA, commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural; therefore, they include building types that might not traditionally be considered “commercial,” such as schools, correctional institutions, and buildings used for religious worship. This includes retail and wholesale stores, hotels and motels, restaurants, and hospitals. Excluded from the sector are the goods-producing industries: manufacturing, agriculture, mining, forestry and fisheries, and construction. Analysis of the structures, activities, and equipment associated with different types of buildings is the clearest way to evaluate commercial sector energy use.

#### 16.4.5 *Waste Management*

Generally, a large portion of GHG emissions is related to energy use in resource acquisition, manufacturing, transportation, and end-of-life life-cycle stages. The total energy consumed related to waste management activities is a result of direct fuel and electricity consumption associated with raw material acquisition and manufacturing, fuel consumption for transportation, and embedded energy. Not all GHG emissions are related to energy, however, and the effects of GHG are not directly translatable to energy impacts. Alternative materials management practices, source reduction, recycling, combustion, composting, and landfilling strategies all can be used to reduce GHGs. The EPA Office of Solid Waste and Response found that 42 percent of U.S. 2006 GHG emissions were associated with the manufacturing, use and disposal of materials and products. As a result, changing materials management patterns is an important strategy to help reduce or avoid GHG emissions. Reducing the amount of materials used to make products, extending product life spans and maximizing recycling rates are examples of possible materials management strategies that can significantly reduce GHG emissions.

Source reduction, or waste prevention, refers to practices that reduce the amount of materials entering the waste stream, including changes in the design, manufacture, purchase or use of materials. When a material is source reduced, GHG emissions associated with producing the material and/or manufacturing the product and managing the post-consumer waste are avoided. Consequently, source reduction provides GHG emission benefits by: (1) avoiding the “upstream” GHGs emitted in the raw material acquisition, manufacture and transport of the source-reduced material; (2) increasing the amount of carbon stored in forests (when wood and paper products are source reduced); and (3) avoiding the downstream GHG emissions from waste management.

EPA defines recycling as “minimizing waste generation by recovering and reprocessing usable products that might otherwise become waste (i.e., recycling of aluminum cans, paper and bottles, etc.)” (EPA, 2008). In evaluating the relative GHG reduction benefits of recycling compared to an existing materials management practice (i.e., evaluating the benefits of recycling relative to source reduction, composting, combustion or landfilling), the recycling GHG emissions must be compared against the corresponding emission factors for the existing management practice. According to the EPA, source reduction techniques, such as double-sided copying and reducing the weight of products (light-weighting) are

important in reducing energy because source reduction significantly lowers energy consumption associated with raw material extraction and manufacturing processes.

During composting, microbial decomposition aerobically transforms organic substrates into a stable, humus-like material (Brown and Subler, 2007). Composting results in some carbon storage (associated with application of compost to agricultural soils), as well as minimal CO<sub>2</sub> emissions from transportation and mechanical turning of the compost piles. The GHG reduction benefits from composting include a comparison between composting and other possible disposal options for yard trimmings (i.e., landfilling and combustion).

According to the EIA, the solid waste industry currently produces more than half of America's renewable energy, more than combined energy outputs of the solar, geothermal, hydroelectric, and wind power industries. Landfill-gas-to-energy projects involve capturing methane and waste-to-energy activities displace fossil fuel sources and lower landfill methane emissions by diverting waste from landfills helping to reduce GHG emissions.

In the County, disposal of solid waste is currently handled by three transfer station operations where waste is prepared for transportation and disposal at an out of county location. The County provides recycling services for residential properties but businesses must arrange for service with local providers as outlined in the Solid Waste Element.

## **16.5 Present and Projected Impacts from Climate Change: Land and Habitat**

Almost all impacts from climate change relate to increasing air temperatures with global sea level rise largely attributable to the thermal expansion of the oceans and melting of glaciers and ice sheets.<sup>8</sup> Altered precipitation patterns, heat waves, floods and droughts are all related impacts. Not all impacts will be uniform and there will be some variation by location due to differences in atmospheric and oceanic circulation. Inundation, erosion and flooding are also resulting impacts. Areas with greater precipitation will see more sewer overflows, more runoff and nonpoint pollution, and infrastructure overloading. Areas of lesser precipitation will struggle with meeting water demands and habitat shifts. A great area of uncertainty is the combination and interrelationships of these impacts in the future. In particular, predicted changes in storm intensity and sea level rise create the need for integrated potable water, storm water, and wastewater infrastructure planning and greater interagency coordination.

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<sup>8</sup>If global atmospheric temperatures rise, the oceans will absorb more of that heat and expand known as "thermal expansion". A greater volume of ocean water due to thermal expansion will lead to a rise in sea level. Lombard, A.; Cazenave, A.; Le Traon, P., Contribution of Thermal Expansion to 1993-2003 Sea Level Rise (2005).

