


FLORIDA'S HANDBOOK FOR MUNICIPAL ACTION ON CLIMATE ACTION

UF | IFAS Extension
UNIVERSITY of FLORIDA

CLIMATE SMART FLORIDA

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Climate Smart Florida: Climate and Sea Level Rise Work Action Group

This group of contributors is part of the UF/IFAS Florida Sea Grant Extension Program's Work Action Groups (WAGs). These groups strategically plan and coordinate regional and statewide Extension programs, which often begin as local initiatives. This collaborative approach has strengthened the UF/IFAS Florida Sea Grant Extension program, benefited coastal communities throughout the state, and made Florida Sea Grant the strongest Sea Grant Extension program in the country. There are WAGs for Aquaculture, Sustainable Marine Fisheries, Shorelines, Estuaries and Aquatic Systems, and Climate Smart Florida: Climate and Sea Level Rise. This handbook was put together by the Climate Smart Florida: Climate and Sea Level Rise Work Action Group. The goal of this WAG is to provide information on climate impacts and solutions to various stakeholders (e.g. residents, local governments, businesses, and youth) in a variety of formats. To find out more about the work of the Climate Smart Florida WAG, please visit our Sea Grant webpage.

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Introduction

A changing climate presents a threat to the entire globe. Extreme heat temperatures, rising sea levels, warming oceans, less predictable precipitation events, intensified storm events – these are the impacts of changed climate that are expected to occur in the state of Florida by the end of the century. While some of these impacts are not immediately endangering Florida communities, there are some that occur today – sunny-day flooding, changing precipitation, high temperature records, etc. Whether impacts are occurring now or in the future, it is known they will affect every community's or individual's way of life in this state – directly or indirectly. A changing climate means changes to the physical, social, and economic elements of a community. The exact changes will vary between local communities, but all communities will experience changes. In this way, the global threat is also a local one. So, each community will have to address the issue of climate change, and local governments provide an effective way of doing so.

Visit **Barometer Florida** to review the current state of climate change in Florida's communities. The data reviews both the climate impacts and the extent of climate preparedness in each of the state's regions.

Purpose of this Handbook

This handbook was produced by Climate Smart Florida: Climate and Sea Level Rise Work Action Group in recognition of the threat of climate change to Florida and the importance of local government action for reducing and preparing for it. Today, local climate action is occurring or beginning to occur throughout the state in some form. However, only a few communities in Florida have been truly successful. Scientific projections indicate that *now* is the time for action. The purpose of this handbook is to encourage more communities, especially those with few resource capacities, to implement climate mitigation and adaptation strategies. These will reduce and prepare for climate change. With this handbook, we hope you become more knowledgeable in climate change and find ways to overcome barriers preventing your community from moving forward with climate action. We would like you to note that this handbook is only one of the many resources that our group can provide to you for climate solutions. To find out more about these resources or to provide feedback on this handbook, please visit our website or contact one of the group members indicated on the 'About' page.

The Layout of the Handbook

The handbook is split in two chapters, as described below.

Chapter 1 "Climate Change: What is it, what should Florida expect, and what can be done?" serves mainly as an introductory primer to the subjects of climate change and climate actions. It is broken into three sections that review basic climate science, expected climate change impacts for Florida, and the importance of government in leading local climate action. While we hope you review these sections, they are not entirely necessary to achieving the purpose of this handbook.

Chapter 2 "Preparing for a Changing Climate at the Local Level: Steps, Strategies, and Methods" is where the bulk of information regarding climate action lies. The chapter provides the steps for creating

and implementing climate strategies as well as methods to do so effectively. Along with this, case studies of local government in Florida are provided alongside the chapter's content to show real-life applications. There are seven sections that each build upon each other and align to the steps identified in the chapter's introduction. While it may suit you to review each section as needed, we recommend going through each one.

Each section is set up in a similar manner with the following elements:

- **Chapter Introductory Page:** This page(s) is found before the first section of each chapter. It provides an overview of the content in the chapter as well as a list of each section and their goal that is linked to quickly jump to that section.
- **Goal and Learning Objectives Sidebar:** On the right side of each section's first page, there is a sidebar that list the goal and learning objectives of each section. This can provide you expectations of the content you will learn about in that section.
- **Introduction Textbox:** On the first page of each section is an introduction textbox that will provide context and basic priming information before you read the section's content.
- **Checklist of Actions:** At the end of each section there is a checklist of actions. These actions are ones we hope you follow to apply the knowledge you learned in the section and begin taking real steps towards climate preparedness.
- **References List:** The references are indicated by superscript numbers throughout each section. At the end, there is a reference list to correlate to these numbers.
- **Additional Resources List:** While our content is thorough, there are many resources available for learning additional information regarding the sections content. This list provides these types of resources as well as others that can aid you in your climate efforts. Most of the resources provided are accessible online.
- **Contact Information for UF/IFAS Experts Textbox:** At the very end of each section, there is a textbox with contact information for experts that can provide more information on the subject at hand or answer any questions you have regarding it.

Chapter 1 – Climate Change: What is it, what should Florida expect, and what can be done?

Whether your community is rural or urban, inland or coastal, small or large, climate change will impact your community directly or indirectly. Before you can take actions to prepare or prevent climate change, you will need to know its causes, projected changes, and the nuance solutions for overcoming it. Understanding the basics of climate change will help you see the complexity of the issue and find solutions that best fit the needs of your community. In this chapter, you will learn about the basics of climate change, specific impacts on Florida, and the role of government for creating solutions. Please note that these sections serve as brief primers to understanding climate change. Additional resources and contact information to experts are provided in each section if you want to learn more about specific scientific processes, climate effects, or climate actions.

Section 1.1 Understanding Climate Science	Goal: To learn and understand general climate science concepts and terminology.
Section 1.2 The Impacts of Climate Change on Florida	Goal: To learn the main physical, social, and economic impacts of a changing climate for Florida.
Section 1.3 Solutions and the Role of Government	Goal: To learn the types of climate solutions available and the role of government in responding to climate change.

SECTION 1.1 UNDERSTANDING CLIMATE SCIENCE

It is crucial that local government staff and employees know and understand the scientific principals behind climate change because it gives context to the issues of climate change. By understanding climate science, you will see the complexity of climate change, and thus, the difficulty of finding a solution for it. This section reviews essential climate science information that you should know if you are tasked with finding climate solutions. However, please note that climate change involves more complex scientific processes and impacts than those just presented in these pages. To find out more information, visit "Additional Resources" at the end of this section.

GOAL AND LEARNING OBJECTIVES

GOAL:
To learn and understand climate science concepts and terminology.

LEARNING OBJECTIVES:
By the end of the section, you will be able to:

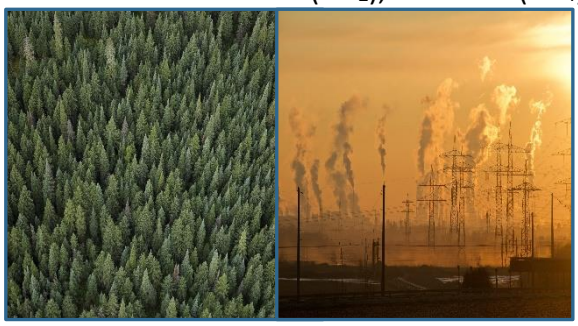
- Distinguish between weather and climate.
- Identify greenhouse gases and their sources and sinks.
- Explain the greenhouse effect and its pivotal role in a changing climate.
- Define climate change.
- Describe how scientists attribute today's climate change to human actions.
- Communicate the importance and uses of climate models.

Weather v. Climate

Although people use them interchangeably, weather and climate are different. Generally, weather refers to day-to-day conditions of the atmosphere in a localized area that can change often.[1] Examples of weather include rain, snow, clouds, winds, or heat waves.[2] On the other hand, climate is best described as weather averaged over long periods of time (e.g. several seasons, years, or decades).[1] It tends to vary less for the same location, but can be measured at different times, seasonal to annual, and spatial scales, regional to global.[3] An analogy for this difference is that weather is like a person's mood - it can change day to day; whereas, climate is like a person's personality - it is rather constant, slowly evolves over time, and is impacted by significant changes.

The Role of Greenhouse Gases and the Greenhouse Effect on the Climate

The global climate is affected by a multitude of factors including greenhouse gases. As a component of Earth's atmosphere, greenhouse gases (GHGs) are those that trap heat from the sun within atmosphere.[3] In this way, they contribute to the greenhouse effect. Common natural GHGs include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), ozone (O_3), and water vapor. Human activities can produce other powerful and enduring GHGs like hydrofluorocarbons (HFCs).[4] These GHGs are added to the atmosphere by sources and removed from it by sinks.[3] Sources and sinks can be natural, like the processes used in forests, grasslands, and wetland ecosystems to release or capture carbon.[4] Or, they can be related to human activities, such as burning fossil fuels, agricultural production, or waste treatment.[3]



A Carbon Dioxide Sink v. A Carbon Dioxide Source

GHGs vary in atmospheric concentration due to the amount emitted from its sources or trapped in its sinks. With the highest emissions of GHGs, CO_2 is highly concentrated in the atmosphere. For this reason, CO_2 is used as a baseline measurement for GHG emissions and their effects (i.e. warming).[3] Because GHGs are well mixed in the atmosphere, the atmospheric concentrations of these gases are approximately the same across the globe.[4] These gases also differ in the length of time that they remain in the atmosphere (a few years to thousands of years) and their ability to trap heat, which affects the extent of their warming or cooling impacts.

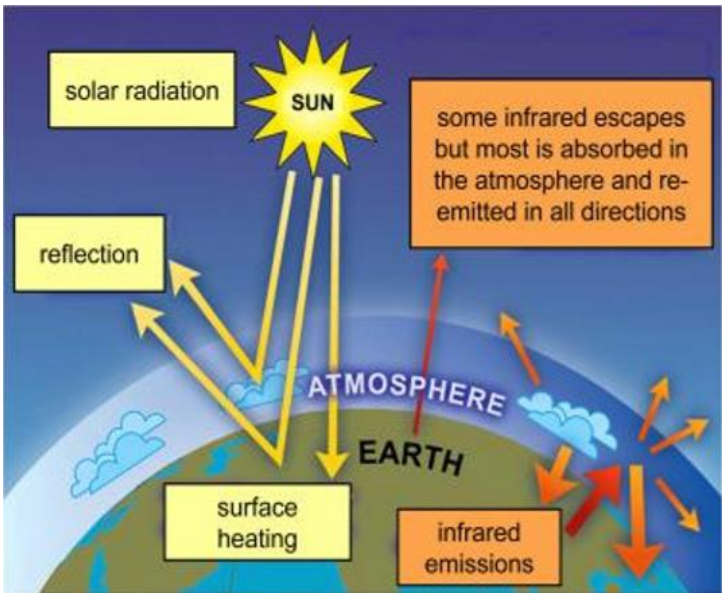


Figure 1. Diagram of the Greenhouse Effect. Source: Intergovernmental Panel on Climate Change Working Group 1 (2007)

As mentioned, these greenhouse gases are important for the occurrence of the greenhouse effect. Similar to a greenhouse, the process traps heat within the enclosed atmosphere to regulate the Earth's temperature. The greenhouse effect works as follows. The sun emits energy as radiation. This radiation is either reflected by the atmosphere or passes through it. Once it passes through the atmosphere, the radiation is reflected or absorbed by either the oceans or the land on the earth's surface. If it is absorbed, it warms the earth's surface. As the surface warms, it releases heat as infrared radiation. Some of the infrared radiation is lost to space, but some of it is absorbed by GHG molecules that reemit it back to the surface. By doing this, the heat becomes trapped in the lower atmosphere through a back-and-forth process of absorption and reemission where it eventually passes the atmosphere. Through this process, GHGs become an essential atmospheric component for keeping the Earth inhabitable.[3] Figure 1 above shows a visual of the greenhouse effect process.

The extent that Earth's climate warms depends on various feedback mechanisms, *or processes that either dampen or amplify the response of the climate.* These feedback mechanisms are driven by climate forcings, or the initial causes of changes to the climate. GHG emissions is only one example of an external climate forcing as it leads to varying atmospheric concentrations. These concentrations can change the amount of radiation absorbed or reflected, and in turn, the heat trapped during the greenhouse effect.[1] In this way, too much or too little GHGs can lead to large changes in Earth's temperature regulation as well as its climate.

What is Climate Change and How Do We Know it is Happening?

Often, people associate a changing climate with global warming. Global warming is the long-term increase of Earth's annual surface temperature.[5] While it is an important aspect of climate change, it is only one. To describe the variations in complex climate processes, the term "climate change" is better because it includes the range of changes (e.g. warming, melting glaciers, changing patterns of extreme events, etc.) and their effects. Note, climate change refers to long-term, persistent trends of variability.[1]

Scientists have identified a few different indicators that the climate is changing today. One of the main ones is global warming. Since 1880, the worldwide average surface temperature has risen about 1 °C (about 2 °F).[2]

Other indicators of climate change include, but are not limited to, shrinking ice sheets, global sea-level rise, ocean acidification, increases in atmospheric humidity, and increases in extreme weather events.[5] Figure 2 below shows some of these climate change indicators.

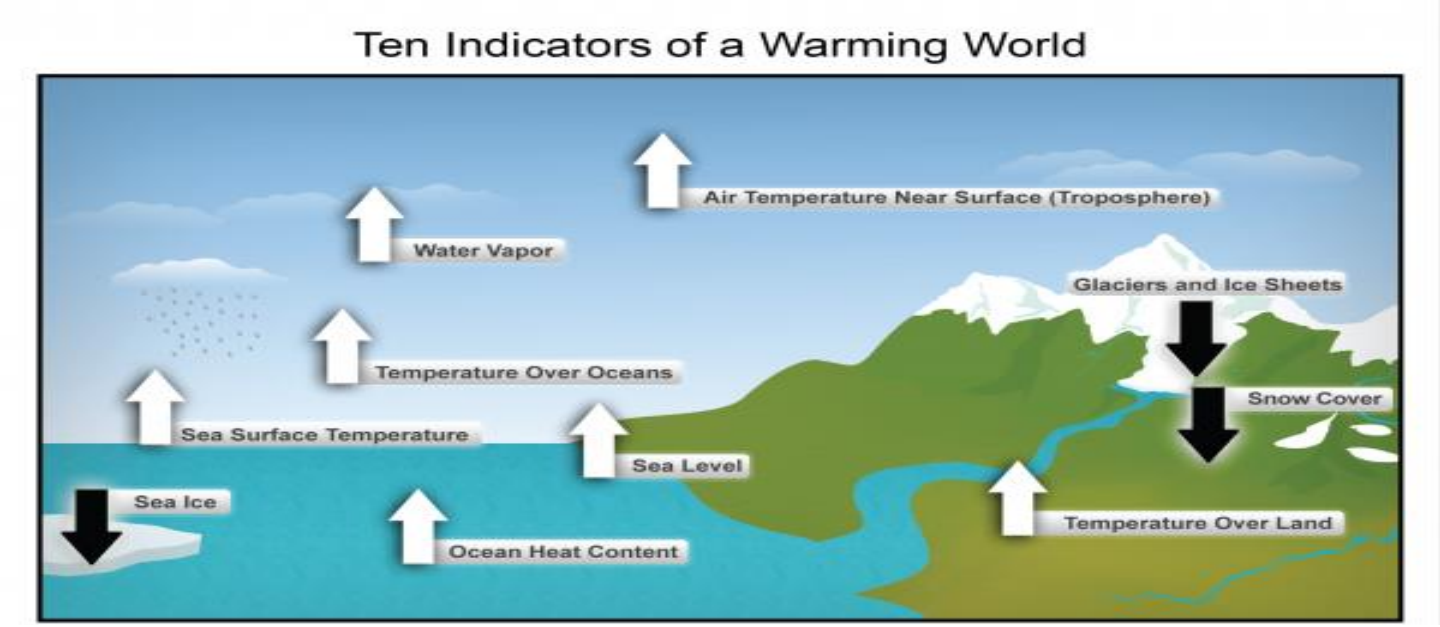


Figure 2. Climate Change Indicators. Source: Climate Change Impacts in the United States: The Third National Climate Assessment (2014)

Human Influences of Climate Change

There are both natural and anthropogenic influences on the climate. Scientists attribute human activities as the dominant cause of the increased rate of climate change observed since the 1950s.[5] Scientists have eliminated other causes, like earth's orbit or changes in the sun's energy output, because of the time scale of changes in the climate and the sparse evidence that these pathways have been altered significantly.[5] Figure 3 shows that there have been no net increases in solar energy since the 1950s, while temperature has continued to rise. Figure 4 provides further evidence of human drivers as the dominant cause of a changing climate. Based on climate models, the figure shows that without human influence, the temperature would have cooled over the past century. Since this is not the observed case with the average temperature, scientists have attributed human activities as the main influence.

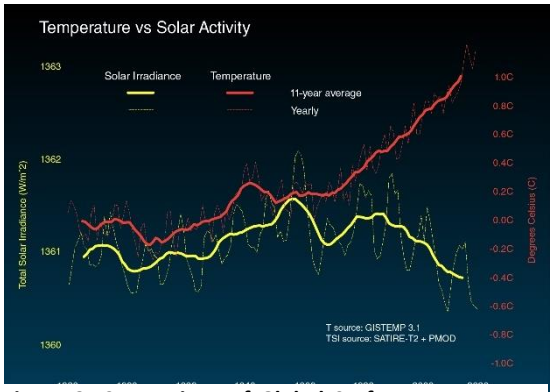


Figure 3. Comparison of Global Surface Temperature Changes and Changes in Solar Activity (watts per square meter) since 1880. Source: NASA/JPL-Caltech

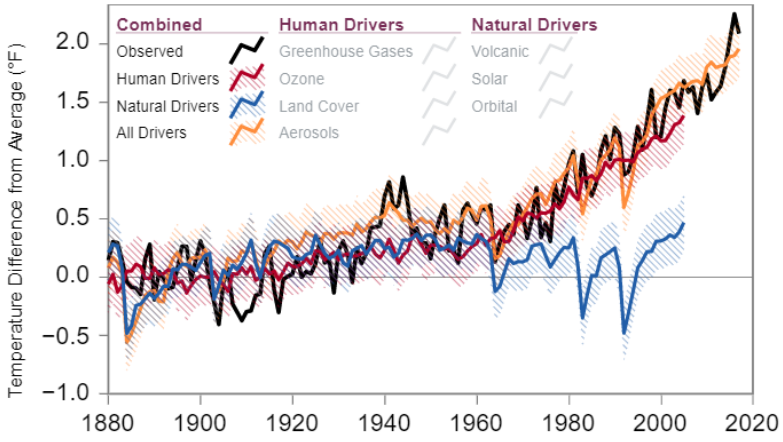


Figure 4. Human and Natural Influences on Global Temperature. Source: NASA GISS

When talking about human influence, scientists are mainly concerned with greenhouse gas emissions. Since the industrial revolution, GHG concentrations have increased much higher than any levels observed over the past 800,000 years.[5] Evidence shows that carbon dioxide concentrations have rapidly increased from 270 parts per million prior to the industrial revolution to 412 parts per million in 2020.[2] So, this brings up the question: What caused this rapid increase? Remember, there are many natural and anthropogenic sources and sinks for GHGs. However, human activities have become a large source of GHG emissions through agricultural production, land use changes (e.g. deforestation and urbanization), and fossil fuel production – which has increased since the industrial revolution. These activities have also altered and demolished ecosystems that are great at *sequestering*, or removing, GHGs. Because of this, scientists have linked anthropogenic emissions rates to increasing GHG concentrations over the last two centuries. This has been verified through computer simulations based on historically observed data. These simulations showed that the only way to reproduce the past historical observed warming is by including human activity.[5] Therefore, there is a consensus among scientists that human activities are likely the dominant factor for a rapidly changing climate.

Climate Models

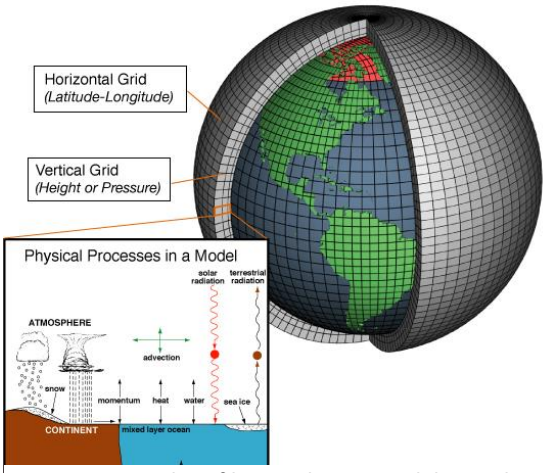


Figure 5. Graphic of how a climate model is made.
Source: NOAA

Climate models are those that recreate the real-world climate to predict future changes to the climate. These models are created from mathematical equations representing the complex processes affecting Earth's climate system.[5] Models vary by scale and what they simulate. They are validated through "hind-casting", where the model is ran backwards and compared to past climate conditions.[5] Despite these tests of validity, climate models still have *uncertainty* related to their reliance on predicting future human emission choices, natural variability events, and limited knowledge on some climate processes.[5] Nevertheless, they are reliable because they provide accurate information on basic trends and major effects that can be expected with a changing climate, and computer models are becoming more accurate as technology expands.[3]

Once these climate models are validated, they are administered under various scenarios to produce climate projections. These scenarios are sets of assumptions about future emission rates, population growth, land use, socioeconomic circumstances, and atmospheric conditions.[6] The climate change projections that come out of these varying scales of models can be useful to countries, states, and local communities in planning and preparing for the impacts of climate change.

CHECKLIST OF ACTIONS

- ☐ Encourage your colleagues to get educated on climate science. UF/IFAS Extension has online and in-person workshops designed to give staff and stakeholders information on the basics of climate science. See the "Additional Resources" section if you are interested in this.
- ☐ Stay up to date on the latest climate science. Check out websites, such as those listed in "Additional Resources", and newsletters for new climate information, as new reports and science come out yearly or every few years.

References

[1] Climate Smart Floridians. "Section One: Climate Change". https://drive.google.com/file/d/1oT8UcqVKPOYmDFqEhwdJF4waQlRSZT7X/view?usp=sharing

[2] National Aeronautics and Space Administration. "Climate Frequently Asked Questions". https://climate.nasa.gov/faq/.

[3] Climate Change and Florida: Frequently Asked Questions. https://edis.ifas.ufl.edu/ss682 .

[4] Environmental Protection Agency. "Greenhouse Gas Emissions". https://www.epa.gov/ghgemissions.

[5] Fourth National Climate Assessment. "Appendix: Frequently Asked Questions". https://nca2018.globalchange.gov/chapter/appendix-5/.

[6] National Oceanic and Atmospheric Administration. "Climate Models". https://www.climate.gov/maps-data/primer/climate-models.