16.5.1 Sea Level Rise

Approximately 100 years ago, early in the Industrial Revolution, sea level rise began to accelerate, averaging about 2 mm/yr during the 20th century and 3.1 mm/yr since 1993 based on satellite altimetry (Cazenave et al., 2008). On average, globally, the sea level has risen by approximately 200 mm (8 inches) during the past century (IPCC, 2007). As illustrated in **Table 16.1**, a Florida Institute of Technology Report (Maul, 2008) shows an average rate of sea level rise of  $2.27 \pm 0.04$  mm per year from 1915 to 2005 based upon tide gauge readings in Key West, which has the Western Hemisphere’s longest sea level record.

**Table 16.1 - Average Rates of Historical Sea Level Rise (Heimlich et al., 2009)**

Location	Rate	Source
Global average sea level rise, 1870-1990	2.0 mm/yr	Church and White, 2006
Global Average sea level rise, 1993-2007	3.1 mm/yr	Cazenave et al., 2008
Miami, Florida, 1931-1999	$2.39 \pm 0.22$ mm/yr	US EPA, 2009
Key West, Florida, 1913-1999	$2.27 \pm 0.09$ mm/yr	Maul, 2008

Source: Heimlich et al., 2009

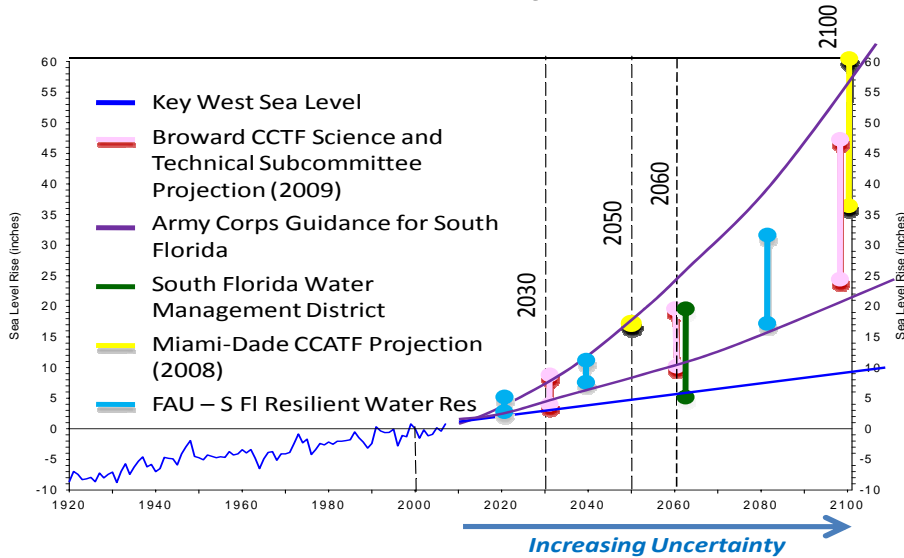
The rate of sea level rise is accelerating, although scientists differ on that rate of acceleration; over the past 2,500 years south Florida has experienced an average rate of sea-level rise of 3.8 centimeters per century. From 1932 to 2000, tide-gauge data reveals that the sea level rose by 22 centimeters, a rate equivalent to 30 centimeters per century or 8 times higher than the average rate over the past 2,500 years. Today, analysis of satellite data suggests the sea level is rising 50 percent faster than it was just 15 years ago (IPCC 2007). An increasing number of papers concerning future sea level rise due to climate change are appearing in the scientific literature. Publications and reports about future rates of sea level rise to date apply relatively simple empirical correlations and extrapolations based upon limited historical data.

Sea level rise data is generally considered to be a conservative estimate of the impacts for the following reasons:

- Most of the sea level rise in the 20th century was due to thermal expansion as a result of rising global temperatures;
- A relatively small contribution was from the melting of ice sheets and glaciers and may not be a reliable guide for the increasing contributions due to melting in the 21st Century; and
- The mechanisms of glacial melt and flow are not well understood (Heimlich et al., 2009) but numerous scientific publications point to acceleration.

Extensive research is underway on this important issue and better projections will no doubt be forthcoming. There does not appear to have been a significant difference in sea level rise during the 20th Century between Southeast Florida and globally; therefore, published predictions for global sea level rise are applicable locally. **Figure 16.1** shows the diversity of some of these predictions. **Figure 16.2** shows the current Unified Sea Level Rise Project agreed to by the participants in the Southeast Regional Climate Compact.

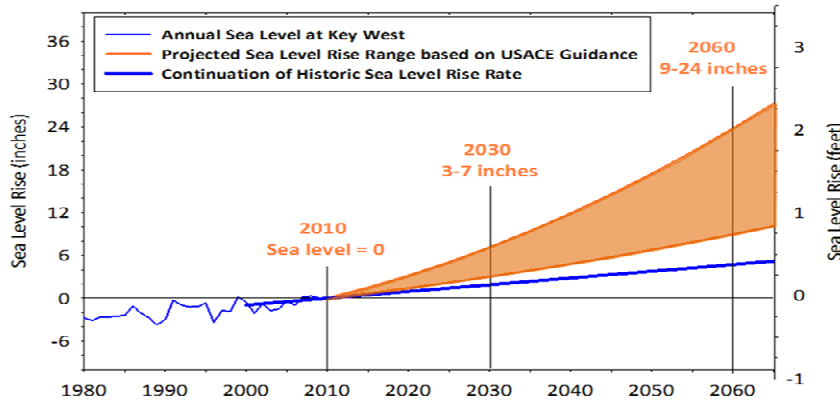
### SE Florida Projections



Source: Southeast Florida Regional Climate Change Compact (2011).