Additional Resources

"Chapter 2: Our Changing Climate" - Fourth National Climate Assessment (NCA). *This assessment was created by United States departments and researchers. This chapter reviews similar information to what was in this section but goes more in-depth.*

"Climate Change and Florida: Frequently Asked Questions" - *This UF/IFAS document answers some common questions asked by people during workshops, including those related to basic climate science.*

Climate Resources - National Oceanic and Atmospheric Administration (NOAA). *This website includes articles and reports from climate scientists about the causes and impacts of climate change.*

"Florida Climate Outlook: Assessing Physical and Economic Impacts through 2040" – Resources for the Future. *This report provides basic information on recent climate change trends in Florida, along with projections for the next 20 years.*

Glossary of Climate Change Terms - Environmental Protection Agency (EPA). *This glossary reviews other common terms that are often mentioned with basic climate science.*

Interactive Climate Time - National Aeronautics and Space Administration (NASA). *This interactive activity shows various key indicators of climate change and how they have changed over the past few centuries.*

Intergovernmental Panel on Climate Change (IPCC) Website. *This website is for the international group of scientists who are assessing new climate research and providing them to policymakers and the general public in comprehensive reports.*

"Section One: Climate Change" - Climate Smart Floridians. (ADD LINK). *As part of a UF/IFAS training on climate change for residents of Florida, this section reviews the basics of climate change.*

For questions about this section's content or to learn more information, please contact:
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SECTION 1.2 THE IMPACTS OF CLIMATE CHANGE ON FLORIDA

Local communities in Florida will experience varying types, extents, and timings of these changes. For example, coastal communities in South Florida are already affected by changes in sea levels, whereas, inland communities are not expected to experience these impacts for a few more decades. So, some communities are more at risk than others to certain changes based on location, population (urban v. rural), and socioeconomic circumstances. Nonetheless, all Florida communities will experience physical, social, and economic impacts from changes to the climate. These impacts are exacerbated by human activities and population growth as communities extend and increase the capacity of their built environment into the natural one. This section will review the projected changes to Florida's climate as well as the main impacts and consequences of changes to Florida communities. Understanding these impacts is an important step for determining the vulnerability your community faces and actions to become resilient.

GOAL AND LEARNING OBJECTIVES

GOAL:

To learn the main physical, social, and economic impacts for Florida from a changing climate.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Apply your knowledge of climate projections for Florida to actions for their community.
- Identify the expected physical impacts of climate change on your community's ecosystem services and natural resources.
- Identify the expected social impacts of climate change on your infrastructure, socioeconomic opportunities, and population's health.
- Identify the expected economic impacts of climate change on your community's properties and main sources of economic revenue.

Climate Change Projections for Florida

There are general projections of the way climate will change globally, like sea-level rise, glacial melting, and extreme weather. Some of these changes will not be experienced at the same rate all over the world, which means regions and local communities can expect different outcomes. However, it is difficult to downsize climate models to create these projections for a state like Florida because of its narrowness and closeness to the ocean.[1] So, they are often based on observed historical data trends. Some of the projected changes to Florida's climate include:

INCREASED TEMPERATURES, EXTREME HEAT, & DROUGHTS

Since the beginning of the 20th century, temperatures in Florida have increased by about 1°F.[2] This has been seen with rising frequency of very warm nights over the last two decades.[2] Projections in Figure 1 show higher increases in temperature changes for Florida under both high and low emission scenarios.[2] Even under scenarios of lower emissions, average annual temperatures are expected to exceed historical levels by 2050.[2] This temperature increase combined with high humidity in Florida will impact Florida's economic industries, like tourism

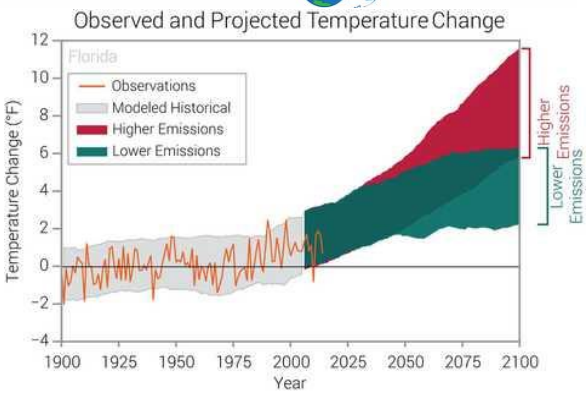
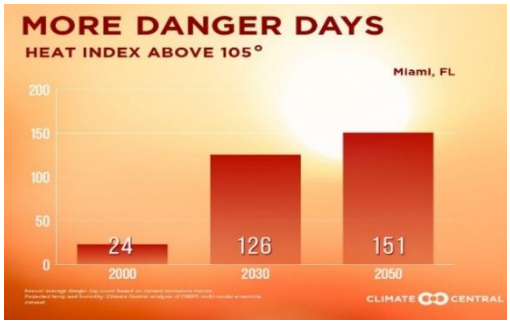


Figure 1. Observed and Projected Temperature Change. Source: CICS-NC and NOAA NCEI (2017)

and agriculture, as well as increase human health vulnerability. Projections also indicate increases in extreme heat events such as more than 50 days a year with temperatures exceeding 95°F by 2055 as well as an increase in the summer heat index by 8°F to 15°F, the largest in the nation.[2] Figure 2 shows the projections for the number of days that Miami will experience extreme heat events. Along with this, projections show increased intensity of natural droughts, especially as water evaporates more quickly from the increased heat events.[3] These droughts are likely to lead to more frequent wildfire events.[2]

SEA LEVEL RISE AND INCREASED TIDAL FLOODING EVENTS

Figure 2. Projected Changes in the Number of Extreme Heat Days in Miami, FL. Source: Climate Central



As temperatures rise and land ice melts, global sea levels have risen by about 8 inches since 1880.[2] In Florida, it is expected to rise by another 1 to 4 feet by 2100.[2] As a low-lying, peninsular state surrounded by the Gulf of Mexico and the Atlantic Ocean, Florida's coastline makes it vulnerable to sea level rise. In particular, South Florida is projected to have increases between 6-10 inches by 2030 and 14-26 inches by 2060 (Figure 3).[4] Increased sea levels can impact community infrastructure, ecosystem shorelines, and lead to more frequent tidal floods. Tidal flood days, especially, have increased in Florida and cause nuisance impacts like road closures and saltwater intrusion in groundwater supplies.[2] Some climate models project tidal flooding almost every day in Florida communities by the end of the century.[2]

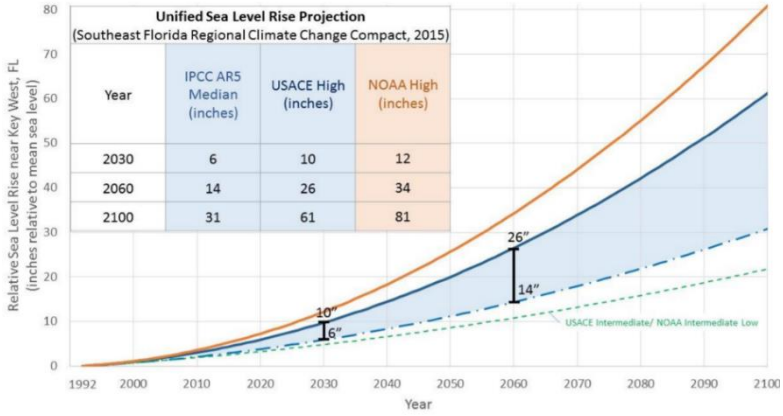


Figure 3. Unified Sea Level Rise Projections for Southeast Florida. Source: Southeast Florida Regional Climate Change Compact (2015)

OCEAN WARMING

Since 1998, all ocean basins have experienced significant warming, which is partly due to oceans being a major absorber of heat from the GHG effect.[5] This warming is melting glaciers leading to the sea level rise mentioned above. Moreover, this warming affects the marine life in these areas. For example, warming oceans are stressing corals – even killing them. In this way, it is destroying ecosystems.

CHANGES IN PRECIPITATION AND INLAND FLOODING

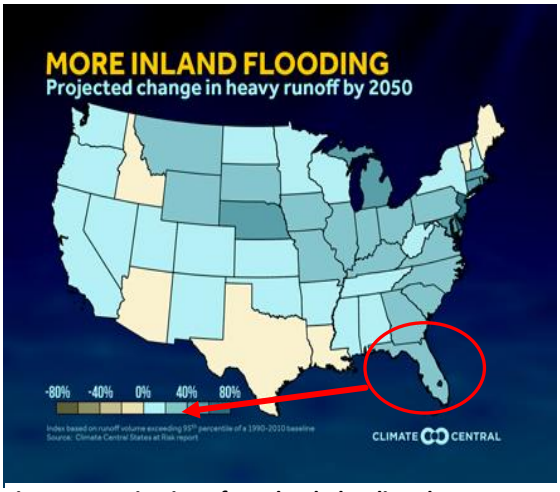


Figure 5. Projections for Inland Flooding due to Heavy Rainfall Runoff by 2050. Source: Climate Central

In the past decade, extreme precipitation events, those greater than 4 inches, have been variable and precipitation has been below average.[2] However, because precipitation is related to a number of climatic factors, it makes it difficult to project the future average precipitation amounts for the state of Florida.[2] Although, some projections indicate that there will be increases in the intensity of rainfall and the days with extreme precipitation events.[1,2] More intense rainfall may exacerbate the tidal floods from sea level rise as well as inland floods with heavy runoff and poor stormwater management (Figure 5). Located in the tropical zone, Florida experiences

CHANGES IN EXTREME WEATHER AND STORM THREATS

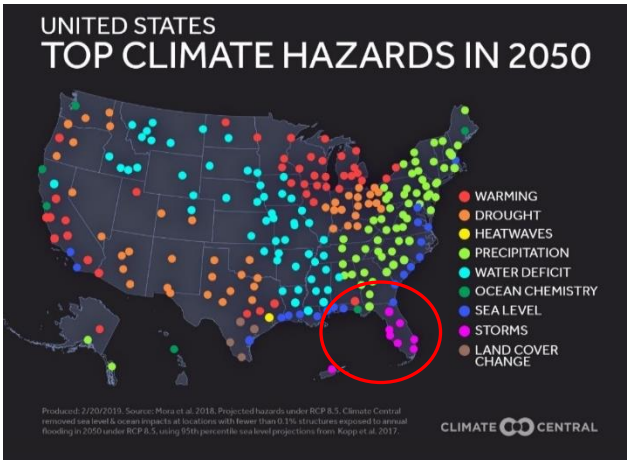


Figure 6. Climate Hazards for 2050. Source: Climate Central

extreme weather threats, like hurricanes and intense coastal storms. Figure 6 shows that the majority of Florida will be threatened by tropical storms. Although there is little evidence that hurricane frequency will increase with climate change, there is accumulating evidence that these coastal storms will rapidly intensify – greater wind speeds and rainfalls. This is because they are expected to move more slowly as ocean water warms and the air is likely to increase in moisture. This is alarming as Florida has experienced 13 extreme weather events with $1 billion in damages over the past decade.[2]

The Impacts of Climate Change on Florida

PHYSICAL IMPACTS

Florida has a diverse range of ecosystems and natural resources that are unique to the numerous communities within it. Right now, you could probably name some important natural features that your community is reliant on for ecosystem services (e.g. regulation of water quality and quantity, providing wildlife habitat, producing raw materials, and creating recreational opportunities). These key natural systems have become threatened by the consequences of climate change.




Source: Florida Sea Grant

COASTAL ECOSYSTEMS

- **Flooding and Saltwater Intrusion:** Coastal ecosystems are highly vulnerable to flooding and saltwater intrusion due to storm surge and sea level rise.[6] This flooding and increased salinity could lead to wildlife and human migration, salt-tolerant coastal ecosystems moving further inland, and damaging impacts to estuarine systems where sea water and freshwater are supposed to be balanced.[6] In other words, this will lead to ecological transformations of the ecosystems, changing not only the natural resources available to these areas but also the way coastal communities function.
- **Beach Impacts:** With tropical storm and hurricane intensity increases and rises in sea levels, beaches are highly prone to moving sands that will destabilize shorelines.[7] This will affect the plants, wildlife, and humans who are reliant on it as a habitat or for other recreational purposes, especially exposing land to the effects of sea level rise.
- **Coral Reefs Impacts:** As another example, coral reefs have begun dying off, especially in the Florida Keys, over the last few decades and are expected to worsen as the climate warms. Mainly due to the rising ocean temperature and ocean acidification, the algal organisms that provide coral food have become stressed and harmed.[8] Once stressed, the corals turn white, or 'bleached', from the lack of nutrients and this makes it difficult for the dependent marine organisms to continue to live in the environment.[8]



Source: UF/IFAS File Photo

INLAND ECOSYSTEMS IMPACTS

- **Precipitation and Droughts:** Changes to precipitation and drought events can lead to changes in the seasonality of wildfires as well as stress current wildlife and plants who are not used to these differing periods of inundation and unable to tolerate the stress. This is particularly true in forested areas, where intense periods of drought is expected to increase wildfires as well as reduce the effectiveness of prescribed fires.[6]
- **Extreme Heat:** Similarly, the wildlife and plants of freshwater ecosystems will be endangered if they fail to adapt to changing temperature patterns, increases in intensity and frequency of storms, changes in inundation, and fire events.[9] This will change the way these forested areas grow and adapt.
- **Sea Level Rise:** Sea levels continue to threaten these areas because they will push human and wildlife inland. This will further pressure the existing inland ecosystems to support a higher number of organisms for which they may not have the capacity.[6] Along with this, many freshwater ecosystems that are along the coasts of Florida may experience saltwater intrusion as well. For example, the Everglades is highly susceptible to sea level rise and saltwater intrusion because it is less than three feet above sea level.[6] This will transform the ecosystem, lead to biodiversity loss, as well as change the hydrologic cycle of the region. In this way, there will be far reaching consequences.

WATER QUANTITY

- As the population of Florida grows, so does the demand for water. The availability of freshwater will be questionable as it is consumed at a rate faster than it supplied. Unfortunately, changes to the timing and intensity of precipitation and drought events make it difficult to recharge groundwater and ecosystems.[10] This further threatens the availability of water resources.


Source: FL Sea Grant

WATER QUALITY

- Changes to the intensity of precipitation events will impact the connectivity between waterways and increase pollution concentrations found in them.[6] Moreover, recent research indicates that toxic microorganisms, like algae, are likely to form more intense and frequent blooms during periods of warmer temperatures and more intense rainfall or extreme weather events.[10] The toxicity of these species can make water supplies and ecosystems more potent for human or wildlife use. Along with this, sea level rise can lead to saltwater intrusion that infiltrates drinking water supplies of coastal communities.[6]

PLANT AND WILDLIFE RELATED SERVICES

Source: UF/IFAS File Photo

- The distribution and abundance of plant and wildlife species creates many opportunities for nearby communities, such as recreational hunting or bird watching and providing raw materials. However, wildlife and plants are vulnerable to the consequences of climate change, like temperature extremes, warming waters, and changing timings and intensities of drought, rainfall, and seasonal fire events.[9] These changes affect the species' habitats by destroying critical plant species and forcing ecosystems to transform.[9] Because of this, species are forced to leave or adapt, which can mean shifts in their distributions, life cycles, and interactions. Today, there are observed northward movements of tropical and subtropical plant and animal species.[6] Due to this, associated recreational and economic activities are expected to redistribute across the state and temperate northern species become threatened. These movements and adaptations also apply to invasive species, like the Burmese python and the Brazilian pepper tree, which are predicted to change their ranges, invade disturbed ecosystems, and come in from new areas.[6]

SOCIAL IMPACTS

The impacts of climate change on the natural environment extend into the built human environment. As impacts to society worsen, the characteristics of a community will be reshaped, and internal equities will be created or exacerbated. These impacts will be different based on the characteristics of the community, such as urban v. rural, inland v. coastal, and socioeconomic statuses. Those living in rural communities are more vulnerable to the changing climate because of the general demographics and occupations of these areas.[6] Urban communities in Florida are also at high risk, especially those along the coasts.

CLIMATE DISPLACEMENT

- As Florida's coastal communities experience more flooding and storm events, those in low-lying, flood-prone areas are expected to move towards higher ground areas or inland communities.[6] One report indicates that about 6 million people in Florida will be forced to adapt or leave their homes due to sea level rise projections by the end of the century.[11] This "climate displacement" poses many issues. For one, climate gentrification becomes more prominent.[12] In many coastal communities, wealthy homebuyers tend to live in low-lying areas while those experiencing socioeconomic issues live on higher ground. However, as sea levels rise, real estate developers are investing in the higher ground areas, which increases the price of homes. This pushes out those unable to afford higher prices while bringing in wealthier residents. Neighborhoods in Miami, especially those of cultural significance, are experiencing this today.[12] Another problem with climate displacement is the preparedness of rural or inland communities for climate migrants. Some homeowners in the community may choose to leave altogether and move inland, where the risks of sea level rise are lower. It may be difficult for the inland communities to adjust to this movement if they do not start planning for future scenarios of climate migration.

LOSS OF CULTURE

Source: National Park Service

- With many historical communities of Florida being located on the coast, there is a high risk that cultural sites will be lost or damaged by sea level rise and other extreme events. The Southeastern United States is expected to lose over 13,000 recorded historic and prehistoric sites with a meter of sea level rise.[6] Along with this, the cultures and histories of people forced to migrate may be lost.

VULNERABLE INFRASTRUCTURE

- Much of the Southeastern United States has deteriorating infrastructure, including those for transportation (roads, railways, ports) and water management (stormwater, drinking water, and wastewater). This makes it vulnerable to climate change and climate-related events, like heat waves, rainfall events, and coastal flooding. Coastal areas in Florida are expected to experience more immediate threats, especially older historical cities that built their water management systems, roads, and bridges a few inches above the current mean higher high water (MHHW).[6] As sea levels rise, water management systems will have a higher potential to fail and increased maintenance costs. Roads and bridges that flood restrict resident and tourist's ability to travel.[6] Extreme heat and increased intensity of storm events can have a damaging effect on infrastructure. So, it is essential that communities find ways to improve the resiliency of infrastructure. However, these communities must remain aware of the socioeconomic implications of updating infrastructure and keep it affordable for low-income areas.

ACCESS TO WATER, ENERGY, AND FOOD

- Climate change will also affect people's access to clean freshwater, reliable energy, and nutritious foods. First off, the issue of freshwater quantity and quality is already one of importance as aquifers dry up and populations continue to grow. Climate change is expected to further this issue as the timing of recharge events becomes unpredictable, extreme heat increases water demand, and saltwater infiltrates potable water supplies for low-lying communities. Saltwater intrusion is already an issue for South Florida communities, where Broward and Miami-Dade Counties have lost freshwater drinking wells.[6] These effects will increase the competition for water among communities and exacerbate the supply from the natural environment.[4] Secondly, the availability of water is also connected to energy production. With the threat of more high heat and dry days, the generation of energy is at risk of becoming less efficient.[6] On top of this, increasing temperatures are expected to lead to more energy use and demand, which can overpower systems.[6] This increase could also harm those of low socioeconomic status, who are unable to afford higher costs for energy.[6] Lastly, climate change will threaten the security of nutritional foods. Changes to precipitation, impacts from severe weather events, and increasing pests and weeds from changing ecosystems are expected to lead to decreased crop yields, livestock, and fish production.[13] Climate change will also affect the distribution of these products making it difficult to reach rural communities or neighborhoods with food deserts.[13] Therefore, communities must prepare to find ways to provide equal access to water, energy, and food as these resources become endangered.

HEALTH-RELATED IMPACTS

- **Heat-related Illnesses:** As established, extreme heat days are expected to rise in Florida, which means people will be more at risk for heat related illnesses, like hyperthermia or heat stroke. For urban communities, this can be especially impactful with the additional urban heat island effect that makes the city warmer than surrounding areas from the way it is built.[6] Some groups of people are more vulnerable to these issues, including children, the elderly, the sick, and the poor who may not be able to afford air conditioning or have cool areas.[8] Those who work outside in industries like agriculture, forestry, fishing, or construction are the most vulnerable to these effects, with almost 68% of heat-related deaths in the U.S.[6]
- **Vector-borne Diseases:** Vector-borne diseases are those transmitted by vector organisms, like mosquitoes or rats. One vector organism that finds Florida habitable is the mosquito species *Aedes aegypti*, which can spread dengue or Zika viruses.[6] Climate change is predicted to change conditions to those that are more suitable for vectors to exist year-round.[6]
- **Respiratory Illnesses:** Air quality is also expected to change with climate change, which can harm those with respiratory and heart issues. Warmer temperatures may lead to higher concentrations of ground-level ozone, which is a harmful pollutant.[8] Also, during the warmer months, urban cities tend to have the poorest air quality.[6] If these areas experience prolonged seasons of warmth, pollution from emissions may worsen air quality. Furthermore, wildfires, which produce smoke and air pollutants, are expected to increase in frequency and intensity under drier conditions. Lastly, rising temperatures and increased CO_2 levels can lead to higher exposure to plant-based aeroallergens, like pollen.
- **Mental Health:** While the effect of climate change on mental health is not fully understood, it is predicted to be damaging. Those with mental illnesses are vulnerable to the changes in heat through the interactions of their medications and human responses to climate conditions.[13] Along with this, climate change is expected to affect the occurrence and intensity of natural disasters, from hurricanes to floods. These natural disasters can destroy people's properties, businesses, and communities, which may lead them to experience a variety of mental health problems in response to life changes.[13] Furthermore, research is being done to predict how the environmental degradation and impacts of climate change may elicit anxiety and despair in people.[13]

ECONOMIC IMPACTS

Changes to the natural environment also have large economic consequences. Not only are Florida's top industries connected to the well-being of the environment, but climate change is also expected to impair the health of workers, destroy properties, and reduce productivity.

REAL ESTATE AND PROPERTY VALUES

- Many homes and businesses, especially waterfront properties in coastal communities, are at high risk for damages from physical impacts of climate change including changes to the strength of hurricanes and storm surges, rising sea levels bringing coastal flooding, varying seasonality of droughts, and the higher frequency of wildfires. One report estimated that by 2045, 64,000 homes in Florida will be at-risk for flooding every other week with that number jumping to a million by 2100.[14] These risks are highest for communities and counties with a large number of people living on the coasts, like Miami-Dade, Pinellas, Monroe, and Hillsborough.[15] These physical impacts could cost homeowners and businesses in maintenance and repair costs, insurance, and home values. A recent analysis estimated that Florida could lose more than $300 billion in property value due to rising sea levels alone by 2100.[16] Furthermore, the impacts on real estate will be harmful as people are shown to be less willing to live or work in areas that are increasingly becoming more at-risk. This may mean communities lose tax bases.