**Figure 16.1 – Sea Level Rise Predictions, (SE Regional Climate Compact)**

### Unified SLR Rise Projection



Source: Southeast Florida Regional Climate Change Compact (2011).

**Figure 16.2 - Unified Sea Level Rise Projections of the Southeast Regional Climate Compact**

16.5.2 *Impacts on Property Loss*

The Nature Conservancy (TNC) evaluated the impacts of sea level rise on Big Pine Key and the Florida Keys (Bergh, 2009). In 2007, TNC acquired high-resolution Digital Elevation Models derived from airborne Light Detection and Ranging (LIDAR) data for Big Pine Key and the best-available Digital Elevation Model for the entire archipelago. Future shoreline locations and distribution of generalized habitats of Big Pine Key in the year 2100 were estimated using sea level rise scenarios described in the scientific literature. Property value loss estimates for Big Pine Key were based on the same 2100 sea level rise projections using 2008 property values. In every scenario, the island becomes smaller, marine and intertidal habitat moves upslope at the expense of upland habitat, and property values are diminished.

In the best-case scenario, 18 cm (7 in.) of sea level rise, 1,840 acres (34 percent) of Big Pine Key are inundated resulting in the loss of 11 percent of the island’s upland habitat. This degree of inundation would displace native species dependent on upland habitat and threaten \$40 million of property value. Four other scenarios are modeled for Big Pine Key using the same high-resolution data. With a rise of 140 cm (4.6 ft.), the highest modeled rise, about 5,950 acres (96 percent) of the island would be inundated with all upland habitat and \$1.6 billion in property value lost (Bergh, 2009).

Under the most optimistic Intergovernmental Panel on Climate Change scenario (a rise of 18 cm over the next 100 years), \$11 billion in property value and 58,800 acres are at risk of inundation in the Florida Keys (Bergh, 2009). Under the highest Rahmstorf (2007) estimate (a 140 cm rise by 2100), approximately \$35 billion in property value and 142,000 acres are at risk from sea level rise or are already inundated in the Florida Keys (Bergh, 2009).

16.5.3 *Impacts on Habitat*

Plant and animal species and natural processes of ecological systems have evolved to fit specific climate regimes. Certain biological processes (e.g. flowering of plants, migration of birds) and ecological processes (e.g. natural fire regimes, aquifer recharge) are dictated by seasonality and these processes are sensitive to changing climate regimes. Some species may have the ability to adapt to slower changes by dispersing to habitat that meets their needs, but the insular nature of the Keys will prevent species that cannot fly or swim long distances from dispersing naturally and more abrupt climate related shifts may threaten even highly mobile plant and animal species. Ecological disturbances related to climate change (e.g. flooding, storms) also invite an increase in non-native species which compete for resources with native species.

The effects of sea level rise on the natural habitats of the Keys are already apparent. In the publication, “Sea Level Rise and the Reduction in Pine Forests in the Florida Keys,” Ross et al. (1994) surveyed upper Sugarloaf Key elevations, vegetation distribution, groundwater

salinity and other factors and examined historic aerial photographs from 1935 to 1991, ultimately learning that the area of pine forest on Sugarloaf Key declined from an initial 88 hectares (“ha”) (217 acres) before 1935 to 30 ha (74 acres) by 1991. Transformation of pine forest to more salt-tolerant vegetation types proceeded continuously over that time period and advanced from lower to higher elevation, leading the authors to attribute the decline in pine forest area to sea level rise.

Simply stated, as sea level rises, water over land displaces tidal habitat, which moves upslope and in turn displaces transitional habitat, which moves upslope and displaces upland habitat (Bergh, 2009). As sea level rises, some habitats will change rapidly and others will disappear. Although not well documented in the literature yet, it is widely believed that many native plants and animals, particularly the already imperiled species, those with limited ability to disperse naturally and those dependent upon freshwater or other climate or sea level-sensitive habitat requirements for all or a portion of their lifecycle will have an increasingly precarious existence as sea level rises.

#### 16.5.4 *Hurricane Intensity and Frequency*

There is ongoing debate regarding whether global warming will increase the frequency or intensity of hurricanes. Regardless, hurricanes are likely to be more destructive to coastal areas because an elevated sea level will cause higher storm surges that will penetrate further inland. Hurricane Wilma caused \$215 million in damage to the County. (2005) Based on work by Harrington and Walton (2008), when a similar storm hits the County after sea level rise of 1.02 ft, the damage costs are predicted to be 39 percent higher (\$298 million). When a similar storm hits the County after sea level rise of 2.13 ft, the damage costs are predicted to be 72 percent higher (\$370 million). The County is more susceptible to increased damage costs than neighboring Miami-Dade County. For the latter storm described above, the percent increases in damage costs are substantially higher for the County (72 percent) than Miami-Dade County (31 percent) (Harrington and Walton, 2008).