TOURISM AND RECREATION

- All the consequences of climate change will impact the ability of people to travel to and visit Florida's natural and built environments. As mentioned earlier, many impacts will harm existing ecosystems of which include state and local parks as well as other venues for outdoor recreation. Beaches, the most famous attraction for tourists, may become inaccessible as the shorelines change. Even if tourists are not here for the outdoors, the extreme heat and increasing frequency of natural disasters may deter them from visiting. According to a study, Florida's tourism industry is estimated to lose $178 billion annually by 2100.[14] As one of the top industries, this will have devastating consequences for Florida's economy and jobs.

AGRICULTURE

- Florida's agricultural sector generates $120 billion in economic revenue for the state and supports more than two million jobs.[17] Although a decrease in the number of days with freezing temperatures may benefit agricultural production of products like citrus, climate change is expected to decrease economic revenue. Hotter temperatures reduce yields of corn, sugar, peanuts, and cotton as well as livestock productivity due to heat stress.[8] More frequent and longer dry summers will further diminish production.[6] Agriculture will also be stressed by issues like water availability, risks of wildfires, damages from storms, and the movement of invasive species and diseases.[6] So, communities dependent on this sector will be more at risk for economic uncertainties if agriculturalists do not adapt to the changing climate.

FORESTRY

- The timber and logging industries are especially prevalent in North Central Florida. However, as mentioned previously, forest ecosystems are at risk for experiencing harm with a changing climate. Specifically, changes to the seasonality of droughts will alter fire regimes as well as the distribution and survival of tree species.[6] This means the industry will have to change practices to ensure trees are surviving and thriving to retrieve raw materials.

AQUACULTURE AND FISHERIES

- Marine and freshwater fisheries as well as the aquaculture industry bring in $15 billion to state of Florida.[18] As mentioned earlier, climate change will affect the types and spatial locations of freshwater and marine organisms. This will damage aquaculture and fishery businesses and recreational activities that rely on the current temporal and spatial scales of these species fish species. For example, marine fisheries' productivity and accessibility will be affected by sea level rise, the frequency of severe storms, coastal habitat loss, and changes to the nutrient availability. Furthermore, the ecosystems of freshwater fisheries will be affected by increased temperatures, changes to the availability of freshwater, and the frequency of storms. Lastly, the most vulnerable aquaculture businesses are those producing shellfish, which are highly sensitive to changes in the climate such as sea level rise, coastal habitat loss, and increasing conditions prime for algal blooms or ocean acidification.[18]

CHECKLIST OF ACTIONS

☐ Identify impacts that will affect your community. Research and list various impacts your community may face from climate change. This will be helpful in creating educational messaging and prioritizing climate action (See Section 2.3: Identifying Risks and Vulnerabilities)

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Additional Resources

"Chapter 19: Southeast" – Fourth National Climate Assessment. *This assessment was created by United States departments and researchers. This chapter reviews specific impacts of climate change for the Southeastern United States.*

Climate Change and Florida: Frequently Asked Questions - *This UF/IFAS document answers some common questions asked by*

"Florida's Climate: Changes, Variations, & Impacts" Book – Florida Climate Institute. *This books reviews the current state of research on Florida's climate, including the impacts of climate and climate change on the people and natural resources of Florida.*

"Florida Climate Outlook: Assessing Physical and Economic Impacts through 2040" – Resources for the Future. *This report*

people during workshops, including those related to climate impacts in Florida.

"Climate-Sensitive Hazards in Florida" – Florida Department of Health. *This document provides an overview of climate-sensitive threats within the state of Florida and analyzes their impacts across the state.*

provides basic information on recent climate change trends in Florida, along with projected impacts for the next 20 years.

Section One: Climate Change - Climate Smart Floridians. *As part of a UF/IFAS training on climate change for residents of Florida, this section reviews the basics of climate change.*

U.S. Department of Agriculture Southeast Climate Hub website. *This website provides content on impacts of climate change for the Southeastern United States.*

For questions about this section's content or to learn more information, please contact:
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SECTION 1.3 SOLUTIONS AND THE ROLE OF GOVERNMENT

The past two sections reviewed the causes and harms of climate change. Now, the question becomes: How can we stop it? The answer to this is not simple, as climate change is a complex, global issue. While we may not be able to stop it, we can slow its rate and lessen its impacts. This can only be done through a multilevel set of actions by individuals, businesses, community groups, and governments of all scales. Governments, especially, will assume a critical role as they set regulations and influence the actions of people. This section will review the solutions to climate change and the importance of government in taking the lead on these solutions.

GOAL AND LEARNING OBJECTIVES

GOAL:

To learn the types of climate solutions available and the role of government in responding to climate change.

LEARNING OBJECTIVES:

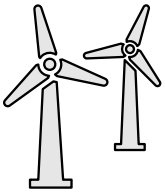
By the end of the section, you will be able to:

- Explain why reversing or completely stopping climate change is not feasible.
- Differentiate between mitigation and adaptation.
- Justify the role of government in taking climate action.
- Provide examples of international, national, and state government actions.
- Connect the responsibilities of local government to building community resilience.

Types of Solutions

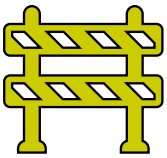
So, how do we reverse or stop it? Some think preventing further carbon and GHG emissions would be enough to stop climate change from happening. However, this is incorrect because of time lags.[1] The planet responds to changes in its environment at varying rates. So, there would be a difference in time between when we stop emitting and when climate responds. This is partly attributed to the remaining GHG concentrations that are higher than pre-industrial times and can linger for decades, centuries, or millennia.[1] So, others think the solution is reversing emissions through geo-engineering, or the use of technological interventions that can capture and store atmospheric CO_2.[2] In turn, this would restore concentrations to pre-industrial levels. There are a few issues with geoengineering. First, the technology is not fully viable technically, economically, socially, or politically.[1] Although the technology is being improved, it is still not being used on a global scale that would make it effective.[2] Secondly, scientists disagree on the usefulness of these technologies, as it is unknown how successful it will be at preventing climate change impacts.[1,2] So, in essence, we cannot reverse or prevent the current trajectories of climate change.

However, we can change the extent of impacts and our level of preparedness through mitigation and adaptation strategies. Climate mitigation is the reduction or stabilization of greenhouse gas emissions, mainly carbon dioxide, to diminish the rate of climate change and its impacts.[1] This idea is similar to the reversal of climate change as they both include strategies that remove GHGs. However, mitigation includes other efforts such as using fewer fossil fuels or increasing carbon storage in soils.

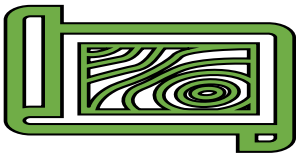


Examples of mitigation strategies include[1]:

- Relying on mass transit systems rather than individual automobiles
- Protecting or restoring ecosystems to build carbon storage capacity
- Requiring building to be energy-efficient



The other common solution is climate adaptation, which is the adjustment of human and environmental behaviors, interactions, and systems to better respond to and reduce the impacts of climate change.[1] In general, these adaptations are small or incremental adjustments. However, if the effects of climate change are about to reach the point of no return the adaptation can be drastic and transformational. Along with this, these adaptation strategies can be physical, social, or policy changes.



Examples of adaptation strategies include: [1]

- Building a seawall or living shoreline to prevent harm from sea level rise
- Planting new crops that grow better in conditions of drought or flood
- Creating new land use policies that address the impacts of climate change

The Role of Governments

Because of the global scale of climate change, actions will need to be taken by individuals, businesses, and organizations on local, regional, state, national, and international scales. Governments are the most effective entities to lead these efforts. Their access to funding and research efforts makes them better equipped to define the issue impacting their communities and implement solutions. Along with this, their ability to influence individuals through community engagement and adopting policies allows them to have a larger impact. International, national, and state governments have led climate actions around the globe and in their communities. The following are examples of government action at these various levels.

International Agencies and Actions

United Nations Framework Convention on Climate Change (UNFCCC)[3]

The UNFCCC is a group of 197 countries, including the United States, that hosts annual conferences and negotiations to stabilize greenhouse gas concentrations to preindustrial levels in an efficient time frame. The convention oversees funding opportunities and negotiated deals for developing and developed countries to adopt mitigation and adaptation techniques. It is the main international organization responsible for climate policy at a global scale.

International Panel on Climate Change[4]

This organization is made up of 195 member governments that are part of the United Nations or World Meteorological Organization. Their purpose is to provide those member governments and their regional and local counterparts with the most up-to-date climate science in the form of assessments or special reports that can be used to develop climate policies at all levels of government. The assessment reports are created by thousands of scientists from all over the world who assess scientific literature to create comprehensive summaries on climate change drivers, climate impacts and future risks, and options for adaptation and mitigation.

National Agencies and Actions

National Climate Assessment[5]

In 1990, the U.S. Congress passed the Global Change Research Act to create a group that would oversee a research program for understanding, assessing, predicting, and responding to climate change. This group consists of 13 federal agencies and departments. Together,

they produce numerous reports and tools related to climate change prediction and response. However, their main report is the National Climate Assessment, which is prepared every four years and delivered to the President and U.S. Congress. Representatives from the 13 agencies and 300 experts research, write, and engage stakeholders to create this report. The most recent report from 2017-2018 was released in two volumes. Volume 1 reviews the foundational climate science that the assessment is based on, whereas Volume 2 examines the effects of climate change across the United States and responses by various communities. The development of the next report is currently underway and anticipated to be delivered in 2023.

Actions by Congress

While nationally, there is no comprehensive climate action plan, Congress has proposed many mitigation and adaptation strategies as well as funding initiatives over the years. These proposals have created emission reduction programs, incentivized clean energy, improved emissions reporting, and funded research.

Actions by Agencies

Federal agencies tasked with addressing climate change are responsible for collecting emissions and environmental data, developing regulations or voluntary programs to mitigate or adapt, and updating policies that account for the effects of climate change. However, their main responsibility is to provide technical assistance, tools, and support for local communities across the United States to better understand climate change and its effects. Some agencies that perform such tasks include the Environmental Protection Agency (EPA), U.S. Department of Agriculture (USDA), National Oceanic and Atmospheric Administration (NOAA), and National Aeronautics and Space Administration (NASA).

State Agencies and Actions

Policy Actions[6]

Strict climate change action began in the early 2000s in Florida, focusing on energy policies, like emission reductions, renewable energy portfolios, and energy efficiency. This changed in the second decade of the 2000s. In 2011, a bill was passed that eliminated many energy policy initiatives and gave local government more discretion on what action they took. Moreover, policies began to focus more on disaster planning and flooding, as seen by the adoption of optional adaptation action areas and flood peril risks.

Actions by Agencies

Similar to the federal government, state agencies have been directed to address climate change and provide important resources for local governments and community stakeholders on the issue. Agencies have taken climate action by including resiliency and adaptation in their policies, collecting data on emissions and natural resources, planning around sea level rise, reducing emissions, protecting and restoring habitats, and preparing for disasters. Examples of these agencies include Regional Planning Councils, Department of Transportation (FDOT), Florida Fish and Wildlife Conservation Commission (FWC), the Department of Health (FLDOH), and the Department of Environmental Protection (FLDEP) – more specifically the Office of Resiliency and Coastal Protection.

The Pivotal Role of Local Government in Building Community Resilience

Although small, local governments are essential parts in solving the climate crisis. They can build community resilience to withstand the impacts of climate change. Community resilience is the ability of the natural and human systems within a community to tolerate, recover, or respond to disruptive climate hazards and still maintain their social, economic, and environmental well-being.[1] A high community resilience means that the community is less harmed by climate hazards and will recover more quickly. Building resilience is a way for local communities to mitigate and adapt to the effects of climate change. It involves a multifaceted approach by government in which a diverse environment with contingency plans is created through the shared knowledge of various governmental officials, experts, and stakeholders. Because local governments have local knowledge, they are best equipped to create the adaptation and mitigation plans that fit the social, economic, and environmental values of the community.

Over the last decade, local government climate action has played a large role in both the United States and the world. When groups of citizens or government officials felt that not enough was being done by the state or nation regarding climate change, they assumed the responsibility of preparing for climate change. Although it started in large metropolitan areas, communities of all sizes and backgrounds have begun taking climate action in some way, even indirectly. A great resource for these communities has been the networks of local governments across the globe. These networks form partnerships with resource sharing and technical assistance capabilities.

In Florida, specifically, local governments have been the main source of climate action. Communities create climate policies through comprehensive plans, strategic and community planning documents, and resolutions and ordinances. Examples of implemented adaptation and mitigation strategies include stormwater upgrades, updating roads and other drainage infrastructure, retrofitting vulnerable buildings or government properties, installing beach and shoreline protection, flood-proofing infrastructure and buildings, transitioning the power grid, and converting public transportation to clean energy. Many local governments in Florida have formed their own networks and collaborations to pool resources and create consistent policies in their regional areas. The rest of this handbook will delve further into the steps that take climate policy solutions from the proposal stage to the implementation stage.

CHECKLIST OF ACTIONS

- ☐ Find local government programs from state, federal, and international agencies that would help your community. Research the agencies that you can form partnerships with or receive technical assistance for creating climate policy. This will be useful for identifying strategies as well as funding sources for implementation. (See Section 2.1: Convening Partners and Staff/Establishing Leadership)

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Additional Resources

Climate Mayors website. *This is an example of local governments taking action. This website was formed as a peer-to-peer network of U.S. mayors.*

Environmental Protection Agency Climate Change website. *This website explores the climate resources available through the Environmental Protection Agency.*

Fourth National Climate Assessment website. *This is the climate assessment performed by United States Departments. It is an example of national climate action.*

Global Covenant of Mayors website. *This is an example of local governments working together at an international scale.*

International Panel on Climate Change website. *This website is for the international group of scientists who are assessing new climate research and providing them to policymakers and the general public in comprehensive reports.*

Office of Resilience and Coastal Protection website. *This is one of the main state partners that can provide resources to local governments.*

United Nations Framework Convention on Climate Change website. *This is the website for the UNFCCC, an international climate action group mentioned above.*

U.S. Department of Agriculture Southeast Climate Hub website. *This is the website for a federal government action group that focuses on climate issues in the Southeastern United States.*

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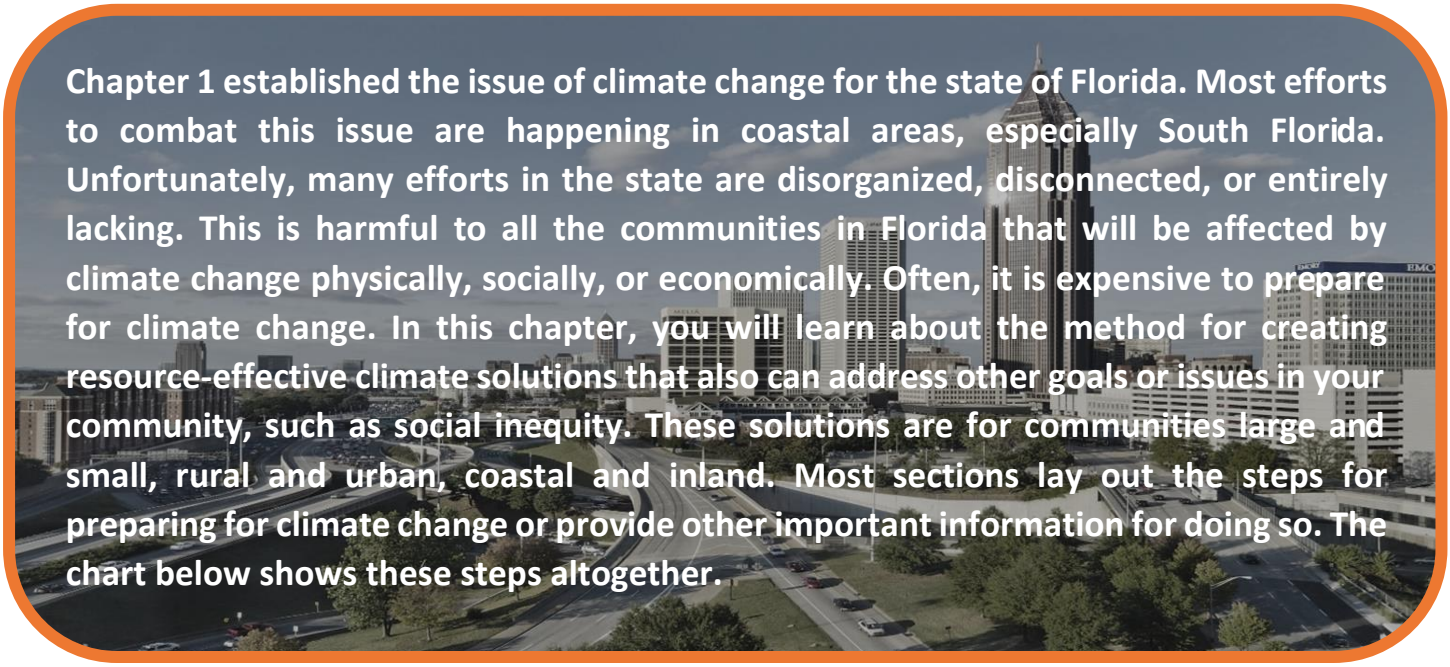
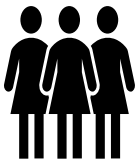
Chapter 2 – Preparing for a Changing Climate at the Local Level: Steps, Strategies, and Methods



Chapter 1 established the issue of climate change for the state of Florida. Most efforts to combat this issue are happening in coastal areas, especially South Florida. Unfortunately, many efforts in the state are disorganized, disconnected, or entirely lacking. This is harmful to all the communities in Florida that will be affected by climate change physically, socially, or economically. Often, it is expensive to prepare for climate change. In this chapter, you will learn about the method for creating resource-effective climate solutions that also can address other goals or issues in your community, such as social inequity. These solutions are for communities large and small, rural and urban, coastal and inland. Most sections lay out the steps for preparing for climate change or provide other important information for doing so. The chart below shows these steps altogether.

- **Step #1: Form a Leadership Team**
  - Establish Goals and Guiding Principles
  - Identify Community Partners
- **Step #2: Defining the Climate-Related Problems**
  - Climate Vulnerability Assessments
  - Greenhouse Gas Emissions Inventory
- **Step #3: Identify Climate Action Strategies**
  - Mitigation Strategies
  - Adaptation Strategies
- **Step #4: Implement the Strategies**
  - Understand Your Resources and Capacities
  - Prioritize Your Strategies
  - Develop an Implementation Plan or a Climate Action Plan
  - Get Approval and Implement
- **Step #5: Monitor and Evaluate**
  - Adjust Plans and Policies as Needed
  - Communicate the Results



Section 2.1 Establishing Leadership

Goal: To understand and identify leadership for climate efforts at the local level.

Section 2.2 Climate Change Education and Engagement

Goal: To learn ways to engage the community on climate impacts and possible solutions.

Section 2.3 Characterizing Risks and Vulnerabilities

Goal: To learn the importance of and steps for performing a Climate Vulnerability Assessment.

Section 2.4 Conducting Greenhouse Gas Emissions

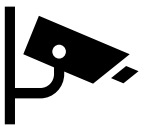
Goal: Inventory GHG emmisions and set GHG reduction targets

Section 2.5 Identifying Climate Action Strategies

Goal: To understand general options for climate action and create a list of potential solutions.

Section 2.6 The Steps of Implementation

Goal: To understand the processes for prioritizing, planning, and implementing climate action strategies.

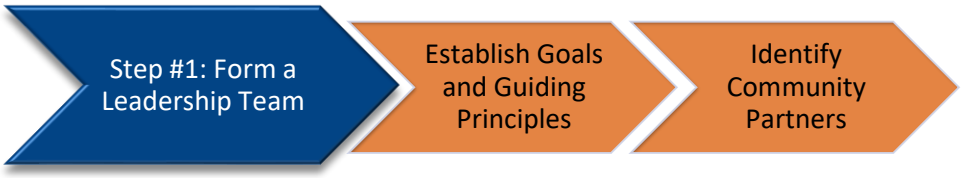


Section 2.7 Monitoring and Evaluating

Goal: To understand the usefulness of monitoring and evaluation systems for climate policies.

SECTION 2.1 ESTABLISHING LEADERSHIP

The multidisciplinary nature of climate change makes it necessary for governments to work with people across departments and within the community. This work requires leadership that can facilitate the policy conversation and oversee the programs and initiatives for building a sustainable, resilient community. Communities can convene a team of staff and key community partners to be this leadership. This section reviews the forms of leadership used to direct climate efforts at the local level and details how to build a leadership team. This is step one in the climate policy process.



GOAL AND LEARNING OBJECTIVES

GOAL:
To understand and identify leadership for climate efforts at the local level.

LEARNING OBJECTIVES:
By the end of the section, you will be able to:
- Explain the importance of leadership for climate action.
- Differentiate between forms of climate action leadership at the local level.
- Identify the form of leadership that is best for the community.

The Importance of Leadership

As mentioned previously, climate change will affect every type of government entity and service from planning to public works to parks. So, departments and services will need to join efforts to effectively address climate change. In order to coordinate these policies successfully, leadership via a single person or group of people is essential. Leadership, in this sense, means having a representative or group of representatives from the local government and community overseeing and guiding the policy process from proposing a policy to implementing and evaluating it. It is responsible for:

- Determining the values and needs of the community
- Establishing goals and objectives for climate efforts
- Keeping the community and government officials engaged and educated on efforts (See Section 2.2 Climate Change Education and Engagement)
- Performing vulnerability assessments and conducting greenhouse gas inventories (See Section 2.3 Identifying Risks and Vulnerabilities and Section 2.4 Conducting GHG Emissions Inventories)
- Identifying and selecting policy actions (See Section 2.5 Creating and Adopting Policy)
- Coordinating efforts between government, businesses, and local organizations (See Section 2.7 Implementation)
- Tracking and evaluating all climate action policies enacted by government entities in the community (See Section 2.8 Monitoring and Evaluating)

The benefits of having leadership includes well organized efforts, centralized reporting, and assistance in decision-making. Also, this leadership serves as the point of contact for climate or resilience efforts in the community. Thus, leadership for climate policy efforts leads to more organized and transparent efforts.

How to Establish Leadership

When it comes to deciding who will lead the efforts, local governments must think of the needs and values of the community as well as the capacity of the government. For those with small local governments only providing essential services, it may make more sense to form a community board that oversees efforts with individual, business, regional government, and technical expert members. However, a larger government with the capacity to build efforts may create a new division for climate efforts or assign responsibility to an existing division. The point is that your government must decide the best form of leadership based on capacity, community interaction, values, and needs.

The following reviews the forms of leadership that are commonly adopted in local communities.

DEPARTMENTS AND STAFF

One method of leadership is internal oversight. This means creating new departments, divisions or offices related to sustainability or resiliency, hiring a staff member for a new or existing department to be solely responsible, or reassigning the responsibility to an existing department or staff member. One way or another, leadership in this form builds the technical capacity and expertise of your government to handle climate change issues. Most departments and staff designated to these efforts have the knowledge to understand the climate science and solutions. Even if they do not have a substantial background in the issue, there are many trainings and certifications staff can receive to be able to lead this effort. The main downside to this method is that it can be costly in some sense because it could cost hiring new staff, training existing staff, or budgeting for a new department. However, there are many funding options to overcome this issue (See Section 2.7 Implementation).