Hurricane return periods were evaluated by FEMA in a Flood Insurance Study for the County (FEMA, 2005). The purpose of the County *Flood Insurance Study* was to develop flood risk data for various areas of the County, to establish actuarial flood insurance rates, and assist the county in promoting sound floodplain management. Hurricane Wilma resulted in a 2.76-foot (0.84 m) high surge in the County. Based on FEMA’s study, it was classified as a 7.35-year hurricane event. For sea level rise scenarios of 0.28 ft (8.53 cm) and 1.02 ft (0.31 m) (Florida State University’s Beaches and Shores Resource Center estimates for years 2030 and 2080), the same hurricane storm surge as Wilma would be reduced from 7.35 years to 6.04 years and 3.61 years, respectively. For a 0.49-foot (14.9 cm) and 2.13-foot (0.65 m) scenario (Intergovernmental Panel on Climate Change estimates for years 2030 and 2080), the same hurricane storm surge would be reduced to 5.22 years and 1.65 years, respectively. It is important to note that at a given elevation, sea-level rise increases the likelihood of storm-surge flooding and synergistic effects between these two variables could cause upland habitat to be reduced more rapidly than predicted. For example, sea-level rise has rendered pine forests in the Keys more

vulnerable, by reducing the area capable of capturing precipitation and recharging fresh groundwater supplies. Droughts that sometimes follow late- season hurricanes can further diminish the volume of freshwater available to dilute salts deposited by storm surge. A second mechanism that may exacerbate the situation is that the background level of the water table is brought closer to the surface resulting in reduced drainage capacity. The interaction between sea-level rise and storm surge will soon reach a tipping point with respect to the maintenance of freshwater ecosystems in the County.<sup>9</sup>

#### 16.5.5 *Ocean Acidification and Coral Reef Degradation*

Oceans are being acidified by carbonic acid formed from dissolved carbon dioxide and a corresponding decrease in pH; this is detrimental to marine resources. The oceans have absorbed about 50 percent of the carbon dioxide released from the burning of fossil fuels, resulting in chemical reactions that lower ocean pH. This has caused an increase in hydrogen ion (acidity) of about 30 percent since the start of the industrial age through a process known as ocean acidification. A growing number of studies have demonstrated adverse impacts on marine organisms, including (1) the rate at which reef-building corals produce their skeletons decreases, (2) the ability of marine algae and free-swimming zooplankton to maintain protective shells is reduced, and (3) the survival rate of larval marine species, including commercial fish and shellfish, is reduced. The reduced rate of coral reef building could lead to diminished resiliency from bleaching, disease, and coral death. Reef building rates could decrease to levels insufficient to maintain reefs in any oceans when atmospheric carbon dioxide levels reach approximately 840 parts per million, which may be reached by the year 2100 (NOAA, 2008).

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<sup>9</sup> Michael S Ross, Joseph J O'Brien, R Glenn Ford, Keqi Zhang, and Anne Morkill, "Disturbance and the rising tide: the challenge of biodiversity management on low-island ecosystems", *Front Ecol Environ* 2009; 7, doi:10.1890/070221.

## **16.6 Present and Projected Impacts from Climate Change: Infrastructure and Services**

### *16.6.1 Water Supply Impacts*

While the precise level of sea level rise, or speed with which it rises, may not be known, sea level rise will reduce the amount of fresh water available for potable water use. The County's wellfields in Miami-Dade County are at risk from sea level rise impacts because of the low elevation of southern Miami-Dade County and the elevation of the groundwater within the Biscayne Aquifer close to the surface level. The easterly wellfields of Miami-Dade County are at risk from saltwater intrusion caused by sea level rise, and to the west, inundation of the southern Everglades with seawater would also affect the Biscayne Aquifer (Heimlich et al., 2009). This impact will be even more pronounced during the dry season potentially impacting the location and continued productivity of certain wellfields. The relationship between future growth and alternative water supply planning will become an even more important consideration as traditional water resources will become impacted in the future from sea level rise.

In the future, increased water conservation through demand management will become even more important as supplies could become scarce. Cutting the demand for landscape irrigation, generally the highest type of water use becomes more of a priority. Given the County's history related to water conservation, additional focus could be placed on upgrades to the efficiency of water use such as in buildings and irrigation infrastructure. Recent 2008 legislation (Senate Bill 2080/494) provides a source of model ordinances for assuring water efficiency for landscape irrigation.

### *16.6.2 Wastewater Impacts*

Wastewater treatment contributes CO<sub>2</sub>, CH<sub>4</sub>, and N<sub>2</sub>O in quantities totaling approximately 3.4 percent of total US GHGs. CO<sub>2</sub> and N<sub>2</sub>O are generated in aerobic (e.g. activated sludge) treatment. CH<sub>4</sub> and CO<sub>2</sub> are generated in anaerobic (e.g. biosolids digestion) treatment. Wastewater treatment facilities use a great deal of electricity to run the equipment. Greater power consumption efficiency in wastewater treatment can significantly lower GHG emissions.

Encouraging full utilization of the energy products from the wastewater treatment process, such as biosolids and methane gases can mitigate some of the impacts from process energy use. The decomposition of the sludge generated in the treatment of wastewater causes significant contributions of methane to the atmosphere. Sludge can be shipped off-site to a landfill or treated on-site by composting, incineration or digestion. Methane emissions generated in these processes are normally lost to the atmosphere, but the process of anaerobic digestion allows the methane to be captured. Due to global interest in reducing greenhouse gas emissions, it is anticipated that anaerobic digesters could be installed to reduce methane emissions from wastewater treatment facilities more commonly. Methane is not only a greenhouse gas; it is also a source of energy when it is burned. As a result, power generators can be installed at wastewater treatment facilities to burn the methane

emitted from anaerobic digesters and the electricity can be used to power equipment at the facility.

Impacts to treatment processes, system hydraulics and conveyance facilities may occur at pump stations, plants and distribution lines. Another impact to wastewater infrastructure could stem from increased chlorides in raw wastewater which will result in different treatment requirements depending on whether the wastewater is injected or reused. Flooding may impact wastewater infrastructure as well necessitating protective improvements to maintain capacity and processing of wastewater. In particular, it is noted that the anticipated service life of infrastructure becomes an increasingly important consideration given anticipated climate change.

### *16.6.3 Stormwater Impacts*

As sea level rise occurs, drainage and stormwater structures will diminish in their effectiveness to direct and capture stormwater flows. Since the rate of sea level rise is uncertain, this loss of effectiveness will take place over a gradual progression reducing the difference between water levels on either side of a flood control structure (Heimlich et al., 2009). Eventually, a structure could lose its entire operational capacity if the water levels upstream and downstream are equal. Effects of the loss of this operational capacity could occur with as little as three to six inches of sea level rise predicted as soon as the next 10 to 25 years (Heimlich et al., 2009). Additionally, the capacity of the ground to absorb stormwater is reduced.

The lower topography of a region will result in even more challenges for operating flood control structures. The gradual loss of operational capacity of flood control structures could be exacerbated by the increased frequency and intensity of major storm events. These considerations will need to be factored into the design of flood control structures with further specific vulnerabilities identified.

### *16.6.4 Water Quality Impacts*

More intense storms will result in increased storm water and non-point runoff. Water quality vulnerabilities will also occur such as increased algae growth, higher levels of water quality indicators such as fecal coliform bacteria and turbidity, pH changes and higher water temperatures. Aquatic life will be impacted by the change in water temperature and changes in seasonality; changes in nutrient loading; and increased eutrophication. Warmer water temperatures will reduce assimilative capacities of surface waters and increase the impacts of certain pollutants, leading to more impaired waters and more complex water quality and regulatory challenges.

### *16.6.5 Additional Infrastructure Considerations*

Other infrastructure could be impacted in the future including, but not be limited to, hospitals, libraries, transportation facilities, multi-modal stations and commercial centers. Additional infrastructure impacts that also need to be considered include: historic or

archaeological resources, existing landfills, abandoned dump sites, remnant septic tanks and underground storage or petroleum tanks. Determining the life expectancy of a project, as related to capital investment, is also a critical factor to consider for decisions related to the development, or improvement to, infrastructure in the face of sea level rise and other climate change impacts. Economic decisions related to the funding of capital improvements will have to be made in the context of strategies to mitigate impacts to infrastructure.

#### 16.6.6 *Green Infrastructure Considerations*

It is also important to consider the value of the County’s “green infrastructure” and the corollary benefits it provides when considering energy and climate issues. Practices such as aggressive onsite water conservation, wetlands and habitat enhancement/maintenance, transportation systems with alternative paving materials and onsite stormwater retention have long been known for their benefits related to heat island effect, water quality improvement, improved air quality, lower energy demand and increased carbon storage. But now, green infrastructure approaches have been recognized to help achieve GHG mitigation and climate change adaptation goals because their benefits are also generally related to their ability to moderate the impacts of climate change such as extreme precipitation or temperature.<sup>10</sup> In many instances, maintenance and enhancement of green infrastructure involves stewardship of the natural setting (e.g. preventing and controlling exotic species invasions, maintaining fire regimes, restoring wetlands, etc.). This concept is also known as Ecosystem Based Adaptation (EBA). For instance in the context of the County, the reefs, natural beaches, coastal berms, wetlands and other natural communities are just as important for protecting people and the built environment from the negative consequences of climate change as “grey infrastructure” such as seawalls, stormwater drains.

A concurrent benefit is that green infrastructure attributes provide these resiliency benefits at a much lower cost than constructed infrastructure components.<sup>11</sup> Green infrastructure approaches can be implemented at the macro level with larger centralized public projects or at the micro level on private property.<sup>12</sup> Economic values can also be placed on green infrastructure assets in terms of carbon sequestration and the cost savings with maintaining certain habitat functions as opposed to constructed solutions such as sea walls.<sup>13</sup> The County could benefit from considering how green infrastructure practices can achieve resiliency goals with less adverse impact and cost.

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<sup>10</sup> Foster, Lowe and Winkelman, “The Value of Green Infrastructure for Urban Climate Adaptation”, February 2011.