The departments or staff members that tend to be given this responsibility include:

- Environmental Management Departments or Natural Resource Managers
- Emergency Management Departments
- Public Works Departments
- Planning Departments or Specialized Planners
- Sustainability Offices or Coordinators
- Offices or Officers of Resiliency

Most local governments have environmental management, public works, or planning departments. Many staff members in these departments are well equipped with the knowledge and skills to lead climate efforts or have the capacity to be trained in them. So, if your local government is not interested in or capable of creating a new department or position, this may be a good starting point as you begin to increase the priority and need for climate change efforts.

However, if your government has the ability or the will to create a specific entity responsible for climate efforts, then an Office or Officer of Sustainability/Resiliency[i] is commonly created for this purpose. Sustainability is meeting the needs of the present while balancing the availability of resources needed for the future. In other words, it is reducing environmental, social, and economic impacts to improve the quality of life for communities for generations to come. Related to this topic is resilience, which includes designing the natural and human

[i] Note: There are a variety of names or divisions similar to these offices or positions. However, this is the more common term for it.

environment in ways to adapt and endure physical, social, and economic stresses. Both sustainability and resiliency practices can achieve interrelated goals, and they include ideals beyond the natural environment, such as fiscal and social aspects of a community. As mentioned in Section 1.2 The Impacts of Climate Change on Florida Communities, all aspects of society will be affected by climate change in some way. So, it is essential that these practices also look at associated social and economic ties.

Offices of Sustainability have been around for the last two decades and focus on the goal of enhancing the quality of life for the community by creating a clean and healthy environment, promoting a prosperous economy, and addressing social and intergenerational justices. Today, many offices are integrating resiliency and climate change practices into their offices to further this goal - even adding it to the name. Overall, these offices mainly work on green climate initiatives such as:

- Reducing the community and government's carbon footprint
- Tracking greenhouse gas emissions community-wide and within city operations
- Conserving natural resources (energy, water, land, and raw materials) and providing equitable access to them
- Reducing waste (i.e. recycling and composting)
- Adopting, producing, and managing sustainability or climate action plans
- Coordinating with city departments and community stakeholders on sustainability and resiliency practices (i.e. land use plans or building designs)
- Educating and training on sustainable activities and practices for the community, businesses, and other government entities
- Promoting zero waste policies
- Managing advisory groups related to sustainability or environmental considerations
- Tracking or reporting progress related to sustainability and environmental goals.

To begin creating internal leadership, it is best to assign or hire someone to the role that leads the office or program, such as a coordinator or program manager. For communities who have adopted Sustainability/Resiliency Offices in Florida, this person is usually the only person working in the office at the beginning. However, over time and if needed, other roles in the office can be created. Again, it depends on the values, capacity, and needs of your community and government. The purpose of the coordinator is to oversee the sustainability and resilience goals of the office, be the community's point person for resilience and sustainability, and coordinate all of the city's efforts to prevent wasting resources or duplicating projects. It is essential for this staff member to have communication skills as they must interact with a variety of people from other departments, the local community, and businesses. Their daily duties will include researching, developing, implementing, monitoring, and enforcing policies and goals related to sustainability and resilience. This may be done through individual initiatives and/or climate or sustainability action plans.

Offices or positions for Sustainability/Resiliency can exist in many forms - as a separate department or a division under an existing department. Another form is partnering with UF/IFAS Extension to create a sustainability position or program. This is a prime opportunity for **counties**, where Extension is already budgeted. An example of this is in Sarasota County, where the sustainability office and manager are a UF/IFAS Extension Agent. If needed, a community can also decide to make a position or department specifically for climate resilience rather

than the general idea of sustainability or environmental efforts. *Nonetheless*, it is up to your government to decide which form of internal leadership is best for your operations and community. For examples of these various positions and offices in Florida communities, see Appendix B: Table 1.

ADVISORY COMMITTEE

Another form of leadership is a community advisory committee including external actors and stakeholders. Steering committees tend to have similar duties to internal leadership, such as proposing climate policy and sustainability initiatives, engaging and educating the community on climate and sustainability issues, collecting, and providing data, and writing climate or sustainability action plans. However, because steering committees include representatives from the local community, they do not normally have the ability to enact or enforce policy. Although, this depends on the roles established for them early on in their formation. For example, a working group is expected to implement specific actions, whereas an advisory group stands to provide guidance and input on policies and initiatives. Either way, the steering committee is expected to guide and track policies in the community and government. Nonetheless, the main value of a steering committee comes from its members. Due to the members being tied to community organizations and businesses, they can better engage these groups and individual members of the public on government policies related to climate resiliency. Furthermore, they can facilitate communication between government and the community. Not only does this build community relations, but also it coordinates actions of the entire community on climate-related issues.

When it comes to the members that tend to be on these committees, it is dependent on the type of committee and responsibilities given to them, especially because each member can contribute a valuable resource. For example, scientists or technical experts can help assess risks for climate change and recommend expert standards for policies. As another example, businesses or nonprofits can fund projects or initiatives. In this way, members of the committee build partnerships within and for the community.

In general, these committees have a blend of members that represent the interests and groups in the local community to ensure equitable representation and input. The following includes a general list of members that are often on these committees *and examples.*[ii]

[ii] Note: There are many other organizations that provide partnership opportunities and can become a member on the steering committee.

LOCAL GOVERNMENT STAFF: Public Works Directors, Planning Directors, Sustainability or Resilience Officers or Staff, Emergency Management Department Staff, Municipality or County Commissioners, Municipality or County Managers, School Board Members

OTHER LOCAL GOVERNMENT COMMITTEES AND BOARDS: Local Mitigation Steering Committee or Floodplain Management Planning Committee

FEDERAL AND STATE GOVERNMENT AGENCIES: Florida Regional Planning Councils, Water Management Districts, FL Department of Environmental Protection – Coastal Resiliency Program, State of Florida Climatology Office, National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Agriculture Climate Hubs, U.S. Geological Survey (USGS), Army Corps of Engineers (ACOE), U.S. Department of Energy

TECHNICAL EXPERTS: Biologists, Geologists, Engineers, Public Finance Specialists, Researchers, Academia, Economists, Insurance Industry Experts, Geospatial Analysts, Hydrologists, Environmental Planners, Meteorologists, Wildlife Specialists

Source: UF/IFAS Photo File

UF/IFAS COUNTY EXTENSION STAFF or **SEA GRANT STAFF**

COMMUNITY GROUPS: Advocacy Groups, Climate/Environmental Justice Groups, Neighborhood Organizations – Especially In Vulnerable Communities

BUSINESSES: Local Businesses, Chamber of Commerce Representatives, Real Estate Agents, Real Estate Developers, Green Building Contractors, Engineering Firms, Environmental Firms

NONPROFITS: 1000 Friends of Florida, The Nature Conservancy, Audubon Society, Cleo Institute

Although the composition of the steering committee can vary, it is highly recommended that a local government official or staff member from the community leads the committee. This helps with facilitating communication and more efficiently addressing issues. These members will ensure actions are formalized and implemented. For this reason, some communities have both a dedicated staff member or department and a steering committee. The steering committee tends to take an oversight and input role whereas the staff or department enact and enforce policy. Once more, this depends on the role and goal set for the committee. The following explains common types of steering committees.

LOCAL BOARDS, COMMITTEES, OR TASKFORCES

These steering committees are smaller and more localized. They are usually created by ordinances or the local legislative bodies (i.e. commission or council). Most members are appointed and approved by legislative bodies. They meet monthly to put forth recommendations, especially related to adaptation and mitigation strategies, for the legislative bodies to implement. This type of steering committee also recommends partnerships and grants for initiatives. These committees can be created specifically for climate change actions, but often existing sustainability boards or committees are assigned the responsibility to oversee climate actions. In some communities, this responsibility is integrated into other existing task forces or committees, like local mitigation

strategy committees already focus on reducing vulnerability to natural disasters. Examples of these task forces and committees are listed in Appendix B: Table 2.

SCIENCE ADVISORY COUNCILS

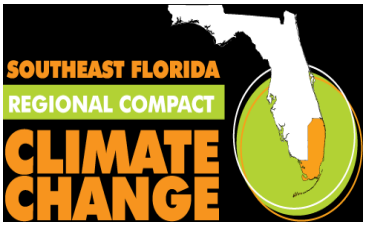
Another type of steering committee is a science advisory council. This group is composed of local and regional independent scientists and technical experts. They provide expertise to help guide government decisions, which is needed for the complex topic of climate change. They can also provide data and analyses for climate policies. One example of this in Florida is the **Tampa Bay Climate Science Advisory Panel**. Formed in 2014, this group provides recommendations to the Tampa Bay Regional Planning Council for actions related to climate resiliency. One of their main contributions has been the "Recommended Projections of Sea Level Rise in the Tampa Bay Region", which was recently updated in 2019.

REGIONAL GROUPS

Another type of steering committee is a regional group. This is useful, especially since nearby communities will experience similar impacts. Regional groups address the impacts of climate change on communities in the area and come up with recommendations for smaller communities as well as plans for the region that would better coordinate efforts at a larger scale. They can help local governments build capacity for climate change and understand the best actions to implement. In other words, regional groups strengthen climate efforts by pooling together resources, policies, and engagement with community partners. *Normally, these groups consist of a steering committee who handles most of the business and then member organizations who will have the opportunity to provide input on ideas as well as receive useful information.*

In Florida, there are a few examples of regional groups.

Southeast Florida Climate Change Compact: An example for many communities across the country, the



Southeast Florida Climate Change Compact was established in 2010 with the goal of forming regional collaborations focused on climate mitigation and adaptation. It is a four-county partnership between Broward, Miami-Dade, Monroe, and Palm Beach and their respective local communities. Each County has appropriated staff and resources as members of the compact. Along with this, there is at least one member from a municipality in each county as well as representatives from the Army Corps of Engineers, National Oceanic and Atmospheric Administration, Environmental Protection Agency, South Florida Regional Planning Council, the South Florida Water Management Districts, and the Nature Conservancy. This group produced a Regional Climate Action Plan in 2012 with 110 recommendations for various local and regional organizations to implement. This plan has led to the widespread adoption of climate policies by South Florida communities.

Tampa Bay Resiliency Coalition: Coordinated by the Tampa Bay Regional Planning Council, this recently established group discusses complex climate issues in the region and develops responses for them. They are also responsible for building regional consensus on policy actions. Members include 29 local governments from Citrus, Hernando, Hillsborough, Manatee, Pasco, and Pinellas Counties. Currently, they are working on incorporating the sea level rise recommendations from the Tampa Bay Science Advisory Council into a climate action plan.

East Central Florida Regional Resilience Collaborative: The East Central Florida Regional Planning Council established this collaborative in 2019 to develop a structure and framework for resilience. The policies and actions created from this group are based on the pillars of Health + Equity, Build Infrastructure + Natural Environment, and Economic Resilience. Besides assessing risks, proposing policies, and identifying community actions, this group is also focused on creating partnership opportunities for local governments and agencies. Currently members consist of representatives from 25 governments from the 8 counties (Brevard, Lake, Marion, Orange, Osceola, Seminole, Sumter, and Volusia) as well as 6 member organizations and agencies (River to Sea TPO, Space Coast TPO, Stetson University, The Nature Conservancy, UCF's GEEO Center, Volusia County League of Cities). Florida Sea Grant also serves as a partner.

Public Private Regional Resiliency (P2R2) Committee: This committee was formed by the Northeast Florida Regional Council to address the issues of sea-level rise and resiliency. Their main purpose is to engage the community and send recommendations to the council. Because of their work, the council has begun providing resiliency services. One of its main accomplishments has been designing the Regional Resilience Exposure Tool, which allows local governments, businesses, and citizens to determine the resources at risk to storm surge, flooding, and sea level rise in Northeast Florida. The council and committee have also hosted workshops and educational presentation. Members include those from the seven counties (Baker, Clay, Duval, Flagler, Putnam, Nassau, and St. Johns).

Concluding Remarks

Whichever structure your community decides to establish, it is essential to outline the goals and responsibilities of that leadership clearly. This will help them understand their extent of involvement in the climate policy process and what actions are expected of them. It will also set the expectations for community members and government officials that need to report to them. Also, your community should establish an internal and external communication strategy with the leadership team to ensure that actions and plans are transparent and open. From there, the leadership will lead engagement efforts, assess expected climate impacts the community, and identify possible policy solutions. The following sections will provide further details on these steps.

CHECKLIST OF ACTIONS

- ☐ Decide the form of leadership that best fits your community.
- ☐ Clarify responsibilities and roles of the leadership and establish communications and organizational plans for leadership.
- ☐ Engage the community and research organizations that would like to be part of any advisory or working groups.
- ☐ Determine if your community would be interested in joining an existing regional group. If there is not a current regional group near you, investigate forming one with other governments.
- ☐ Train your respective leaders to be certified experts on the issue of climate change, building climate resiliency and creating climate adaptation and mitigation strategies.
- ☐ Once the leadership is formed, establish goals and guiding principles for climate action in your community. This should be done with the entire leadership team as well as community members. Goals and guiding principles will help define the concerns of the main community, clarify the role of the local government in climate efforts, and establish focus areas. Overall, it will help guide the leadership through the next steps explained in this handbook.

Additional Resources

"Guide to Public-Private Collaboration on City Climate Resilience Planning" – Center for Climate and Energy Solutions. *This guide provides recommendations for how local governments can work with private businesses for climate resilience planning.*

Florida Adaptation Planning Guidebook – Florida Department of Environmental Protection Coastal Management Program. *This guide provides recommendations on forming leadership at the local level and the actions that leadership should take once formed.*

"Tips for Creating Partnerships with FEMA, NOAA, and State Emergency Programs" – NOAA Digital Coast. *This quick reference shows ways you can leverage programs and resources for planning, funding, engagement, and training support from federal and state agencies.*

COMMUNITY/ORGANIZATIONAL PARTNERS

Local Governments for Sustainability (ICLEI). *This group forms alliances with local governments globally to invest in capacity and knowledge for climate solutions.*

Southeast and Caribbean Disaster Resiliency Partnership. The Partnership is comprised of a wide variety of organizations and individuals, from government to businesses to nonprofits. Partners share experiences, expertise, and resources with one another.

TRAINING/CERTIFICATION RESOURCES

U.S. Climate Resilience Toolkit. *This website provides multiple trainings available for building capacity with local leadership.*

UF/IFAS Extension Workshops *– Contact your local agent for more information on this.*

Florida Sea Grant Workshops *– Contact your local agent for more information on this*

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SECTION 2.2 CLIMATE CHANGE EDUCATION AND ENGAGEMENT

An important aspect of creating climate policy is engaging the community stakeholders and internal government workers on the issue and solutions being considered. It should be a goal set by leadership, especially because most people do not talk about climate change often and are not fully aware of its impacts. Stakeholder involvement helps to build capacity and support in your community for climate adaptation and mitigation strategies. As you engage stakeholders, you provide them information and receive feedback or ideas in return that can help you in crafting policies. This section reviews the importance of engagement, vital aspects that must be remembered as you engage stakeholders, and the steps for creating engagement opportunities.

GOAL AND LEARNING OBJECTIVES

GOAL:

To learn ways to engage the community on climate impacts and possible solutions.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Explain the importance of climate engagement.
- Identify purposes for engagement.
- Create engagement strategies for your community.
- Utilize communication and engagement trainings or resources to lead more effective engagement strategies.

The Importance of Climate Engagement

One of the most important aspects for creating and implementing climate policy is stakeholder engagement. It is a great way to generate support for climate policy in the community and local government as well as provide community perspectives on the issue and solutions throughout the process. Furthermore, it is an opportunity to strengthen community relations and to empower vulnerable, socioeconomic communities. *Stakeholders include both internal policymakers and external actors in the community. Engaging internal employees helps build credibility with the public and better engage the community as they can implement climate-related ideas into their procedures. Also, informing and involving upper management, like department directors or councilman, throughout the process allows for buy-in on climate policies. External community members vary from community partners to technical experts (i.e. engineers) to long-time residents. Many of the types of people considered for leadership committees, as mentioned in the previous section (2.1 Convening Partners and Staff/Establishing Leadership), should also be engaged for community awareness and input.*

There are many purposes for engaging stakeholders during the climate policy process, such as:

- To inform stakeholders about expected climate-related impacts and possible considerations for climate solutions.
- To identify community goals and focus areas (i.e. assets, strengths, and hazards) to guide leadership actions.
- To collect input on proposed climate actions for prioritizing projects or policies.
- To create representative and inclusive climate response strategies that address all concerns of the community.

Because of the multiple purposes for engagement, there are many strategies available for government use. They range from involvement on a leadership team to sending out surveys on issues to hosting discussion forums. Also, sometimes engagement can focus on one approach (e.g. a single in-person event) or multiple approaches

(e.g. digital and in-person engagement over a period of time). The strategies implemented by a local government depends on the characteristics of the community, the relationship between government and the local citizens, the resources available, and the topic of discussion. Choosing strategies will be discussed later on in this section. As to not waste resources or opportunities, it is important that any type of stakeholder engagement is effective. To do this, engagement strategies need to ensure the following:

- *Offered throughout the policy process.* Normal public or internal engagement happens after policy plans have been structured. This tends not to be effective or useful because it overlooks community perspectives and does not allow enough time for feedback. However, if the community and internal actors were engaged more often, it would be beneficial because it can keep the stakeholders interested in the topic and be more characteristic of the needs of the community. For this reason, engagement should happen prior to planning, during planning and implementation, and on an ongoing basis as policies are monitored and evaluated.
- *Transparent.* To build trust within the community, it is necessary that the process of planning is open and clear. The stakeholders should be able to find information on it or contact a point person about climate efforts throughout the process. Also, they should have access to the names of organizers, partners, and sponsors, the outcomes of engagement events, and the range of views and ideas expressed during these events.
- *Acknowledge equity issues.* Stakeholder engagement must involve input from the community. Many times, the most climate vulnerable communities are underrepresented in this engagement because of failure by leadership teams to ensure accessibility or inclusion. So, equity must be integrated into every engagement process. Doing so will empower citizens from these areas to shape decisions that will impact their lives and ensure that resources are prioritized for areas with the greatest needs. Resources that review ways to integrate equity can be found in "Additional Resources".

Steps for Engaging Stakeholders

The leadership for climate efforts is responsible for overseeing engagement strategies as part of the policy process. Sometimes, it is best to hire staff, volunteers, or consultants from the community that reflect the stakeholders you are engaging. Throughout the process, you will need to decide the best forms of engagement that meet the needs and goals of climate efforts as well as align with the resources available. *This means that you must establish a WHY, WHO, WHAT, and HOW.* To do this, leadership should follow the steps described below. Note, prior to any engagement or outreach strategies, you may want to assess your community needs and values to create effective opportunities and messaging.

1) The Why - Identify the purpose of engagement.

In this first step, leadership and those planning engagement opportunities must establish the reason for having such an event. Sometimes opportunities are made just for informing stakeholders on the current status or plan, whereas other times they are made in order to receive comments and feedbacks on those plans. There are many purposes for engagement activities, and these can be summed up into the following categories.[1,2,3]

Category	Goal	Characteristics of Engagement
To Inform	To increase knowledge about a project or problem by educating stakeholders on the	• Led by local government • One-way communication • One-time interaction (typically)

	issue and build community support for government action.	• Short-term engagement • No influence on decisions
To Consult	To advise government efforts/projects by obtaining feedback from individuals or key stakeholders on an issue, plan, or decision.	• Led by local government • One-way communication • Several interactions (typically) • Short-term to medium-term engagement • Some influence on decisions
To Involve	To align goals and build partnerships within local government and the community that deliberate and co-develop solutions.	• Led by all partners • Two-way communication • Multiple interactions • Medium- to long-term engagement • Large influence on decisions
To Share Leadership	To give stakeholders leadership authority or a formal role in making recommendations on actions that government should take.	• Led by stakeholder leadership • Two-way communication • Continuous interactions • Long-term engagement • Full influence on decisions

These categories form a spectrum of engagement, where some purposes require more thorough engagement than others, as noted in the characteristic's column. Most forms of engagement tend to focus on the first three (informing, consulting, and involving). The last one, sharing leadership, was discussed in Section 2.1 Convening Partners and Staff/Establishing Leadership. However, leadership teams can be formed during the policy process to investigate specific strategies, plans, or methods of communication. Nonetheless, you should establish the purpose of your engagement as one of these four categories.

In order to determine which category your engagement fits in, you need to define the role of the audience in influencing decisions. For example, if the audience is not expected to influence decision making through this engagement, it is most likely because you want to raise awareness amongst them or begin building relationships. The level of influence over decisions for each category is described in the table. Along with this, you must establish your role in engaging the public. Those roles include teacher, facilitator, moderator, or resource provider.

The following questions may aid you as you identify the purpose:

- What are the expected outcomes for the leadership team? For the participants?
- Do you need help with policy making or do you need to build community relations?
- Is the topic you are engaging on related to a decision, question, problem, or opportunity?
- What, if any, types of decisions are to be made in this process?
- What part of the policy process are you at that you need engagement?

2) The Who - Decide which stakeholders will be engaged.

After you have identified your purpose, you should decide the target audience for engagement. It is often difficult to engage all stakeholders during one opportunity. Even choosing the general public is too vague and

difficult to achieve representation. So, it is best to set a goal of the types of stakeholders you want to engage. This will depend on the goal of your engagement opportunity (i.e. receiving feedback from the community, obtaining technical expertise, building community relations, bridging efforts in local government, etc.). The types of stakeholders that are engaged will affect the venue, timing, and messaging, which is why it must be decided on early in the planning process.

The following lists general types of stakeholders, both internal and external, that could be considered for climate engagement opportunities.

- **Decisionmakers** – locally elected officials, local departments (planning, zoning, stormwater, public works), neighboring communities, or partnered agencies at the regional, state, and federal level
- **Businesses** – real estate, hospitality, finance, insurance, agriculture, tourism, or those near climate hazard areas
- **Community Organizations and Leaders** - rotary clubs, civic organizations, homeowners' associations, or non-profits
- **Sectors of the Public** – youth, climate vulnerable populations, socioeconomic vulnerable populations, or underrepresented populations

Note, often, those most vulnerable to climate change are underrepresented in engagement opportunities. Remember, it is important to close the equity gap through these processes, which means including considerations for these populations. To help in identifying these populations and other stakeholders, you can ask these questions:

- Who does this issue, project, or decision affect directly? Indirectly?
- Are there any people responsible for a specific issue?
- Who could be potential community partners?
- Which groups are not often present at public meetings?

3) The What – Select an engagement strategy that best fits your purpose and audience.