<sup>11</sup> *Id.*

<sup>12</sup> *Id.*

<sup>13</sup> For instance a 20% tree canopy over a house results in annual cooling savings of 8-18%. *Id.*

## 16.7 Needs, Goals and Opportunities

### 16.7.1 *The Need for Baseline Data*

CEQ suggests that where climate change effects are likely to be important, but there is significant uncertainty about such effects, it may be useful to consider the effects of a proposed action or its alternatives against a baseline of reasonably foreseeable future conditions that is drawn as distinctly as the science of climate change effects will support. Baseline information is helpful on two levels. First it is helpful in terms of understanding and prioritizing energy use to reduce GHG emissions. Second, it is helpful in terms of understanding what is vulnerable to the impacts of climate change. Without such baseline information on the mitigation or adaptation level, it is difficult to assess the types of strategies to employ to alleviate future impacts.

### 16.7.2 *Mitigating County and Community GHG Emissions*

To date, the County has initiated an effort to quantify energy use for its facilities and operations with the aforementioned grant funds. While local government GHG emissions are typically a small percentage of the overall communitywide footprint, this sector of emissions is critical for two reasons. First the County leads by example. Second, knowing a local government's GHG emissions provides a mechanism to prioritize GHG emissions and energy use. Typically, water and wastewater facilities are among the largest and most energy-intensive systems owned and operated by local governments and account for approximately 30-50 percent of municipal energy use according to EPA. Streamlining, retrofitting and implementing efficiency projects at the County level, based on prioritized energy use data, will be critical to meet the County's GHG target for county operations (Resolution 067-2010). Additional countywide GHG emissions data will be useful to help meet the County's goal of a 20 percent countywide reduction of GHGs by 2020 as measured from a 2005 baseline inventory.

### 16.7.3 *Evaluating County Infrastructure Assets*

The consequences of climate change impacts and strategies to address those impacts must be planned for in the future. This includes identification of infrastructure deemed to be "vulnerable" or susceptible to adverse impacts and the resilience factors to be considered. The capacity of that infrastructure to maintain levels of service can then be evaluated. An Asset Management Plan, or harmonizing the County's LMS process with achieving this goal, could establish a comprehensive baseline of infrastructure under the County's control. This process should also include an inventory of green infrastructure under the County's control. Building upon the existing LMS, additional protection, accommodation, adaptation or resiliency strategies could then be developed to address access and operation of this infrastructure.

But complicating the identification of vulnerable infrastructure and facilities, social and economic diversity issues will also warrant further review. Different populations will be impacted in various ways and this will be evidenced by issues related to access to

affordable housing, infrastructure dependence, wealth and age. Physical as well as social impacts can be identified.

#### *16.7.4 Opportunities to Develop Strategies and Regional Approaches*

Upon mapping and prioritizing areas that may be vulnerable to sea level rise impacts, protection, accommodation and retreat strategies can be developed. Protection strategies should include the green infrastructure principles discussed as a means of managing systems to prevent the landward migration of tidally influenced water bodies. This could include shoreline stabilization via shoreline armoring, protection of wetlands and other natural communities that minimize erosion or a combination of engineered and nature-based solutions. This could require analysis of current and future land acquisition practices. Accommodation strategies may include adaptation of buildings or infrastructure to the periodic impacts of storm surges that also account for rise of sea levels. This could include increased or improved management of flood management systems. Retreat strategies include relocation of structures and infrastructure from areas that will be subject to increased and repeated impacts. A County planning effort such as this will also provide necessary information to dovetail with the various Work Groups of the Southeast Regional Climate Compact and the existing LMS. More data based on specific planning horizons will assist in determining which strategies to implement and consider in the future.

#### *16.7.5 The Need for Additional Monitoring Data*

The County will strive to reach the goal of becoming a resilient community by anticipating, preparing for, responding to, and recovering from significant multi-hazard threats with minimum damage to social well-being, the economy and the environment. To reach this goal, the County will employ the “Guiding Principles for Climate Change Adaptation” developed by the CEQ:<sup>14</sup>

- Adopt integrated approaches;
- Prioritize the most vulnerable;
- Use best-available science;
- Build strong partnerships’
- Apply risk-management methods and tools;
- Apply ecosystem-based approaches;
- Maximize mutual benefits; and
- Continuously evaluate performance.

Many of these Guiding Principles are already being implemented by the County such as using best available science and building partnerships and adoption of integrated approaches through maintaining the LMS. But, it is also important to continue monitoring for impacts from climate change throughout the County to achieve better understanding of

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<sup>14</sup> Council on Environmental Quality, Implementing Climate Change Adaptation Planning in Accordance with Executive Order 13514, “Federal Agency Climate Change Adaptation Planning”, Support Document, March 4, 2011.

the timeframe and rate at which impacts will be experienced. This can be done through updating the energy use and infrastructure asset baselines mentioned earlier. Capital improvement planning decisions are made over the long term and as better data and more certain projections become accepted, such as those for sea level rise, the County will develop more specific assumptions in relation to capital improvement planning decisions. Even though certain County and community-level GHG emissions data is unknown, and specific capital infrastructure vulnerabilities have not been entirely inventoried, the County will utilize the recommendations of the Green Initiatives Task Force, the new Climate Change Advisory Committee, and the strategies developed from the Southeast Regional Climate Compact, to develop a more robust response strategy incorporating the concepts of mitigation of GHG emissions, adaptation and resilience to climate change impacts based on the CEQ Guiding Principles.