Now that you have your purpose and stakeholders, you can choose a strategy that will be most effective. This can be a single strategy or continuous communications with your target audience. It is very dependent on the timeline of the project or decision as well as the budget and resources you have available. So, you can narrow down the options by identifying those that you are allowed to use, fit within your established budgets, and you have adequate resources to supplement. Resources include staff members that may have to oversee the opportunity. For example, digital communication may involve your communication department or liaison, but also require you or another leader to create content. Overall, it is up to your team to identify the strategy or combination of strategies that will get you to a satisfactory outcome with your target audience.

These are some questions you can ask to decide if the strategy is a best fit.

- Will this strategy accomplish the purpose I identified?
- Will my target audience have access to this strategy?
- Can I make this inclusive?
- Will I get the product I want from this activity?
- Is it feasible to move forward with this strategy?

Below is a general, non-exhaustive list of engagement strategies for both internal and external stakeholders.[4]

Types	Engagement Activities/Events	
Informative	• Broadcasts • Fact sheets, Brochures, Pamphlets, Fliers • Inter-office emails • Mailed/Online Newsletters – including those for internal use • Memos to the City Commission	• Newspaper articles • Pop-up stands in the community • Posters • Posting on City's website • Press releases and conferences
Digital	• Apps • Podcasts, Videos, Music, etc. • Social media	• Story Map • Webinars
Participatory	• Charette • Contests • Field Trips • Focus Groups • Forums/Panels • Lunch-and-learn session • Large Group/Small Group meeting • Listening sessions	• Open House • Public Hearing • Public Meeting • Retreats • Town Hall Meetings • Workshops • Youth Climate Summits
Other	• Door to door • Exhibits/displays (in public areas) • FAQs for Customer Service Hotline • Hotlines • Storytelling	• Interviews/Polls/Surveys • Participant observation • Promotional Materials (e.g. caps, T-shirts, mugs) • Public Art

Examples of Florida communities engaging stakeholders for climate actions are provided below.

Case Study #1: Miami -Dade County

Miami-Dade County partnered with a local grass roots organization called Dream in Green. Together, they educate and provide resources to homeowners on increasing energy efficiency at home and at work. Most of this takes place during local workshops, but they also reach out via digital media, fliers, other community meetings, and individual consultations.

Case Study #2: City of Fernandina Beach

The City hosted a Waterfront Resiliency Workshop to engage community stakeholders on critical assets in waterfront areas that will be shocked and stress by a changing climate. Prior to the meeting, they reached out to stakeholders, especially industries in the area, and reviewed objectives and concerns for discussion at the meeting. During the meeting, there was an overview of projected flooding scenarios, sea level rise scenarios, and current projects for waterfront resiliency. While presenting, stakeholders were able to voice their questions, comments, and concerns.

Case Study #3: City of St. Augustine

In 2018, the City held a resiliency workshop as part of developing their resiliency plan. The purpose of the workshop was to identify solutions, ideas, and opportunities to build resilience and allow the city to adapt and thrive to climate change. It was an all-day event with speakers including city government staff and business

partners who worked on the plan. Topics included: the importance of resiliency, the reason for creating a resilience strategy, the framework for the strategy and how the city is supporting it, inspiration success stories from around the world, and expected climate impacts. Towards the latter half of the event, participants were broken up into small groups to identify priority areas and critical city assets, discuss vulnerability, and evaluate resilience projects.

Case Study #4: Broward County

In January 2020, the Broward County School District hosted a Youth Climate Summit. The theme was Sea Level Rise. Over the course of the day 800 middle and high school students attended breakout sessions on topics related to sea level rise, including engineering, civic government/planning, insurance/real estate, communication/media, and technology/science.

4) The How – Develop the engagement plan.

Once you have decided why, who, and what, you need to start planning on how you will achieve this strategy. This means creating an action timeline that outlines key activities, deadlines, and expected products. The depth of this timeline will depend on the type and number of engagement activities you chose. The whole strategy should identify one team leader and each key activity should have a point person. Also, someone, most likely the team lead, should be designated as the point of contact for any internal or external stakeholders to get information on the project. As you create the timeline and list of products, you should identify any resources you may need and where you can get them. For example, if you are hosting a lunch-and-learn, you should identify the food that will be provided. This should be advertised ahead of the activity so your participants can know ahead of time.

Once you have determined this timeline, you need to designate the time and place of the activity or event. Even if it is a poster, there should be a set date of when the poster goes up and what venues it will be available. For participatory events, it is helpful to examine community or neighborhood/homeowner association calendars and identify meetings where individuals are already involved. This can maximize the number of stakeholders you reach out to and puts less pressure on you organizing the event. If you are organizing the event, possible settings for participatory events are prime community locations, like libraries, community centers, neighborhood services, and city hall meeting rooms.

After the details of the meeting or event are done, you should come up with a communication plan for outreach. Whether it is to promote an event or request a place to allow posters, brochures, or fliers, there are many points of outreach you can take advantage of, such as: posting requests on local websites or social media (e.g. Facebook event with RSVP), handing out materials in public, using community leaders or partners to spread the word, asking the current participants to recruit more people, using community websites (i.e. Next Door), mailing information, or sending out through press releases, featured stories, op-eds, news conferences, and email lists. It is important that you are extensive in your efforts and target populations that tend not to participate.

5) Craft the message and content.

From the outset of engagement, you will want to create a clear message about what your leadership team is doing and what you want the various stakeholders to know, including those internal stakeholders that are not well-versed on the issue. It is recommended that you create a theme message consistent throughout your

engagement strategies as well as individual messages specific to each piece of the process. You want the messaging to inform, promote, and involve stakeholders. When it comes to climate change, there are many different perceptions of what it means and whether it is a serious issue. For some, the words climate change have a negative connotation. So, creating messages that will engage both those who are supportive of climate policy and those who are not aware or interested in the issue requires careful consideration. Fortunately, there are many resources available, such as trainings, exercises, and guides, to help you craft messages and content that is effective, meaningful, and well-received. Remember, it is impossible to ensure that everyone agrees on actions or the idea of climate change, especially when you have a wide range of audience members. So, the goal is to get general consensus. These resources can be found in "Additional Resources" later in this section. However, *we have gathered some general tips to help you:* [4,5,6]

- *Know your audience.* With any type of communication, it is vital you know the values, pre-existing beliefs, and attitudes of your audience towards a particular issue. These factors will affect the way a person interprets messages. The issue of climate change is hard to relay to people who work full-time or are more focused on other issues. However, as mentioned previously, climate change is going to have a major impact on all aspects of society. So, you can relate your messages about climate change and the work your local government is doing in terms that connect to the audience's values. For climate communication, messages are framed around answering the question of why the audience should care or do something about it. To answer this, you may need to assess the community on their values or opinion or find data that contains information relating to the values of stakeholder groups (See "Additional Resources"). The most common frames used for climate messages are built around the ideas of health, safety, welfare, responsibility for vulnerable populations or natural resources, and impacts to livelihoods. Note, that if you are engaging cultural communities, you must consider their cultural values and terms in creating your own messaging and content.
- *Localize climate change*. Although a global issue, climate change will have immense local impacts. It is important to emphasize this message with your local audience, especially since people tend to perceive it as a distant problem for the future and for other communities. So, framing the conversation in terms of local impacts and local solutions will be more appealing. Examples of specific impacts include those related to water resources, energy uses, food production, and economic costs from destructive weather events. These impacts should be presented with compelling evidence, like credible local predictions and visual representations of current impacts. It is also important you focus on solutions that are happening at a local scale to address these impacts. Many times, these solutions have other benefits unrelated to climate change, such as reducing pollution or providing a new recreational area. Mentioning these other benefits will bring broader appeal for your efforts by showing that smart climate actions do more than address the issue of climate change.
- *Focus on solutions and actions*. Although important, focusing too much on impacts of climate change to frame the issue can lead to unresponsive or panicked audiences. You want to make sure whatever engagement you have motivates the audience to continue the conversation, stay involved, and take action individually. That is why it is recommended to focus only 1/3 of the content on impacts or expected change and 2/3 on hopeful actions for climate change or ways your government has begun addressing these impacts.
- *Allow the audience to craft the message as well.* Many times, climate engagement tends to be one-way communication with presenters talking at the audience about climate science, impacts, and individual or governmental actions. Instead, these presenters should be talking with the audience, asking for input and

opinions on the actions and climate science. When talking about climate action, it is also important to ask citizens what should be done rather than telling them. Citizens can and should share experiences with climate impacts or reasons they felt compelled to take climate action. In this way, they will be involved in the conversation.

- *Be concise and attentive with any messaging elements you use*. Your content should be clear and concise so that the audience follows, especially since many times the audience is not an expert. This means using synonyms for common technical terms, making references to ideas and phrases that the audience can connect to, and choosing symbols that appeal to values. However, it is also important to not go overboard with symbolism or references. Also, when you are showing examples for impacts or actions, be specific, localize them, and explicitly connect them to how your government is going to move forward knowing about them. It is highly recommended that you include visual imagery or personal narratives when providing examples. Use images of places and resources that are vulnerable to the effects of climate change (i.e. sea level rise) and important or known to stakeholders. This will add place-based context to the products and decisions for which you are trying to get feedback. Lastly, the way you word important messages or ideas is critical to the way the audience understands or engages with it. So, it is best to avoid polarizing language especially if political factors are a major aspect of your community. For example, instead of using "laws" or "regulations", it may be better to refer to it as "programs".

6) Engage!

Now, it is time to initiate your plans and engage your stakeholders. During the engagement opportunity, you should ensure a welcoming atmosphere, clarify meeting objectives at the beginning, and use technology (e.g. Loomio, menti.com, Poll Everywhere) appropriately. As mentioned previously, it is also important to promote inclusivity and diversity during engagement activities. Examples of doing this include translating key documents and presentations in community languages, providing interpreters at events or making translation equipment available for non-English speaking participants, offering childcare services or culturally appropriate food.[i] Lastly, make sure you are taking notes of progress or any feedback received during the event. It may be helpful to send your participants feedback forms or include evaluation forms at meetings or activities. This will help you in the evaluation stage.

7) Evaluate your outcomes and the method of engagement.

As the final part of engagement, you must review the outcomes from the strategy or strategies. Especially if your focus was on consulting, involving, or sharing leadership, you need to review the feedback and comments from your activity. Along with this, those who worked on the engagement should set a time to evaluate the effectiveness of the activity and any issues that could be avoided in the future. Then, you should summarize this information and present it to the full leadership team. From there, your team should incorporate it into your plans and evaluations for the policies and programs you create.

Also, remember that even if your engagement opportunity is completed, you will want to plan more opportunities to spread the messages and maintain a presence within the community. It is found to be more

[i] Note: See "Additional Resources" for more ideas of closing equity gaps.

effective to introduce information over time rather than in one programming event. So, when evaluating, begin planning what the next set of messaging will be or ways you can keep the community engaged and updated on government plans. Regular updates with meaningful content will aid in future engagement efforts and continue strong relationships in the community.

Concluding Remarks

Overall, engagement opportunities should be consistently made throughout the climate policy process. There are many methods for engaging internal and external stakeholders. The strategies your government chooses will depend on the needs and characteristics of the community. There are many resources (listed below in the "Additional Resources" section) to help you understand how to make your engagement and communication effective and meaningful. UF/IFAS Extension is a great community resource to identify opportunities, plan them out, or provide agents to serve as professional facilitators for participatory events.

CHECKLIST OF ACTIONS

- ☐ Identify opportunities for engagement that best fit your internal and community needs.
- ☐ (Optional) Conduct a needs and values assessment with your stakeholders.
- ☐ Train staff for climate communication and engagement strategies through Extension or other services.

References

[1] City of Seattle Office of Racial Equality. "Inclusive Outreach and Public Engagement Guide". https://southeastfloridaclimatecompact.org/wp-content/uploads/2020/03/RCAP_InclusiveOutreachandPublicEngagement.pdf.

[2] Urban Sustainability Directors Network. "Guide to Equitable, Community-Driven Climate Preparedness Planning". https://southeastfloridaclimatecompact.org/wp-content/uploads/2020/03/RCAP_InclusiveOutreachandPublicEngagement.pdf.

[3] Federal Reserve Bank of San Francisco. "Promoting Equitable Climate Adaptation through Community Engagement". https://www.frbsf.org/community-development/publications/community-development-investment-review/2019/october/promoting-equitable-climate-adaptation-through-community-engagement/.

[4] Florida Department of Environmental Protection Coastal Management Program. "Florida Adaptation Planning Guidebook". https://floridadep.gov/sites/default/files/AdaptationPlanningGuidebook.pdf.

[5] The Society for the Psychological Study of Social Issues. "Building Resilient Communities in the Face of Climate Change". https://www.spssi.org/index.cfm?fuseaction=document.viewdocument&ID=3F28EB86AE4CA3BB2EE025BE0093BF04C3C86089AFFADC9117681192CC17EABCA6952AE18DBE281F122D1C5A3A1CBAA2.

[6] ICLEI. "Climate Communication for Local Governments". https://climateaccess.org/system/files/ICLEI_Climate%20Communication%20for%20Local%20Governments.pdf.

Additional Resources

RESOURCES FOR ENGAGEMENT

"Adaptation Planning Stakeholder Outreach & Engagement" - Florida Department of Economic Opportunity. *This provides ideas and examples of engagement strategies in Florida.*

Climate Access website. *This is a networking and resource hub for engagement.*

RESOURCES FOR COMMUNICATION

"American Climate Metrics Survey: Southwest Florida" - ecoAmerica. *This is a survey of Southwest Florida residents about their attitudes on climate change.*

Building Risk Communication Skills: Questions to Ask and What to Listen For - NOAA Digital Coast. *This document provides questions to help get the conversation started about risks.*

Climate Change Solutions Simulator - Climate Interactive. *This tool provides climate simulations and ideas for engagement content that you can use in your events.*

"Educational Techniques to Facilitate Involvement" - Florida Department of Economic Opportunity. *This guide provides information and ideas for participatory techniques.*

"Guide to Equitable Community-Driven Climate Preparedness Planning" - Urban Sustainability Directors Network. *This handbook reviews ways to make engagement strategies equitable and diverse.*

"Inclusive Outreach and Public Engagement Guide" - Seattle Office for Civil Rights. *This guide provides information on creating equitable engagement strategies. It also provides a good outline of the steps for engagement strategies and questions you should ask during the process.*

"Introduction to Conducting Focus Groups" -NOAA Digital Coast. *This document introduces elements and practices that create a successful focus group effort.*

"Introduction to Planning and Facilitating Effective Meetings" - NOAA Digital Coast. *This guide explains the role of a facilitator and how to plan and execute meetings.*

"Introduction to Stakeholder Participation" - NOAA Digital Coast. *This document discusses the most important considerations and techniques on engaging stakeholders for participation.*

"Introduction to Survey Design and Delivery" - NOAA Digital Coast. *This document reviews effective survey research methods, techniques, and questions.*

"Meeting Engagement Tools" - NOAA Digital Coast. *These tools provide information on holding successful, effective meetings.*

"Stakeholder Analysis Worksheet" - NOAA Digital Coast. *This worksheet identifies stakeholders when addressing a community issue.*

WORKSHOPS/TRAININGS: These are workshops and trainings that can help you form engagement strategies.

- Facilitation Basics for Coastal Managers Workshop
- Planning and Facilitating Collaborative Meetings Workshop
- CIVIC Extension Program

Climate Visuals website. *This is an evidence-based database of imagery for climate change communication. The website has a library of images to provide inspiration and motivate.*

Reframe Cards Sets - National Network for Climate Change Interpreter. *These cards provide specific strategies for various values.*

Risk Communication Resources - NOAA Digital Coast. *This group of resources review strategies and ways to improve risk communication skills related to coastal communities.*

"Using Photorealistic Visualizations" - NOAA Digital Coast. *This publication reviews how to use visuals when communicating in engagement opportunities.*

Yale Project on Climate Communication website. *This website provides research on public climate change knowledge, attitudes, and policy preferences. In this section, the organization provides factsheets for counties across the United States.*

CLIMATE MESSAGING HOW-TOS: *These resources provide specific suggestions for messaging and communicating climate change.*

- "Climate Communication for Local Governments" - Local Governments for Sustainability (ICLEI).
- Climate Interpreter Resources website.
- Climate Outreach website.
- Climate Nexus website.
- "Connecting on Climate: A Guide to Effective Climate Change Communication" – ecoAmerica.
- "Let's Talk Climate: Messages to Motivate Americans" – ecoAmerica.
- "Let's Talk Communities & Climate: Communication Guidance for City and Community Leaders" - Local Governments for Sustainability (ICLEI).
- "Risk Communication Basics" - NOAA's Office for Coastal Management.
- "Suggestions for Effective Sea-Level Rise Communication in Miami-Dade" – The Miami Foundation.
- "The Psychology of Climate Change Communication" – Center for Research on Environmental Decisions (CRED).
- "The #Talking Climate Handbook" – EIT Climate-KIC.

WORKSHOPS/TRAININGS: These workshops and trainings can help you build communication skills that are useful during engagement strategies.

- Building Risk Communication Skills
- Climate Interpreter Workshops
- The En-ROADS Climate Workshop
- U.S. Climate Resilience Toolkit Training Courses

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SECTION 2.3 CHARACTERIZING RISKS AND VULNERABILITIES

Building climate resilience in a community is essential for climate action planning. In order to know where resilience is weak in a community, vulnerabilities and risks have to be identified. To do this, these communities should perform a Climate Vulnerability Assessment. This assessment helps to inform strategic decisions for climate action planning by pinpointing the community assets, locations, or populations that are most vulnerable to climate change. In this way, it contextualizes the climate problem in your community. This section will review the purpose and the process for a Climate Vulnerability Assessment. However, there are many resources and partners that can review the steps of completing an assessment more in-depth. At the end of this section, examples of vulnerability assessments from Florida communities and their best practices are presented.

Step #2: Defining the Climate-Related Problems

Climate Vulnerability Assessments

GOAL AND LEARNING OBJECTIVES

GOAL:

To learn the importance of and steps for performing a Climate Vulnerability Assessment.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Define the purpose and components of a Climate Vulnerability Assessment.
- Explain the process of performing an assessment.
- Identify tools you can use during the steps of an assessment.
- Discuss the best practices for completing an assessment.
- Apply this knowledge to perform an assessment for your community.

What is a Climate Vulnerability Assessment?

A Climate Vulnerability Assessment (CVA) is the measurement of climate change impacts, the identification of the vulnerable physical, social, economic, and environmental aspects of a community, and the evaluation of these aspect's ability to adapt.[1] In general, it assesses a system, asset, or population's exposure to climate impacts, sensitivity to impacts, and adaptive capacity for managing the impacts.[2] It differs from a common risk assessment or analysis. Risk assessments identify climatic threats, the likelihood of the threat occurring, and the consequences of that impact to the community.[1] CVAs do more than just identify and define climate risks for a community. They establish how climate could affect a community and identify mitigative or corrective actions to reduce vulnerabilities. However, risk assessments and other supporting analyses are often integrated into CVAs.

There are many benefits and purposes of performing these assessments at local or regional scales. For one, they are required for certain community plans according to Florida Statute, such as delineating Adaptation Action Areas or "Peril of Flood" Comprehensive Plans. Secondly, these assessments contextualize the community for climate issues. They do this by identifying the sectors, locations, or groups in the community most likely to be impacted by climate change. Also, they help communities understand the climate and non-climate stressors that make these areas vulnerable. Moreover, they determine strengths and weaknesses for reducing vulnerabilities. Thirdly, they inform decisions for building community resilience by ensuring adaptive measures

consider the contextual information. Such decisions include those related to whether and how to integrate adaptation efforts into existing community interventions, designing adaptation interventions, investing in specific programs or initiatives, and increasing the effectiveness of existing adaptation options.

The Process of Performing Climate Vulnerability Assessments

The following are the basic steps for performing a Climate Vulnerability Assessment. Note, the assessment is normally more in-depth. However, the depth and extensiveness of the assessment will be determined early on and your consultants or expert partners will guide you through the process best fit for your community.

Step 1: Define the purpose and establish goals for the vulnerability assessment.[3]

The first step in the CVA process is to define the exact purpose for performing the assessment. Previously, we covered the numerous purposes for a CVA. The design of the CVA will differ depending on its purpose. This step should be done collaboratively by working with partners and stakeholders that are relevant to the scope of the assessment. A few questions that can help you establish this purpose include:

- What are you hoping to accomplish?
- What questions will the assessment answer?
- In what ways do you plan to apply or use the results?
- Which specific decisions do you want the assessment to support?

Step 2: Plan the vulnerability assessment.[3]

CVAs vary in their design, methodologies, inputs (e.g. data), and outputs (e.g. final report). For example, some are narrative descriptions that rely on community perspectives and stories, whereas, others are scientific analyses of a specific asset or sector using climate models and scenarios. Deciding such information depends on a number of factors (outlined below). So, it is important to plan out the vulnerability assessment by identifying its scale and scope. This step can be very research-intensive, but nonetheless, necessary.

Factors to consider:

- Availability of Financial and Human Resources – Assess the level of technical capacity, political support, and the budget available or possible sources of funding. This will help you understand the boundaries within which you can perform your assessment.
- Data and Information – Determine the type of information you need (e.g. geospatial data, climate projections, etc.) and have available for the assessment. Some local governments use recommendations from scientists to determine this information. For example, both the Tampa Bay Region and the Southeast Florida Regional Climate Compact have recommended sea level rise projections that guide their efforts and vulnerability assessments. Questions to ask to determine this include: What type of scenarios do you want to use in the model (Best case? Worst case? Middle-of-the-road?)? Where will you need to look to find information? What climatic and non-climatic stressors should be considered? What projections will you use?
- Areas of Focus/Interest – Decide whether your assessment will focus on specific sectors (water, infrastructure, transportation, etc.), projects, or assets or comprehensively review the community. The more sectors you include, the more resource intensive the assessment will become. Also, define the geographic boundaries for which you will focus your assessment. To do this, the planning team may engage the internal and external stakeholders.

- Timeframe of the Assessment – Establish the amount of time you have available to perform the assessment. From this, create a timeline of when to perform certain aspects of the assessment.
- Partners and Leadership – Identify the leadership that will manage and perform the assessment. Also, note any partners, especially academia or consultants, that can help you perform the assessment.
- Stakeholder Involvement – Clarify the level of engagement you want to or can have with internal and external stakeholders. This will aid in engagement efforts early on and also help you understand the type of information you should expect to gain during the process.
- Output of the Assessment – There are many different final products you can get from the vulnerability assessment, such as a map, report, or narrative description. Determining early on what that final product should look like will help you focus the scope of the assessment.

After considering these factors, you can choose the methodology and approach of the CVA. The following are the different approaches for CVAs:

Top-Down Approach [3,4] – This approach uses quantitative methods and data (i.e. downscaled climate models) to identify vulnerabilities. For this reason, it tends to focus on future climate impacts, mostly quantifiable and biophysical, that are modelled by these simulations. These impacts are based on assumptions of current existing adaptive capacities and strategies that would continue into the future. As mentioned before, climate models are difficult to downscale to municipal or even county levels. So, normally the impacts are projected at a regional scale. This is why it may be helpful to complete such an assessment with neighboring governments, especially since such technology can be resource intensive and expensive. In general, this approach involves partners, such as research institutions and consultants, because it needs the skilled staff and specific types of data accessible to these partners.

Bottom-Up Approach[3,4] – In contrast to top-down, bottom-up mainly uses qualitative methods and local knowledge to identify the risks in the community. However, it can be combined with quantifiable data, like downscaled climate simulations or surveys on the varying socioeconomic sectors in the community. It is commonly used at the local level because it identifies existing vulnerabilities before predicting future ones. These vulnerabilities include social and economic ones as well as the biophysical impacts from climate change. In nature, it is participatory by involving important stakeholders to understand what causes people or assets to be vulnerable to climate change. Generally, its outputs reflect the perceptions and experiences of community members, rather than that of just expert partners.

Integrated Approach [3,4] – More recently, these two approaches have been combined to complete CVAs by using both quantitative and qualitative indicators. First, areas most vulnerable to climate change in the future are identified using climate models and scenarios that consider defined sets of future climate and non-climate variables. Then, those areas are reviewed using qualitative methods to validate the results and understand why they are at risk. By integrating the two approaches, the assessment becomes more comprehensive and useful.

Step 3: Assess Current Vulnerability and Risks. & Step 4: Assess Future Vulnerability and Risks.

The next two steps involve collecting and analyzing data to identify current and future vulnerabilities. It is important to establish both types of vulnerabilities because they change over time. For example, some people or assets may not be currently vulnerable to climate impacts; but, as conditions change, they may become more at risk. The following actions should be done during both steps to get a comprehensive view of vulnerabilities.

They will only change in methodology, where future vulnerability tends to rely on climate models and projections.

Create a profile of the systems of interest. When defining the scope and scale of the CVA, you should identify particular interest points or areas within your city that are of high priority. By doing this, you can focus on particular impacts to these priority areas as you set scenarios and review data. It is important that you also contextualize these priority points. In other words, you should describe socioeconomic dynamics of the area or population, profile demographics, denote environmental issues, and identify government or institutions that have authority within the area or have a relation to it of some kind. Basically, it is a description of current physical, social, and economic statuses in the area or population. This will help in understanding the factors that make these points of interest vulnerable. Note, during the assessment, you will also obtain knowledge on other areas that may be more vulnerable to climate change; but you should know the areas that your community prioritizes to help in reviewing the data.

Exposure Analysis. Exposure is both the spatial and temporal extent to which an area, sector, or population is subjected to the stresses of climate change.[2] An exposure analysis identifies the current and future climate effects a community may experience as well as the level, the space, and the timing of such effects.[1] Often, the output of the analysis is a list or map of areas that are likely to be impacted. Some communities invest in GIS software for mapping and analyzing exposure. The general analysis steps include: [1]

1. Identify climate and non-climate stressors that may affect the location, population, or sector you are assessing.
2. Gather data and characterize exposure in terms of time and place for particular stressors on the geography, sector, or population.
3. Choose a model (especially for future vulnerability) that will be used for assessment.[i]
4. Select the time frames to guide the models during each output of data (i.e. every 5, 10, or 20 years).
5. Run the models to determine the extent of exposure for various impacts.
6. Locate and determine the areas where climate impacts happen currently or are projected to occur.

Sensitivity Analysis. Sensitivity is the positive or negative response of an area, population, or sector to climate stressors.[1,2] In other words, the higher the sensitivity to climate stressors, the more vulnerable an area tends to be.[2] A sensitivity analysis identifies specific natural resources, structures, populations, and other community features that have been, are, or are expected to be stressed by various climate change impacts. It builds on the findings from the exposure analysis, where the greater the exposure is for a system, the more sensitive it is to climate change.[5] The output of the analysis tends to be an inventory of community assets at risks and the level of response they will have for various climate impacts.[1] This inventory includes: [5]

- *Specific planning area or sector identified*
- *Current or expected stresses to the systems*
- *Known climate conditions that are relevant*
- *How those known conditions currently affect the system of interest*

[i]Note: Some communities base these models off scientific recommendations established in the contextualizing stage (i.e. sea level rise recommendations).

- *Projected climate conditions*
- *Projected impacts of changes*
- *Projected changes in stresses to systems*
- *Degree of system sensitivity*

In this way, it can identify which assets are most sensitive or expected to be most sensitive to climate change. It can also identify the threshold for which some assets become sensitive to new or higher levels of climate stressors.[5] Often, the same tool and output from the exposure analysis (i.e. the map) is used to identify sensitivity. In this way, new layers of sensitivity are added into the map by including various characteristics, such as property value, public schools, socially vulnerable populations, evacuation routes, etc.

Adaptive Capacity Determination. Adaptive capacity is the ability for an area, population, or sector to adjust its characteristics to changes in climate conditions.[3] Generally, those with a high adaptive capacity have the resources or characteristics to handle or absorb climate change impacts.[5] Adaptive capacity is determined by assessing the current response system set up by the community for an asset, the planned or undergoing plans for increasing adaptation of an asset, and the potential resources (social, human, institutional, natural, or economic) available to the asset for confronting climate change.[3] Doing this will establish whether highly exposed and sensitive assets are capable of handling climate impacts. Normally, the output of the determination is qualitative by identifying a system as having high, medium, or low adaptive capacity for a particular stressor. During this determination, stakeholders are often engaged to determine current policies, practices, or infrastructure that make an asset adaptive or the resources available to expand its capacity. It may also inform the planning team on barriers and opportunities for expanding adaptive capacity of various assets.

Determine Risks and Onset. Although different from vulnerability, analyzing risks is also important for understanding climate vulnerabilities and priorities. Risk is the likelihood that a projected climate impact will occur and lead to a known or estimated physical, social, or economic consequence.[5] Risk can be determined both qualitatively (i.e. high, medium, low) or quantitatively (i.e. a specific percentage) depending on the resources and information available.[5] This will determine the level of confidence for expecting such impacts.

Step 5: Establish priority planning areas.[5]

After performing the various analyses, assess the overall current and future vulnerabilities and risks for both systems of interests and noted areas of high concern found from the assessments. Determine vulnerability via a vulnerability index or qualitative ranking as high or low based on the level of exposure, sensitivity, and adaptive capacity. Similarly, determine whether risk is high or low based on a standard set by quantitative or qualitative criteria. There are formulas available to set these determinations.[ii] To assign priorities to the areas, populations, or sectors, group the vulnerability results with the risk analysis results as either high or low risk/vulnerability. The matrix[5] below shows an example of how this prioritization occurs. Typically, those with high-risk and high-vulnerability are given priority. For those with a low-risk, low-vulnerability, or both, you will need to set criteria to discern their priorities, such as cultural values, economic information, or stakeholder identification.

[ii]Note: You can also use a medium criterion if you have many types of assets. However, high and low are usually preferred for ease of identification.

PLANNING AREAS WITH SYSTEMS THAT ARE…

	Low Vulnerability	High Vulnerability
High Risk	***May be** priority planning areas*	***Should be** priority planning areas*
Low Risk	***Are unlikely to be** priority planning areas*	***May be** priority planning areas*

Step 6: Conclude with Recommendations

During the vulnerability assessment, you should identify key findings from each analysis as well as stakeholder involvement workshops. Findings may include the list of priority areas, other considerations, the vulnerability index, or possible adaptation actions. These findings should be summarized at the end of your vulnerability assessment, so the leadership team and policymakers know the next steps to take. They could either be summed up as a list of next steps, summaries of specific asset types (e.g. evacuation routes, schools, hospitals), or as a graphic.

Step 7: Finalize Outputs.

The final output of the assessment varies on the methodology and approaches used in each analysis. Typically, a report is produced defining the methodology, data, analyses, and conclusionary statements about priority areas or a summary of the findings. However, there can be other types of outputs produced from a Climate Vulnerability Assessment. For example, they could produce maps, or visuals showing the spatial and temporal aspects of vulnerability (exposure, sensitivity, adaptive capacity).[iii] This was done by the Sarasota Bay Estuary Project and Mote Marine Laboratory. Together, they created the "Sarasota Bay Estuary Sea Level Rise Map Viewer", which visualizes the vulnerability of lands in Sarasota and Manatee Counties to sea-level rise. Another example of an output is a profile. Profiles may compare the different elements of vulnerability (exposure, sensitivity, adaptive capacity) for various assets, characterize priority assets, or illustrate the projected impacts of climate change. They can be done as a written summary, a graphic (i.e. pentagrams or radar charts), or a combination of the two. Lastly, the output could be an interactive website to see all the products created.

Tools to Use for Climate Vulnerability Assessments

As mentioned, throughout the assessment process there will be tools and datasets that need to be used. The following are some basic tools available for free and that can be understood from all ranges of knowledge on climate issues. A more detailed list of tools and databases is provided in Appendix C.

- CanVis Tool – This tool is for coastal communities to visualize future changes related to sea level rise, storm surges, and flooding as well as evaluate the visual impacts of adaptation options. It was developed by the U.S. Department of Agriculture and NOAA. The tool works by importing photographs from a place in the community. Then, users are able to view the potential impacts of rising sea levels in that specific area. Planners may incorporate docks, buildings, rising waters, and other objects into the photo to see potential scenarios. This tool requires minimal expert knowledge.
- Climate Central Surging Seas Viewer - This tool has an interactive Risk Finder, which shows populations, infrastructure, and community assets exposed to sea level rise and coastal flooding for coastal communities.

[iii] Note: This can include exposure, sensitivity, or adaptive capacity maps used during assessment.

There are also other tools on this website that provide interactive maps for visualizing sea level rise under different emissions and warming scenarios. This tool requires minimal expert knowledge.

- Coastal County Snapshots – Developed by NOAA, this tool provides charts and graphs that describe complex coastal data, including information on flood exposure, wetland benefits, and ocean jobs. It helps to provide context for coastal and inland counties in Florida. It requires minimum level of expert knowledge.
- Data.gov Climate – This website provides U.S. Government open data on climate change. It can be used by any level of government to conduct research or design data visualizations that may be helpful for performing vulnerability assessments. It requires a medium level of expert knowledge.
- Hazus – This is a methodology from the Federal Emergency Management Agency (FEMA) that contains models for estimating potential losses (physical, economic, or social) from earthquakes, floods, and hurricanes. It uses GIS to identify high-risk locations. It is mostly used as part of the risk assessment. However, it can be used to improve hazard mitigation.
- NatureServe VISTA – This scenario-based assessment and planning tool requires ArcGIS, as it is an extension to this service. The tool helps managers and planners assess impacts for natural, cultural, or development projects as well as create options for sites and landscapes to judge adaptative options. It supports ongoing, routine, planning, and implementation of adaptive management especially for natural resource management.
- NOAA's Climate at a Glance – This tool provides regional, county, and city level climate data for Florida. It is used to show historical trends that may help indicate future projections. It requires minimal expert knowledge.
- U.S. DOT Vulnerability Assessment - This is an Excel-based tool that helps transportation planners assess the vulnerability of their transportation systems to climate stressors based on indicators. The goal is to prioritize assets based off these indicators. It requires medium expert knowledge.

Climate Vulnerability Assessment Case Studies and Best Practices

Climate Vulnerability Assessments have been performed by communities throughout Florida over the last decade. However, the majority have been done by coastal communities. So, these assessments tend to focus on specific climate impacts, such as sea level rise or coastal flooding risks. Although few communities have comprehensively assessed climate vulnerability or inland communities, this is beginning to be more prevalent, especially as inland ecosystems and economies become more affected by climate change.

These community assessments vary in length and depth. As explained earlier, this is because it is dependent on the scope and purpose of the assessment as well as available resources. Some of these communities only assessed impacts to specific sectors (e.g. transportation, stormwater, schools, buildings, etc.). For example, the City of Rockledge performed the "Sea-Level Rise Inundation Assessment for the City of Rockledge Stormwater System" for stormwater infrastructure. Similarly, Broward, Miami-Dade, Monroe, and Palm beach counties assessed only transportation infrastructure in their "South Florida Climate Change Vulnerability Assessment and Adaptation Pilot Project". Other communities only focused on assessing certain types of properties of the community, such as historic properties. Both the Town of Cedar Key and the Miami-Dade County Office of Historic Preservation performed sea level rise and flood assessments focusing on impacts to these areas. Lastly, some communities have performed vulnerability assessments, but not for the purpose of climate change. For example, Franklin County completed a "Hazard Identification and Vulnerability Assessment" to inform their

Local Mitigation Strategy. While this did not exactly address climate change, most of the data and expected impacts were related to climate hazards and the methodology resembles that for CVAs. Another instance of this is the Town of Bay Harbor Islands "Seawall Condition and Resiliency Assessment". This assessment addressed a current adaptation and resiliency strategy and established the value of it in making the town more adaptive to sea level rise. Overall, these examples show that CVAs do not have to be comprehensive. Instead, if your community is lacking resources, it may be a good start to just focus on a specific type of asset, area, or adaptation strategy to inform you efforts.

Below is a list of best practices for completing Climate Vulnerability Assessments based off these case studies and others from around the world.

- *Stakeholder Involvement* – As mentioned in **Section 2.2 Climate Change Education and Engagement**, stakeholders should be engaged throughout the policy planning process. This includes during the process of planning, performing, and reviewing the Climate Vulnerability Assessment. Stakeholder feedback and ideas help inform efforts by refining the scope and focuses of the assessment, defining vulnerability in local terms, and sharing ideas and findings missed during the analyses. For example, longtime residents or government employees can provide historical information about areas or policies. Moreover, internal government stakeholders should be engaged as partners or experts during this process. For example, Public Works or Environmental Departments staff can provide information or input as well as oversee the process. Even after the assessment is completed, results should be communicated to stakeholders to expose and inform them to current ideas in climate action planning. Examples of engagement opportunities include interviews or focus groups with residents, facilitated discussions, town hall meetings, presentations to the legislative bodies, or meetings with municipal or county staff and community groups. This worksheet from NOAA can help you identify stakeholders you may want to engage during the process.
- *Pool Resources with Other Local Governments* – One strategy for communities lacking resources is to complete a vulnerability assessment with neighboring municipalities or counties. This helps with cost-sharing, developing consistent information on projected climate change impacts, and creating a link between these communities' adaptation actions. Moreover, sometimes climate impact information is hard to downscale to the municipal level. So, this can help pool knowledge of this information across communities experiencing similar impacts. An example of this was done by the Southeast Florida Climate Change Compact, which performed the "Inundation Mapping and Vulnerability Assessment" in August 2012. This assessment looked at sea level rise impacts to Monroe, Miami-Dade, Broward, and Palm Beach Counties. Note, initially there was an obstacle for collaborating as each county had varying mapping methods and approaches. However, after participating in a workshop hosted by NOAA staff members, the four counties developed unified methods and criteria for assessing vulnerabilities.
- *Work with Partners for Funding and Data Sources* – Much of the data that can be used in these CVAs are available through regional, state, and national government agencies. Along with this, these agencies provide funding opportunities to complete these assessments (See **Section 2.7 Implementation**). Examples of these agencies include NOAA, Florida's Department of Economic Opportunity, Florida's Department of Environmental Protection, Florida's Regional Planning Councils, Transportation Planning Organizations, and universities/academia (e.g. University of Florida). Moreover, there are a number of consulting firms that

specialize in performing these assessments. So, they can work with you on the assessment analyses and data.

- *Consider Equity Concerns* – Again, during your assessments, you will want to consider vulnerabilities related to equity issues. This is especially relevant as underserved communities are more vulnerable to and less prepared for climate change impacts. Considering equity can include integrating socioeconomic data or indexes into vulnerability analyses, focusing on the underserved communities for climate impacts, or engaging these groups during the vulnerability assessment process.
- *Continuing Vulnerability Assessments* – Vulnerability assessments may need to be repeated to incorporate this new information or areas that have become vulnerable. Along with this, if your community creates more adaptation strategies, the adaptive capacity for assets will change. So, again information should be reviewed to update and track changes in vulnerability. Furthermore, if your community finds more resources or support for a comprehensive and detailed assessment, you can perform one in the future. The purpose of an original assessment is to identify high priority areas and inform adaptation strategies.

CHECKLIST OF ACTIONS

- ☐ Review case studies of vulnerability assessments and additional tools in the "Additional Resources" section below.
- ☐ Define the purpose and scope of your vulnerability assessment.
- ☐ Identify leadership who will manage the assessment.
- ☐ Select tools and data resources you will use during the assessment.
- ☐ Organize engagement opportunities for the assessment process.
- ☐ Conduct and execute a Climate Vulnerability Assessment.

References

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[3] GIZ India. "Framework for Climate Change Vulnerability Assessments". https://www.weadapt.org/sites/weadapt.org/files/legacy-new/knowledge-base/files/5476022698f9agiz2014-1733en-framework-climate-change.pdf.

[4] Climate ADAPT. "Adaptation Support Tool Step 2". https://climate-adapt.eea.europa.eu/knowledge/tools/adaptation-support-tool/step-2.

[5] ICLEI USA. "Preparing for Climate Change: A Guidebook for Local Regional, and State Governments". https://icleiusa.org/wp-content/uploads/2015/06/Preparing-for-Climate-Change-Adaptation-Guidebook.pdf.

Additional Resources

"Climate Vulnerability Assessment: An Annex to the USAID Climate Resilient Development Framework" – US AID. *This report gives details on the processes and frameworks used for vulnerability assessments.*

"Climate Change Vulnerability Assessment for Natural Resource Management: Toolbox of Methods with Case Studies" – U.S. Fish and Wildlife Service. *This guide provides a toolbox of methods for natural resource managers to perform climate vulnerability assessments.*

"Climate Vulnerability and Capacity Analysis Handbook" – CARE International. *This handbook reviews participatory tools used to create CVAs.*

"Designing Climate Vulnerability Assessments" – US AID. *This guide provides details on the designs and frameworks of vulnerability assessments.*

"Incorporating Sea Level Change Scenarios at the Local Level" – NOAA. *This guide provides insight for coastal communities on using sea level change scenarios for vulnerability assessments.*

"Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments" – ICLEI USA. *This guidebook reviews the steps of performing vulnerability assessments.*

Vulnerability Assessments webpage – NOAA Digital Coast. *This page provides numerous resources that may help coastal communities conduct a vulnerability assessment.*

TRAININGS/WORKSHOPS

ClimateWise website. *This group can help your community perform a vulnerability assessment through a consulting service or through an assisted do-it-yourself program. They also have resources and guides that explains the steps of vulnerability assessments more in-depth.*

NOAA Digital Coast Trainings. *This website provides trainings on a number of vulnerability assessment steps and tools, such as inundation mapping, estimating the marine economy, or understanding lidar. This is more applicable to coastal communities.*

ICLEI USA and Temperate Adaptation Planning Software. *These groups provide capacity building and technical assistance to local governments for climate adaptation and resiliency planning, including conducting a comprehensive risk and vulnerability assessment. This service does have a fee.*

For questions about this section's content or to learn more information, please contact:

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SECTION 2.4 CONDUCTING A GREENHOUSE GAS EMISSIONS INVENTORY

Conducting a Greenhouse Gas (GHG) emissions inventory is the first step to implementing sustainability into municipal planning and policymaking and is the basis from which to develop a Climate Action Plan. This section provides local governments with general information on conducting a GHG emissions inventory; it is intended to compliment already existing technical guides and resources.

Step #2: Defining the Climate-Related Problems → Greenhouse Gas Emissions Inventory

GOAL AND LEARNING OBJECTIVES

GOAL:
Learn to conduct a GHG inventory. Set GHG targets.

LEARNING OBJECTIVES:
By the end of the section, you will be able to:

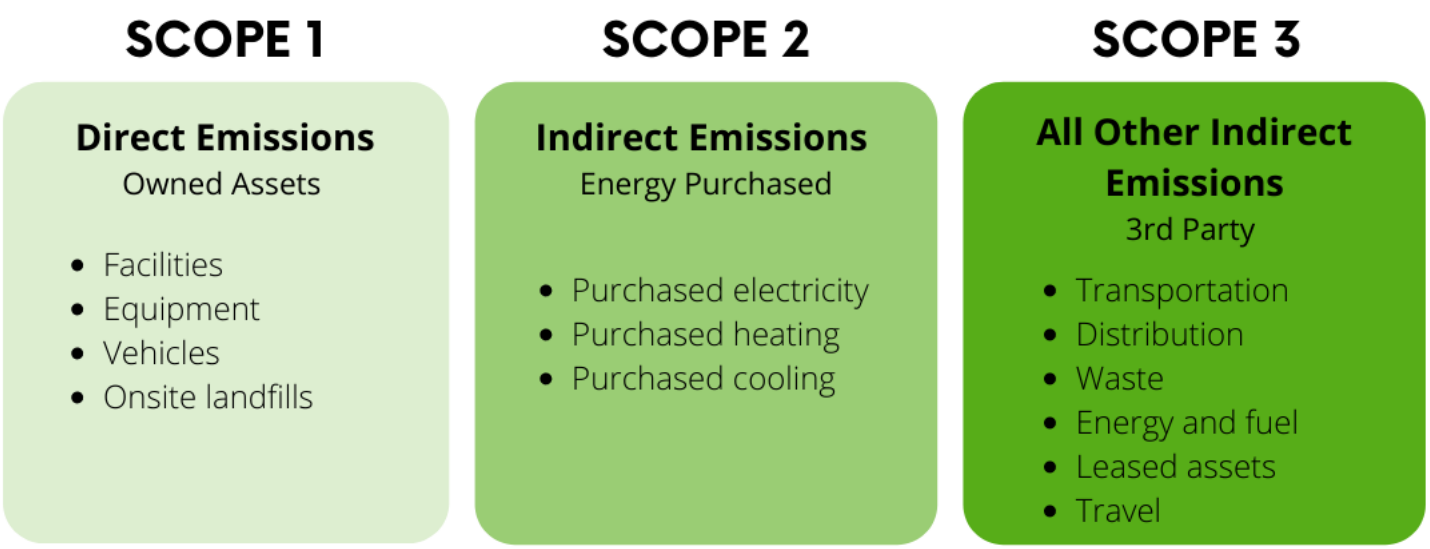
- Identify GHG sources and data
- Conduct a GHG inventory
- Set GHG targets
- Actions for GHG reductions
- Policies to support GHG reductions

Goals and Objectives

- Identification of emission sources within your municipality and community
- Indication of the relative significance of each source
- A historical record of emissions that may prove valuable for future regulatory emission requirements
- Establishment of a solid foundation on which to base decisions on how to cost-effectively reduce and achieve emission reductions
- A framework to set goals and targets for future emission reductions

A greenhouse gas ("GHG") inventory can be developed to guide the actions of local decision-makers and municipal staff and focus work to reduce GHG emissions in the community. A GHG inventory provides a baseline from which to measure progress against and a method for benchmarking the effectiveness of local climate mitigation programs and policies. The data produced provides a local understanding of how residents, businesses, and municipal operations contribute to the community's GHG emissions footprint. Establishing a robust GHG inventory baseline is an important first step to take to set climate goals and inform implementation of local climate action.