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## Chapter: 16.0 Energy Conservation and Climate – Comment Responses

<b>Commenter: Chris Bergh, The Nature Conservancy</b> <b>Date Received: Email, Friday, March 04, 2011 9:04 AM</b>		
Section Number	County Comment	K&S Action
16.1	TNC: Add the language, “and sea levels much lower than today”	Agree, this language has been added or addressed in Section 16.1
16.1	TNC: Address comment regarding “Earth’s warming” language being a red herring	Addressed comment in 16.1 by eliminating first part of sentence and starting sentences with “Most climate scientists believe...”
16.1	TNC: Add language regarding greater variability and lower predictability of weather patterns.	Agree, language added to Section.
16.1	TNC: Change “presence” to “status”	Agree, language changed in Section 16.1.
16.1	TNC: Language revision to final paragraph of “Gaining understanding” versus “Gained understanding”.	Change made.
16.1	Add “c” to chlorofluorocarbons	Agree, spelling corrected.
16.2.1	TNC: Language change from “highest sources” to “largest contributors”	Change made.
16.2.2 (now 16.2.3)	TNC: add atmospheric and ocean and precipitation as adjectives relating to regional climate characteristic.	Change made.
16.2.3	Revise sentence as follows: “There are six GHGs regulated under the Kyoto Protocol.”	Agree, change made.

16.2.4	TNC: This last sentence sounds like the introduction to a new and important paragraph or section about vulnerability. It is important to flesh out what is meant by each of these terms (exposure, sensitivity, adaptive capacity) and to point out the ways in which Monroe Co is vulnerable, or not, in general terms.	Agree, changes made to better define terms.
16.3	TNC: qualify impacts of climate change as “accelerating”	Agree, change made.
16.3.1	TNC: move phrase, “ building upon the energy requirements in the Florida Building Code by”	Agree, change made.
16.3.1	Suggested clarifications regarding building code.	Agree, changes made.
16.3.2	TNC: “It would be useful to insert a statement about the BOCC creation of a new Climate Change Advisory Committee and that group’s mandate. It would be useful to insert a statement about Mo. Co.’ formal participation in the SE FL Climate Compact with Miami-Dade, Broward and Palm Beach Counties and that group’s mandate.”	Both changes addressed with additional language.
16.4.1	TNC: change “as” to “are”	Agree, change made.
16.4.3	“Monroe County does not have TODs, TRDs. We have a height limit of 35 feet.”	Somewhat agree, clarified that TODs and TRDs have been used in other communities. Did not address height comment because discussion is broader regarding land use changes and impacts to energy use.
16.4.5	Refer to the Solid Waste element.	Agree, added, “as outlined in the Solid Waste Element.”
16.5	TNC: comment modifying thermal expansion, “This is pretty high tech. An explanation is warranted.”	Agree, added footnote defining term.
16.5	TNC: comment “The Keys are more likely to respond to CC like the Caribbean Basin as opposed to the SE USA. Predictions for the Caribbean are for dryer conditions than present. If you need and can’t find citation for this let me know and I’ll dig it up.”	Agree, added following sentence after comment: “Areas of lesser precipitation with struggle with meeting water demands and habitat shifts.”
16.4.3	“Monroe County does not have TODs, TRDs. We have a height limit of 35 feet.”	Somewhat agree, clarified that TODs and TRDs have been used in other communities. Did not address height comment because discussion is broader regarding land use changes and impacts to energy use.
16.4.5	Refer to the Solid Waste element.	Agree, added, “as outlined in the Solid Waste Element.”

16.5	TNC: comment modifying thermal expansion, "This is pretty high tech. An explanation is warranted."	Agree, added footnote defining term.
16.5	TNC Comment: "The Keys are more likely to respond to CC like the Caribbean Basin as opposed to the SE USA. Predictions for the Caribbean are for dryer conditions than present. If you need and can't find citation for this let me know and I'll dig it up."	Agree, added following sentence after comment: "Areas of lesser precipitation with struggle with meeting water demands and habitat shifts."
16.5.1	TNC comment on paragraph: "This paragraph switches back and forth between global and local SLR. If this last statement is about global average SLR that should be made more clear."	Agree, reorganized paragraph and clarified sentence, " On average, globally, the sea level has risen by approximately 200 mm (8 inches) during the past century (IPCC, 2007)."
16.5.1	TNC comment on Mozumder citation: "These social scientists were citing a biophysical science publication by someone else. It would be worth citing that here instead of them."	Agree, changed reference IPCC 2007.
16.5.1	TNC comment: add language "about future rates of sea level rise" modifying publications and report.	Agree change made.
16.5.1	TNC comment: "The bullets below do not all relate to the reliability of the publications and reports. They relate to the conservative nature of the predictions of future SLR."	Agree, revised language as follows: "Sea level rise data is generally considered to be a conservative estimate of the impacts for the following reasons" & incorporated suggested language into last bullet.
Table 16.2	TNC comment: modifications to copied table from publication.	New table used at County request, comment no longer relevant.
16.5.2	TNC comments: various language changes to Impacts on property loss section.	Agree, all changes accepted.
16.5.3	TNC comments: various language changes to Impacts on habitat section	Agree, all changes accepted.
16.5.3	Capitalize publication title and define or spell out hectares-ha.	Agree, changes made.
16.5.4	TNC comment: change International to Intergovernmental.	Agree, change made.
16.5.4	TNC comment: "Please review "Disturbance and the rising tide..." by Ross et al. and consider summarizing the discussion about the interactions between SLR and storm surges in this area. This relationship is really important identifying "tipping points" for natural areas, native species and even the built environment and human communities. I'll attach the document to my email with this modified draft."	Agree, reviewed document and incorporated summary of concepts commented upon.
16.5.5	Add "rate" in paragraph.	Agree, change made.