The primary greenhouse gases included in a typical community-scale inventory are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). For accounting purposes, CH_4 and N_2O are converted to total metric tons (MT) of CO_2 equivalent (CO_2e) converted based on their Global Warming Potential (GWP). The Global Protocol is based on a scopes framework for reporting emissions to allow cities and towns to attribute GHG emissions based on where they are taking place. Scope 1 emissions are physically occurred within the geographic boundary, scope 2 emissions occur as a result of use of grid-supplied electricity, heat, steam and/or cooling within the geographic boundary, and scope 3 emissions occur outside of the geographic boundary but are driven by activities within the geographic boundary.



Getting Started

Before diving into data collection and calculation of emissions, there are two key decisions that need to be made for either a community or municipal-scale GHG inventory.

What year am I calculating GHG emissions for? If your community is developing a GHG inventory for the first time, we recommend selecting the most recent year for which data are widely available. In some instances, where communities have set specific GHG emissions reductions goal from a specific year, you may want to calculate emissions for the baseline year if data is available. It can be more difficult to access historic data depending on how far back the comparison year is (e.g. 2002 vs. 2013). Keep in mind that depending on the year selected, data set availability may vary across different sources.

What is the geographic boundary for this GHG inventory? We recommend selecting your city or town's administrative geographic boundary for the purposes of developing a community-scale GHG inventory. For a municipal scale inventory, we recommend anything that the municipality itself owns or operates. This selection will align most closely with many of the data source recommendations that follow. These are both important items to come to consensus on with the necessary stakeholders prior to data collection as they will both inform how you approach decisions later in the process.

Gather the Data

The data sources recommended in this guide are informed by local experience and the Global Protocol's principles for data collection. Please keep these principles in mind as you consider any substitutions or alternate data sources to the ones recommended throughout the guide. Follow these principles and you will be well on your way to becoming a GHG inventory whiz!

Principle	Global Protocol Definition	Key Questions to Ask
Relevance	The reported GHG emissions shall appropriately reflect the emissions occurring as a result of activities and consumption patterns of the entity.	Does the data set directly relate to the geographic boundary of the GHG inventory?
Completeness	Cities shall account for all required emissions sources within the inventory boundary. Any exclusion of emission sources shall be justified and clearly explained.	Does the data set include all information for the selected baseline year?
Consistency	Emissions calculations shall be consistent in approach, boundary, and methodology.	Does the data adhere to the methods of the GHG inventory? Can the same methods be used year over year?
Transparency	Activity data, emissions sources, emissions factors, and accounting methodologies require adequate documentation and disclosure to enable verification.	Can the data be readily documented and shared with the public?
Accuracy	The calculation of GHG emissions shall not systematically overstate or understate actual GHG emissions.	How close to reality is any of the estimated data being used?

Create a Process

There are a few best practices to create a clear and replicable process for updating your GHG inventory periodically.

Identify a department, committee, or other appropriate party who will be responsible for periodic GHG inventory updates. By designating where the responsibility for the GHG inventory lies, you can set the foundation for maintaining capacity and knowledge over time. It may be beneficial to make sure that at least two people understand how to update the GHG inventory and are familiar with the data sources to create a contingency in case of a transition.

Store all files and supporting data in a central location. This may seem like a no-brainer, but a well-organized and clearly labeled file storage system will set you up for success moving forward. This ensures that, in the future, staff will be able to identify what data sources were used and replicate the methods to consistently update the community's GHG inventory.

Log changes made to the data and methods. This practice is important to maintain transparency and consistency in how your data is reported publicly. One of the limitations of using a spreadsheet-based tool is that there is no streamlined way to track changes that are made to formulas or input data. A best practice to remedy this limitation is to maintain a separate document where users can log the data inputs and any method changes made, along with the date and rationale for making the change.

Do a baseline and updated inventory at the same time. For example, doing 2008 baseline and a 2018 inventory will help you see what direction you are headed.

Step-by-Step

Stationary Energy

Stationary energy accounts for GHG emissions resulting from the use and production of all fuels by non-mobile sources. This includes the direct emissions from the combustion of fuels and indirect emissions from consumption of grid-supplied electricity. Primarily, this represents GHG emissions from the buildings within your community – homes, businesses, and municipal operations. GHG emissions from any energy industries located within your community are also accounted for in stationary energy. Stationary energy also accounts for any fugitive emissions, such as electricity transmission and distribution losses and natural gas leaks.

Acronym Key

CNG – Compressed Natural Gas
CO_2 – Carbon Dioxide
CO_2e – Carbon Dioxide Equivalent
EPA – Environmental Protection Agency
GHG – Greenhouse Gas
GPC – Global Protocol for Community-Scale Greenhouse Gas Inventories (also referred to as Global Protocol)
kWh – kilowatt hour
MPG – Miles Per Gallon
MT – Metric Ton
RTA – Regional Transit Authority
VMT – Vehicle Miles Travelled

Electricity and Natural Gas

Calculating emissions from the electricity and natural gas consumed in your community requires collection of total kilowatt hours (kWh) and therms consumed by all buildings during the inventory year. Where you go to collect this data depends on the electricity and natural gas service providers in your community. The electricity and natural gas consumed by municipally owned buildings is accounted for in the Commercial and Industrial account data reported by the Investor Owned Utilities (IOUs). If your community is interested in tracking municipal GHG emissions separately from community wide GHG emissions, additional data on electricity, natural gas, and other heating fuels (oil and/or propane) needs to be collected. If your community is a designated Green Community, this data will be available annually in reports completed by your city or town.

Transportation

Emissions from on-road transportation and railways are calculated within the transportation sector. GHG emissions in this sector are caused directly, through the combustion of fuel, and indirectly, through the consumption of grid-supplied electricity. Municipalities intersected by public transportation routes – regardless of whether there is a stop within their boundary – must also account for these emissions. Public transportation that occurs on roadways, by buses and trolley buses, is accounted for in the on-road transportation subsector. Public transportation that occurs on railways, by commuter rail, heavy rail, and light rail, is accounted for in the railways subsector.

On-road Passenger and Commercial Vehicles

All municipalities, regardless of size and location, must calculate emissions generated by the vehicles moving along their roadways. There are a few approaches for doing so; this guide employs the Florida Department of Transportation (FDOT) Vehicle Miles Traveled as reported annually by the FDOT here. This method is preferred because it can be replicated on an annual basis and reduces the risk of double counting emissions from the allocation of cross-boundary trips across multiple communities.

Public Transportation (On-road and Railway)

Municipalities should begin their calculations by identifying what public transportation operates within their boundaries. If your municipality is served by one or more of the regional transit authorities (RTAs) that provide fixed route and paratransit service across the state, your inventory should account for these emissions. We've outlined one approach for doing so here, which is based on what information the RTA is likely to have available and what is possible to complete with limited resources.

To start, contact your RTA and explain you are conducting a greenhouse gas inventory. Then request the following information:

- Total fuel used for transportation during your inventory base year, by fuel type

- Total route distance for the system during your inventory base year, by route or vehicle/fuel type
- Total route distance for your municipality during your inventory base year, by route or vehicle/fuel type

Once you have this information on hand, create a ratio of route distance for your municipality to route distance for the system. Then, multiply this figure by the total fuel used in your base year. Input this number in the Inventory Tool. *(Route distance for your municipality / route distance for the system) * (total fuel used in base year) = fuel use attributed to your municipality in base year.* You will need to perform a separate calculation for each fuel type used within the regional transit authority serving your community.

Waste

The waste sector is composed of all emissions that result from the disposal of solid waste and treatment of wastewater generated within the geographic boundary of the GHG inventory. This guide covers data collection for municipal solid waste and for wastewater generated within the community. Solid waste is generated by residents and visitors, businesses, public entities, and other organizations in the community. There are two main sources of emissions from solid waste: waste sent to landfill and waste sent to incineration. Emissions from composting and anaerobic digestion are also considered.

Municipal Solid Waste

WHY ISN'T RECYCLING INCLUDED IN A GHG INVENTORY?
Any energy consumed on-site to recycle the materials would be accounted for in the stationary energy sector from any electricity use or combusted fuel. Recyclables also do not emit any methane gas during the refurbishing processes, so the total tonnage of recycling does not need to be accounted for in a methane commitment model.

Landfilled waste results in methane emissions as organic materials decompose in the anaerobic (non-oxygen) environment of a landfill. Organic materials (e.g., paper, plant debris, food waste, and so forth) generate methane while non-organic materials do not (e.g., metal, glass, and so forth). Landfill emissions estimates are based on a variety of factors, including whether it is an open or closed landfill, the volume of waste, and whether the landfill has a landfill gas collection system.

- **For landfilled waste**, GHG inventories should account for methane emissions. These emissions are estimated using the Methane Commitment Model, which assigns the total lifetime emissions based on the amount of waste sent to a landfill in a given year.
- **Incineration of waste** results in carbon dioxide, methane, and nitrous oxide emissions as the waste is burned. GHG emissions from waste generated within the city boundary that is incinerated outside the city are included but are considered as Scope 2 emissions (i.e., those emissions resulting from the consumption of grid supplied electricity) and included as part of the grid-supplied electricity emissions factor.
- **The biological treatment of waste** through either composting or anaerobic digestion results in methane and nitrous oxide emissions. The emissions factors used are determined based on type of treatment occurring and any methane gas recovery that may be occurring onsite. You will need to collect information on the amount of waste generated by residents and businesses, characteristics of the waste stream, and how the waste is disposed of in your community to determine the amount of waste management related emissions. This guide does not cover all waste generated outside of the Municipal Solid Waste stream. However, depending on who is served by your municipal solid waste collection services, some additional data may need to be collected to ensure that all waste generated by residents and municipal operations is included in your GHG inventory. You can also use the Florida Department of Environmental Protection's Annual Solid Waste Report data by county and adjust by per capita for your community. It can be a little hard to find and there is about a

two-year delay in publishing but current reports can be found here and archived reports can be found here. For municipal inventories you can simply request data from your waste hauler.

Wastewater

Wastewater treatment can result in methane and/or nitrous oxide emissions. Some plants use up to 97% of the methane for heating the digester tanks or a cogeneration system where it is used to heat buildings and generate electricity via steam turbine generators. Similarly, treatment plants use methane capture systems that significantly reduce the release of GHG emissions. Because of this, methane emissions associated with wastewater treatment can be excluded from communities served by these facilities. If your community's wastewater is not already tracking its GHG emissions, you can estimate them using per-capita analysis from your county or state emissions data. You can also check if the EPA is tracking that particular facility here. Smaller communities have also just added the note that they were only able to track energy data from wastewater emissions.

Calculate Emissions

The next step to completing your GHG inventory will be to input all the data you have collected in the corresponding fields in the "Inputs" into a GHG management tool. The two we have used are ICLEI-ClearPath platform and City Inventory Reporting and Information System (CIRIS) or find another inventory software that works for you. To proceed in this section, you will need:

- A completed data collection worksheet for your community with data for the appropriate inventory year
- A blank copy of the Tool to input the data

Input the collected data. The "Inputs" sheet provides guidance as you walk through each sector and subsector on how to gather and where to add the data collected. You will need to enter community-specific data from your worksheet using the instructions provided.

Evaluation of the results is where information translates into action. However, before diving into the analysis of your results, it is important to spend the time proofing your outcomes. Review your assumptions, check your calculations, and if possible have an outside reviewer look at your data for consistency and accuracy.

Emissions Forecasting

After completing a baseline year GHG emissions inventory, the general next step is to assess how the emissions are going to change under business-as-usual conditions in the future. Completing an emissions forecast is important because you will need to understand what your emissions projections will be in order for you to efficiently determine your emissions reduction goal. Additionally, forecasting emissions will help you to identify and prioritize emissions measures as the estimated projections will provide insight into potentially the largest emissions sources. There are numerous proxies that you can utilize to estimate your emissions forecast. For instance, within the community inventory, examples of some of those proxies include population growth trends, residential, commercial and industrial development trends, energy use trends, and workforce expansion trends. For municipal emissions forecast, it is possible to use information on *the expansion of municipal services or infrastructure, municipal budget forecast, community population growth trend, among others.* The approach that is selected may depend on the unique circumstances of each jurisdiction. As such, it will be important to discuss with your colleagues which approach will work best for your community. It is important to keep in mind that the emissions forecasting should provide you general insight into your future emissions. As conditions evolve within both the municipal and community sectors, it will be necessary to revisit and update the forecast methods.

Moving Forward

A GHG inventory is only as good as the policies and programs that it is used to create. The inventory is the first step to emissions reductions—your emission inventory results inform you of the sources and magnitude of emissions from your local government so that you can move towards cost-effective reduction of those emission sources.

Establish an Emissions Reduction Target

One of the more important decisions that will arise from the inventory is the establishment of an emissions reduction target. This target is central to your overall prioritization as it determines the amount of emissions you seek to reduce, which will inform the selection and importance of other steps you can take. The **emissions target** will take into account current emissions and your emissions forecast and define a goal for reducing projected emissions in a given timeframe. The emissions reduction target is important in providing a tangible goal for your entity's reduction efforts. When setting a reduction target, keep in mind that the target should be aggressive but also practical in that it can be achievable given your entity's circumstances. It may be helpful to first research what reduction targets other local governments, especially those near you and/or those that have similar characteristics, have selected as a way for comparison. Additionally, if you are doing an inventory for both your municipal and community sectors, you may choose to set a more aggressive reduction target for your municipal sector. In so doing, you are setting an example for the rest of the community to follow.

Create a matrix that allows ranking of emissions sources

A matrix characterizing emissions sources provides for the comparison of savings potential and costs and benefits of target sub-sectors. The matrix should include criteria that are important to consider and be designed in such a way that stakeholders can compare the pros and cons of addressing specific emissions sources. Such a matrix could include:

- Potential measures to address this source
- Co-benefits of reduction (health, jobs, criteria pollutant reductions, etc.)
- Staffing requirements for reducing this source
- Cost per ton reduction (cost of measure minus cost saving over time)
- Potential barriers to reductions
- Ease of integration into existing policy / Fit with existing codes and plans
- Short- / Middle-/ or Long-Term benefits
- Possible sources of funding (utility, state, federal, other)

Providing input to this matrix will require research, some guesswork, and will include many subjective judgments. Although it can be challenging, it is important for the purposes of comparison. However, to ensure that the process is clear and transparent, it is important to document all assumptions you make in this step, as tracking sources will enable verification of facts/estimates and allow for flexibility in updates as data increases and improves. Development of such a matrix will facilitate easier and more clear definition of reduction strategies and policy options in the future.

Involve the Community

Climate change is a complex, and far-reaching subject. It has the potential to affect the entire community. As such, defining priorities can be a challenging and political process. On the one hand, opening discussion of priorities to the public provides for an active civil society and engages people in their community. On the other hand, local governments need to get community to buy-in or they will not be successful in achieving the reduction target. Priorities cannot be based solely on costs and savings, but rather should have broad community support so that they can be readily approved and implemented. Additionally, community members often come up with creative ideas and innovative approaches to challenging problems. Some communities

establish committees for each emission sector (buildings, waste, transportation, etc.). Others hold community meetings to gather ideas across the board. Talk to other cities and counties to find out how they are involving their constituents in sustainability planning. You can ask community members / stakeholders to provide input on criteria that might otherwise require intensive technical assessment, however where qualitative input may be sufficient to support prioritization of strategies. Criteria of this sort includes:

- Technical feasibility of reduction strategy
- Political feasibility of reduction strategy
- Visibility
- Perceived support

With the development of an emissions reduction target, a priority matrix, and collection of community input on these priorities, you are in a position to define your priorities and begin to develop policies and programs that address those priorities. A significant level of effort and input in the prioritization process puts you in a position to make more informed choices about the kinds of policies and programs that can be used to realize your goals, and ensure that once those choices are made, as much of the community as possible supports the direction you choose to go in.

Draw on Existing Models

The number and diversity of existing GHG policies is growing rapidly every day. At this point, many jurisdictions have done the heavy lifting to define regulations, ordinances, and program structures that directly address their GHG emissions. As such, any jurisdiction looking to adopt a new policy does not have to reinvent the wheel. While it is clearly important to tailor policies to specific circumstances, the architecture, the basis, and even the specific structure of another jurisdiction's policies may save significant amounts of time and effort. Further, looking at what neighbor jurisdictions are doing (or are talking about doing), may provide critical input on policy options.

Make the Business Case

Solving the climate crisis is urgent, but perhaps more importantly, doing it in a smart way will unleash enormous economic opportunity. Mitigating greenhouse gas emissions worldwide will require a crash program to use energy more efficiently, and to use renewable energy sources. Doing this can cut costs and drive competitiveness, spread the use of clean energy technologies that already are cost competitive and available and develop next generation technologies in virtually every sector of the economy. If you can demonstrate both long-term and short-term savings potential from emission reductions, you are going to be in a much stronger position to engage stakeholders in the policy adoption process (see the referenced article above). However, don't be held prisoner to short-term return on investment. Some actions (e.g. environmental education) have no or only limited direct payback but are critical for building capacity internally or throughout the community.

Focus on Co-benefits

Because of the breadth of GHG producing activities, policies to reduce these gases can be far-reaching and require significant community support, however the same breadth means that there are often significant co-benefits from GHG reducing policies that become leverage points for building support, or even identifying funding sources for implementation measures. For example, transportation produces significant carbon emissions, but also creates air quality hazards. Addressing transportation impacts through the use of low-emission vehicles can also help create cleaner air, a vital public health benefit. By framing the issue from various perspectives (e.g. health, education, economic development) you will appeal to a broader base of support. The benefits are multifold, including energy independence, clean energy development, and green collar jobs. If you reach out to the likely as well as the unlikely advocates, you may move forward more easily. While environmental groups and certain trade associations may easily support your efforts and advocate on your

behalf at public meetings and through marketing, you may also be able to engage new advocates (e.g. advocates for seniors may respond to increased density policies because it can increase access to services for the elderly). Identifying and highlighting the co-benefits of GHG reduction policies can greatly facilitate support and adoption.

CHECKLIST OF ACTIONS

- ☐ Assign team roles
- ☐ Gather data for emission sources
- ☐ Translate data using a GHG software tool
- ☐ Report baseline and updated inventory
- ☐ Create Reduction Targets
- ☐ Draft Reduction Plan

References

https://www.fdot.gov/statistics/mileage-rpts/default.shtm
https://floridadep.gov/waste/waste-reduction/documents/2019-final-disposition-municipal-solid-waste
http://southernwasteinformationexchange.com/fdep-solid-waste-annual-reports/
https://www.epa.gov/statelocalenergy/local-greenhouse-gas-inventory-tool
https://www.ca-ilg.org/post/greenhouse-gas-inventory-resources
https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities
https://ghgprotocol.org/greenhouse-gas-protocol-accounting-reporting-standard-cities

Additional Resources

https://icleiusa.org/clearpath/
https://icleiusa.org/ghg-contribution-analysis/
https://www.c40knowledgehub.org/s/article/City-Inventory-Reporting-and-Information-System-CIRIS?language=en_US

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SECTION 2.5 IDENTIFYING CLIMATE ACTION STRATEGIES

While addressing climate change through policy is a complex process, the strategies and measures to do so are abundant for community leaders at all scales. With so many options and a lack of resources to implement all at once, it is important that local governments begin identifying the choices they can adopt into current plans as well as an overarching climate action plan. Each community is different and needs to evaluate what is important to determine the types of actions it will take. So, using the goals and objectives created by the climate vulnerability assessment and the GHG Inventory will help along with community input. This section will review the part of the climate policy process that begins addressing solutions. It will review the types of climate policy measures, how to start reviewing and selecting policy options, give overviews on mitigation and adaptation strategies, and provide examples of those strategies for consideration.

GOAL AND LEARNING OBJECTIVES

GOAL:

To understand general options for climate action and create a list of potential solutions.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Begin your list for potential climate action solutions.
- Differentiate between mitigation and adaptation strategies.
- Identify general mitigation and adaptation goals.
- Exemplify mitigation and adaptation measures.

Overview of Strategies for Climate Action Planning

Once the risks and emission levels have been identified by the community, the goals and objectives for climate efforts can be established. Knowing these goals will help in choosing the strategies and measures that can achieve them while also not overwhelming current resources. Depending on the goals that matter most to the community, strategies and specific measures will vary. However, climate actions involve two main goals – reducing greenhouse gas emissions and strengthening adaptive capacity to climate-related impacts. Those that reduce greenhouse gas emissions, the main contributor to a rapidly changing climate, are referred to as mitigation strategies (See Section 2.5.1 Mitigation Strategies). On the other hand, those that strengthen preparedness, recover, and resilience efforts are adaptation strategies (See Section 2.5.2 Adaptation Strategies). There is overlap between these climate goals and other community improvement goals (e.g. economic development, service expansion, community beautification, etc.) These strategies can be implemented for internal government operations or community-wide services, and they will involve every department from transportation to finance in some way as capacity is built and strategies are adopted. Along with this, they can be integrated into existing frameworks or create a new one entirely.

Because of the large variability in climate action options, changes to procedures or current policies may also be considered as part of these efforts, even if they do not directly address climate goals. This is especially relevant for those that build capacity and resources to handle climate change, such as creating a reporting system of sustainability or climate efforts or increasing flexibility of departments to react to impacts of climate change. This flexibility part is essential for all climate strategies, as there is still some uncertainty concerning the extent of climate impacts. So, the more flexible and transparent a policy can be to changing climate scenarios, the better prepared a community becomes.

How to Research and Catalog your Climate Action Options

Since there are so many climate actions options your local government can adopt, it is necessary to research, catalog, and minimize the list to achieve reasonable and feasible goals and objectives. This part of the climate policy process can be research- and time-intensive because it involves understanding all the available options out there. The end product from this step will be a wide-ranging list of strategies that could reduce your climate vulnerability, risks, and GHG emissions. This list must be balanced between being succinct as well as diverse and large. The more diverse the options, the more likely a comprehensive approach will be adopted. For example, rather than having strategies solely focused on shoreline protection and restoration, include those that may involve relocating or incentivize sustainable development in other areas of the community.

There are many approaches to build this list. The approach your leadership team chooses will depend on the characteristics of your community, acceptance of climate change, and communication strategy. For the most part, this task is led by climate leadership. However, governments can hire or participate in expert training and services that help them identify their options. Either way, this process will require them to ask for the input and advice from others in the community. This includes asking community members and populations for ideas or giving them planning exercises to come up with ideas. It can also involve engaging various departments, such as natural resource management, parks and recreation, public works, and transportation, on identifying overlaps between their responsibilities and impacts of climate change. As this happens, leaders from the team can either be assigned to look for specific measures that achieve a certain goal established, or they can look at all available options and match them to the goal. It may also be helpful in identifying past events that have occurred and led to damage to see how they could have been avoided or pose a lesser threat. Researching such measures means exploring case studies, resources with suggestions, and decision-making tools. Many of these are listed in "Additional Resources" below.