16.5.6.1 (new Section 16.6.1)	Spell out Senate Bill.	Agree, change made.
16.5.6.2 (new Section 16.6.2)	Superscript greenhouse gas abbreviations.	Agree, change made.
16.5.6.4 (new Section 16.6.4)	TNC comments: language changes in section, eliminate streams reference, spell out TMDL reference.	All changes made.
16.5.6.5	“Not sure if this goes in this section or in Water Quality above, but the need to deal with the disposition of the existing landfills (4), informal/illegal/abandoned dump sites (many), and other sources of pollution that will be mobilized into the environment by SLR needs to be highlighted.”	Landfills, etc. dealt with in later in another Section 16.6.5.
16.5.6.6	TNC comment: “I would like to suggest that this document should embrace the idea of “green infrastructure” as co-equal with the traditional “built environment” infrastructure that this paragraph is focused on. The Keys’ reefs, natural beaches, coastal berms, wetlands and other natural communities are just as important for protecting people and the built environment from the negative consequences of climate change as seawalls, stormwater drains and so forth, but they provide their services to people at no cost. Rather, the cost is minimal and it involves good stewardship of nature (e.g. preventing and controlling exotic species invasions, maintaining fire regimes, restoring wetlands, etc.). This idea, that if people make our natural systems more resilient to climate change impacts they in turn will help make us more resilient to the same impacts, is more fully explored in the recommendations found in my 2009 report on SLR impacts on the Keys which is cited in this document as well as the Ross et al. paper that I will attach with this draft. The latest term of art for this “nature helping people” concept is Ecosystem Based Adaptation (EBA).”	Researched and added “green infrastructure” see new draft Section 16.6.6
16.5.6.6	TNC comment: “This sentence is weird. I think it’s because the last group of ideas relates to the diversity mentioned at the beginning, not impacts mentioned in the middle.”	Agree, paragraph reorganized now see Section 16.7.1.2
16.5.6.6 (new Section 16.7.1.3)	TNC comment: additional language suggested regarding shoreline armoring, wetlands, etc.	Agree language added.

<b>Commenter: Mayte Santemaria</b> <b>Date Received: 3-30-11</b>		
<b>Section Number</b>	<b>County Comment</b>	<b>K&amp;S Action</b>
<b>Commenter: Last Stand</b> <b>Date Received: June 27, 2011</b>		
16.4.1	Next to last sentence: change "as" to "are".	Agree. Revised.
16.4.2	Use superscript for N <sub>2</sub> O.	Agree. Revised.
16.5	Delete "But" from 3 <sup>rd</sup> sentence.	Agree. Deleted.
16.6.1	Rearrange second sentence to begin "The County's wellfields..."	Agree. Revised.
16.6.2	Use superscripts.	Agree. Revised.
16.6.3	Second sentence: Revise "Because" to "Since".	Agree. Revised.
16.6.4	Spell out "TMDL".	Deleted, replaced with "water quality".
16.5.6.6 (new 16.7.5)	This section has been rewritten.	Changes have been incorporated into new section.
<b>Commenter: Chris Bergh, The Nature Conservancy</b> <b>Date Received: Email, Monday, June 27, 2011</b>		
<b>Section Number</b>	<b>County Comment</b>	<b>K&amp;S Action</b>
	<ol style="list-style-type: none"> <li>1. Add overview of Adaptation Action Areas</li> <li>2. Propose that the Sea Level Rise Vulnerability Analysis mapping completed by Monroe County for the Four County Compact Steering Committee in February be added to the Map Atlas.</li> </ol>	<p>Agree. Have revised to reflect suggestion. The 2030 data by the committee reflects a 3-7" rise (see Figures 16.1 &amp; 16.2 in the Technical Document). The reference maps reflects rise by the foot, not inches. There is currently no mapping available from the County to reflect the 3-7" rise. No change to map atlas at this time.</p>

**Committer: Last Stand**  
**Date Received: June 27, 2011**

<b>Section Number</b>	<b>County Comment</b>	<b>K&amp;S Action</b>
	Last Stand is pleased to see that the Comprehensive Plan update proposes a new element focusing on energy conservation and climate change.	