Once a large, diverse list is compiled, it should be reviewed and narrowed down before moving on to the next step. To do this, it will involve matching it to goals and objectives, identifying existing community structures it could possibly fit in, as well as engaging the community and internal team, especially the legislative body and head of administration, once more. This part should be brief by eliminating any duplicate ideas and combining similar ones. Essentially, you want to have an organized list before you start evaluating and prioritizing options.

Concluding Remarks

The next two subsections, 2.5.1 and 2.5.2, will review the overarching goals of mitigation and adaptation strategies as well as provide some examples and case studies from Florida of the measures to achieve them. These examples are ones that are commonly adopted. However, there are many other ones not noted in this handbook or that can be integrated in other ways, which is why it is important for you to perform additional research. Nonetheless, these are great starting points for your community to consider.

CHECKLIST OF ACTIONS

- ☐ Make a list of mitigation and adaptation strategies or ideas that would be of interest to you and your local government using the following subsection examples, consulting firms, and information in "Additional Resources". As you do this, note the goals or objectives they address from your Greenhouse Gas Inventory or Climate Vulnerability Assessment. Also, denote any immediate issues as well as strengths or advantages that you think might affect the implementation of this strategy.
- ☐ Research other mitigation and adaptation strategies and case studies of similar local governments that are not listed in the following pages and add them to your list.

Additional Resources

(NOTE: These are for both this section and the subsequent subsections.)

Georgetown Climate Center website. *This website provides a number of toolkits, articles, and reports related to green infrastructure, urban heat island strategies, managed retreat strategies, and adaptation.*

Local Government Climate and Energy Series – Environmental Protection Agency. *This series reviews strategies that local governments can use to reduce greenhouse gas emissions.*

Model Ordinance Toolkit – Audubon Florida. *This toolkit provides example ordinances for electric vehicle infrastructure, cool/green roofing standards, stormwater runoff, tree canopy, green building program, and fleet conversion and greenhouse gas emission data.*

Smart Growth – EPA. This website provides resources for creating and implementing smart growth strategies that help communities grow in sustainable ways.

Southeast Florida Regional Climate Change Action Plan 2.0 – Southeast Florida Climate Compact. *This web-built platform allows municipal staff (and others) to search both by who you are (planner, public works) and what topic are you are interested in (natural systems, energy). It provides research based best practices, case studies and policy examples for adoption at the local level and is a great first step for any community in Florida.*

"The Florida Planning Toolbox" – Florida Department of Community Affairs. *This guide provides descriptions and examples of planning tools that can help prepare communities in Florida for climate change.*

U.S. Climate Resilience Toolkit – NOAA. *This website provides a number of training courses, expert resources, and case studies on adaptation and mitigation strategies around the country.*

DATABASES OR REPORTS: These provide best practices and additional examples of climate adaptation and mitigation strategies:

- Climate Showcase Communities Program Database
- Heat Island Community Actions Database
- NRCS Climate Concerns and Adaptation Practices
- Transaction Tracker

SERVICES, TOOLS, OR EXPERTISE: These resources can assist you in identifying strategies:

- ClearPath
- Coastal Adaptation &Resilience Tools Initiative
- Eco-Cycle Solutions Quiz
- Florida Water and Climate Alliance
- Pale Blue Dot
- Resilient Rural America Project
- Temperate

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SUBSECTION 2.5.1: MITIGATION STRATEGIES

The Definition, Goals, and Examples of Mitigation Strategies

As discussed in Chapter 1, mitigation strategies are those that reduce the rate and amount of climate change by either lowering greenhouse gas emissions or removing them from the atmosphere.[1] Common mitigation strategies tend to focus on renewable energies, sequestering carbon, or reducing fossil fuel uses at both the individual and community level. Local governments will have to adopt both internal and community wide strategies to successfully lower a community's emissions, especially if the utilities are provided at the local scale. Internal strategies, or green government operations, minimize the government's impacts and provide a template for partners in the community to follow. There are seven common goals for mitigation strategies, as discussed below, including: Carbon Sequestration, Renewable Energy, Energy Efficiency and Conservation, Water Conservation, Improving Air Quality/Reducing Travel, and Reducing Waste. Sometimes, these strategies achieve multiple goals at once. Nonetheless, deciding the specific goals and strategies for mitigation will mainly depend on the findings of the Greenhouse Gas Inventory because it will identify the sectors and energy uses with the largest consumption. It will also depend on the GHG emission reduction targets and any renewable energy goals that were established in the GHG inventory or as a resolution.

Note, the following will detail each type of mitigation goal. Within each goal there will be explanations of common mitigation policies and practices that can be adopted. There are also some case studies presented alongside these policies and practices to help you get an idea of what they can look like or accomplish. Reviewing the following will help you begin your strategy identification efforts as you find mitigation practices best fit for or needed by your community. These policies are not all the available options, but they do cover a wide range of them that can be implemented by any size or geographically located community. These practices apply to internal government operations, community-wide operations, or both.

Carbon Sequestration

Carbon sequestration is the capture and storage of atmospheric carbon dioxide. It is necessary for this to occur as carbon dioxide can stay in the atmosphere for long-periods of time. Also, a time lag will occur even if all emissions were stopped because of the existing amount already in the atmosphere. It can be sequestered into the ocean, geologic (rock) formations, or terrestrial areas (mainly soils and vegetation). There are numerous approaches to capture and trap CO_2, which means there are many mitigation strategies that address this goal.

Commonly, communities look to existing natural environments for expanding their carbon sequestration capacity. It can help to preserve or conserve these areas to store carbon in soils, vegetation, and water and provide other benefits, such as providing species migration corridors and better stormwater management. So, policies that promote protection of natural assets, open space, and rural areas are needed to keep current natural efforts for carbon sequestration. When protecting or creating these areas, it is recommended to keep as much native vegetation and tree canopies as well as incorporate indigenous plants or those appropriate for the climate. These areas can be planned by an internal government team for a common space area as well as required or incentivized through landscaping, buildings, or development regulations. Another way to promote this goal is through planting more trees for building and development efforts or requiring tree canopies. Trees are a primary aspect for sequestering carbon efficiently and can provide shade to cool open areas around a

community. This planting or preserving can be incorporated into the open space planning through zoning or development codes. Furthermore, promoting sustainable practices in agriculture or other economic sectors (i.e. development) can help preserve natural areas and increase carbon sequestration capabilities.[2]


Source: UF/IFAS File Photo

Tree Planting and Protection: *Trees sequester carbon and can cool nearby areas when planted together as a canopy. So, they play an important role in mitigating emissions. Many local governments have joined or started programs that encourage residents and internal departments to plant more trees on properties, in right of ways, or throughout walking areas in the built environment. Along with this, they have adopted tree protection ordinances to prevent unnecessary removals. This is important since most trees take about 20 years to grow to a size suitable for substantial carbon sequestration.*

City of Cape Canaveral	For the past 30 years, this City has been a "Tree City", which is a nationwide program that guides tree management in public spaces. To become this, the city hired a professional arborist to oversee the care of trees, implemented a tree care ordinance, designated a portion of the budget towards planting, care, and removal of trees, and has an official Arbor Day proclamation and events.
City of Coral Springs	All property owners within the City's limits are required to obtain a Tree Removal Permit for all trees removed. To ensure adequate canopy and to maintain the benefits of trees, all trees removed must be replaced with a similar tree.
City of Miami	Million Trees Miami is dedicated to growing a healthy urban forest that provides a minimum of 30 percent tree canopy coverage. They will do this through free giveaways and planting events as well as the Street Tree Master Plan. This plan outlines designs and plantings in public spaces, such as rights-of-ways.

Renewable Energy

Although energy systems are subject to consideration of state and federal agencies, local governments, especially those that run their own utilities, have an important role in educating on, promoting, and integrating renewable energy into their community. One of the main sources of greenhouse gas is energy, specifically energy from fossil fuels. Fossils fuels are non-renewable sources of energy, which means they do not replenish quickly. *Renewable sources of energy are able to regenerate in a time frame good for human consumption and also do not create direct man-made greenhouse gas emissions.* Renewable energy sources include wind, solar, geothermal, biomass, and hydropower. Solar energy is becoming increasingly considered for the state of Florida, which experiences sunshine most of the year. Besides reducing greenhouse gas emissions, renewable energy can be replenished more easily, can create jobs, stimulate the local economy, and improve air quality. However, renewable energy sources all have drawbacks, such as unreliable or inconsistent power and harmful waste that is generated from sources. Nonetheless, integrating renewable energy into a diverse system can lead to cleaner energy and more cost-savings in the long-term. So, local governments can support clean energy initiatives by changing land use, building, and site design standards for both public and private properties, invest in generating this type of energy through its own utilities or the local utilities, cost-sharing or providing resources for private investment, and incentivizing use of renewable technologies at the individual or household level.

Large-Scale Renewable Energy: *Local governments can achieve renewable energy goals by adopting these sources into their power grids. However, this can be quite costly to both the government and its residents in the short-term. Fortunately, there are a few options that governments can use to reduce the costs. For example, green tariffs allow governments, especially those who do not own their own utilities, to buy a certain amount of renewable energy at a fixed price from a utility. This allows the community to avoid the building and financing costs of entirely new renewable energy facilities. Another option allows for private sector installation of renewable energy on public land through leasing.*

City of Gainesville	In 2013, a biomass facility was added to the City of Gainesville's energy supply. Originally, the City leased the land to American Renewables and had a 30-year power purchase agreement with the local utilities. However, in 2017, the City purchased the plant outright. Up to 30 percent of the local utilities' energy comes from this biomass facility.
City of Tallahassee	The City operates two solar facilities that produce 60 megawatts together. Residential, small- and medium-sized commercial customers can elect for all or a portion of the monthly electric bill to reflect solar at varying levels. Customers who participate pay 5 cents per kWh for their solar energy in lieu of the normal Fuel Charge portion of their bill.

Integrated Renewable Energy Technology[3]: *Local governments should lead by example and integrate renewable energy technologies into their operations (e.g. small wind turbines, solar photovoltaics on building, solar powered parking meters or streetlights, solar bus stop canopies, scrubbers to clean emissions, methane capture from landfills).*

Solar Powered Parking Meter. Source: City of Fort Lauderdale

City of Cape Canaveral	In 2019, the City received its first mobile solar generator from a California-based company. The generator will be used at City events, for appropriate construction duties, and for disaster relief operations.
City of Dania Beach	The City installed over 300 solar street light systems designed to withstand 150 mph winds and improve security in neighborhoods.
City of Fort Lauderdale	The City has recently installed solar powered parking meters in several locations.
Hillsborough County	County Facilities installed a solar array on the Old County Courthouse in Downtown Tampa, using sun to power up to 40% of the electricity for this facility. Additional solar panels have been installed on the All People's Life Center and the Tax Collectors office.
City of West Palm Beach	Solar trees that provide USB charging stations and shade were installed by FPL at no cost in one of the city's parks.

Incentives for On-Site Power Generation[2,3]: *Governments can encourage households or businesses to adopt small-scale renewable energy projects, such as solar panels, through incentives. These incentives include per-watt rebates, loans or grants for installation, net metering, tax credits for both personal and property tax, streamlined permitting process for renewable energy systems, or feed-in tariffs. Some incentives cover or partially cover the cost of installation, while others compensate individuals for having the system and sending some of its generated electricity to the community/utility's grid.*

City of Ocala	The City has a solar/net metering program that credits residential and commercial customers who own and use renewable energy sources.
City of Winter Park	The City offers PACE financing for residents and businesses to install renewable energy sources as well as a net energy metering program for solar photovoltaic systems.

Energy Efficiency and Conservation

Energy efficiency and conservation is a vital aspect of mitigation efforts because it works towards reducing carbon emissions. It is beneficial from the climate perspective as well as a financial perspective through cost saving energy options. Moreover, energy efficiency can benefit the health of those occupying buildings or spaces as well as working within them. Energy efficiency and conservation is promoted through audits, trainings, and upgrades with newer, more efficient products (i.e. lighting, fans, heating and cooling systems). Common solutions include smart system control technologies, increased daylighting, shading and passive solar heating, sun control, and high-performance building shells. Governments should set energy targets to work towards and

then implement a variety of strategies, incentives, or designs to achieve these energy goals both internally and in the community. Note, these goals and policies should consider the equity concerns that often make energy inaccessible or unreliable in certain areas of the community.

Benchmarking and Disclosure Mandates[4]: *These mandates require buildings to measure energy use and report it to the local entity during sales or leasing. It is more of an informational tool that local governments can use to track and identify hotspot areas for energy issues. It can also help building owners improve their energy systems.*

Miami-Dade County	The Miami-Dade Building Performance Ordinance had been proposed to require existing private sector buildings and government buildings over 20,000 sq. ft., to annually track, report, and share their electricity and water use data through a free federal online tool.
City of Orlando	In 2016, the Building Energy and Water Efficiency Strategy was passed. Any City-owned building above 10,000 gross square feet and any commercial or multifamily building above 50,000 gross square feet are required to obtain an energy benchmarking score and report it to the City of Orlando every year. Buildings under a score of 50 are required to perform an energy audit or a retro-commissioning service to better understand their building performance.

Energy Efficient Public Properties and Infrastructure[3]: *A first step for many local governments is to design, retrofit, or install energy efficient technologies and strategies (i.e. LED lighting) into new or existing publicly-funded buildings (e.g. libraries, city hall, hospitals), facilities (e.g. street lighting), and purchases (e.g. government-owned vehicles). In this sense, the local government becomes a trial run and demonstrated leader for energy conservation actions. All new government-owned facilities are required to meet LEED (Leadership in Energy and Environmental Design) and EnergySTAR performance standards under federal law.*

City of Deerfield Beach	In 2019, the City began a city-wide energy efficiency project that is replacing HVAC systems, optimizing power and energy usage, and implementing alternative energy use.
City of Sarasota	From 2010-2012, the City upgraded electrical and water systems through performance-based contracting.
City of St. Petersburg	City facilities over 10,000 sf are required to apply sustainable design and green building certification approaches to design, construction, and operations of new and significantly redeveloped buildings. In addition, the city is incorporating an infrastructure (as opposed to building) sustainable design approach with options for certification under the Institute for Sustainable Infrastructure's Envision program. Furthermore, the city is replacing all incandescent bulbs in the traffic signal system with LED lights.

Source: MRSC

Land-Use and Planning Regulations for Energy Efficiency[2]: *Many land use strategies promote energy conservation, especially those related to Smart Growth. Compact development can lead to more efficient provision of public services and reduce utility and delivery costs. In-fill development can encourage growth in areas that are less vulnerable and reduce the spread of utilities and resources. During redevelopment or adaptive reuse of existing buildings or historic structures, upgrade energy systems (e.g. heating, cooling, and ventilation systems) to current efficiency standards. Some communities implement these strategies via land use elements in their comprehensive plans (See Section 2.6).*

City of Fort Pierce	Sec. 111-153(b) of the City's code promotes energy efficient design guidelines for historic properties and creates an assessment to modify energy structures.
City of Groveland	The City's comprehensive plan outlines energy efficiency land use patterns and policies in Chapter 1 Future Land Use Element: Objective 1.19. Also, the city developed the Mixed Use and North Workplace Development land use tool to produce energy efficient land use development (i.e. compact, mixed-use areas).
Orange County	The County's Infill Development Master Plan was created to promote infill development, rehabilitation and reuse to achieve smart growth and energy efficiency goals.

Building and Energy Codes[2,4]: *Green Building Standards, which create carbon neutral buildings, both publicly- and privately funded, by 2030 are set by several entities. However, in the United States, the LEED rating system created by the U.S. Green Building Council is commonly used to guide standards for local implementation. In Florida, the Florida Green Building Coalition Green Local Government Standard is commonly used by municipal and county governments. Another option is to set minimum standards for building and energy codes to be as stringent as the International Energy Conservation Code, or the American Society of Heating, Refrigerating and Air-Conditioning Engineers, or equivalent. This model green building ordinance can provide a foundation for which you can base your policies.*

City of Apopka	Section 5.11. – Green Building Standards
City of Hollywood	Ord. No. 0-2015-06: Mandatory Green Building Practices
City of Miami Beach	The Sustainability and Resiliency Ordinance requires LEED Gold certification or Living Building Challenge certification for any new construction over 7,000 square feet or ground floor additions to existing structures that encompass over 10,000 square feet of additional floor area.

Incentives for Green Development[2]: *To encourage local businesses and residents to adopt similar energy efficiency standards, your government can implement programs to incentivize energy efficiency improvements, such as expedited permit review, fee waivers, tax credits, and rebates or other subsidies. One example of an incentive program that does this is the Property Assessed Clean Energy Programs which are available for both commercial and residential properties. This program allows a property owner to finance up to 100% of the up-front cost of improvements with a loan that is paid over a period of time, typically 10 to 20 years, through a line-item on the property tax bill.*

Charlotte County	The County incentivizes green building construction and development for single family or commercial buildings. These incentives include fast-track permitting, marketing enhancement, possible reduction in parking requirements, possible increase in floor area ratio, and more.
City of Lauderhill	The City's Energy Star Revolving Loan Fund has provided over 30 residents with zero percent (0%) interest loans to purchase Energy Star products with a 100% repayment rate since 2012.
St. Lucie County	The county offers loans to those wanting to install central air conditioning, caulking and weather-stripping, building insulation, and windows.
Note: More examples can be found here.	

Water Conservation

Because energy and water systems often overlap, promoting water conservation and efficiency is also important to reducing greenhouse gases. However, many water conservation efforts can also be considered adaptation strategies, as they ensure access and availability of water resources. Nonetheless, it is important to promote conservation strategies both for the outdoors and indoors, as doing so will reduce energy usage for providing water. Examples of such conservation strategies are using native plants, maintain healthy soils to minimize runoff, minimize turf areas, avoid watering during the heat of the day, efficient irrigation systems, capture runoff from rooftops with rain barrels, encouraging water reuse, minimize internal water uses (i.e. showers, dishwashers, laundry machines), using water saving technology, or investing in water conservation for public infrastructure.

Require or Incentivize the Use of Water Saving Fixtures: *Water saving fixtures can be used in showers, landscapes, washers, or other appliances and features in new or existing structures. Common examples of such appliances that are often found in building codes are low-flow toilets, WaterSense labelled products, and water-efficient irrigation devices. They can be applied during building or retrofitting publicly- or privately-owned buildings. Furthermore, local governments can offer rebates for installing fixtures or provide them at a low price/for free. Lastly, these technologies can be installed into public infrastructure projects or investments, such as wastewater treatment plants that use a large portion of energy.*

City of Parkland	Parkland residents whose water utility is either NSID or Coconut Creek are eligible for a rebate for high efficiency toilets that conserve water.
City of Port Orange	The City requires the use of low volume plumbing fixtures, including low-flush fixtures, as a potable water conservation tool for all new development. Also, they offer a rebate program for retrofits to low-flush fixtures and other inefficient plumbing devices.
Sarasota County	Over 45 businesses are saving water and energy through the County's Green Business Partnership.

Water Pricing Systems that Penalize Large Users[5]: *Local governments that own water utilities can create a pricing structure that better reflects the cost of providing water. This will help users be more conscious when using water. It can be done to reduce water consumption, reward those who choose water-efficient appliances, target inefficient water uses, and avoid financial hardships on low-income customers. Sometimes, utilities use water meters, increased block rates, water surcharges, or seasonal rates.*

City of Homestead	The City Council approved an increase in water rates for customers and promoted conservation by charging a lower rate for customers using less water.
Lee County	The County created a water pricing structure based on water consumption and also charges 50 cents per ERU for those who go over their initial conservation block.
Town of Jupiter	The utilities bill all customers on a conservation-based block rate structure.

Public Education and Outreach Activities for Water and Energy Conservation[5]: *Local governments can promote individual or organizational water and energy conservation efforts by providing key information and educational programming on how to do this. It is also important that they should review the reasons it is necessary, benefits of doing so, and how current strategies promoted by government may help them. Incentives can be set to encourage training and review of such programming.*

City of Eustis	The City offers free indoor water conservation kits to Eustis water customers and provides fun water educational sites for families and students.
City of Stuart	Offers Water Plant tours with students in the area to teach them about the flow of water. Also, they have signs up through their downtown area promoting water conservation.
City of Titusville	The Conservation Office has informational brochures, children's activity books, and conservation related items for a wide variety of water conservation topics. It also participates in local events throughout the year and makes presentations to schools, civic groups, homeowners associations, etc.

Improving Air Quality/Reducing Travel

The emissions of greenhouse gases through vehicular use contributes to poor air quality, especially in urban centers where cars are used and become congested. So, an important aspect of reducing emissions is promoting public transportation, fuel-efficient vehicles, or encouraging more sustainable and eco-friendly modes of transportation. It is necessary to develop strategies that shift travel demands, manage congestion, discourage

the use of single occupancy vehicles, and reduce the number and length of automobile trips. These goals can be promoted through transportation agencies policies, such as anti-idling programs, congestion management, travel option programs (i.e. HOV lanes), or transit efficiency updates (i.e. coordinated traffic signals and lane shifting programs). These goals can also be integrated with other policies, like land use. Land use policies that can promote these goals involve those that provide affordable housing options near downtown or industrial areas, locating public services near transit options, transit-ready patterns, mixed-use development, or limiting the number of parking spots required for buildings. In this way, transportation policy both alone and combined with other types of policy (i.e. land-use) can immensely improve air quality as well as reduce emissions.

As these policies are created, accessibility and equity concerns should be addressed to ensure that areas of the community with less transportation modes have available, safe options. One way to do this is to assess indicators of Complete Street Policies, which are those that encourage safe, comfortable, and integrated transportation networks to all users regardless of age, income, ethnicity or mode of transportation.

Support Local Food and Service Production[2]: *Food miles, or the distance food products must travel, make up a costly portion of the food cycle emissions. That is why promoting the use of locally produced foods is a sustainable practice. Local governments can encourage farmer's markets, community farming areas or gardens, as well as source internal food from the local community through urban agriculture ordinances, amended zoning laws, and programming. Along with reducing travel miles, community gardens promote carbon sequestration through healthy soils and increase food security, especially in economically disadvantaged areas.*

Source: City of Fort Lauderdale

Collier County	The County's Public Schools have a farm to school program where local farmer and produce distributers provide farm fresh, seasonal fruits and vegetable to students each school day. In elementary schools, there is a program where at least once a week a fresh fruit or vegetable snack is provided to students at no charge. The teachers use this snack as a learning tool for local food and agriculture systems.
Leon County	The County's Community Garden Program offers technical, material, and grant support to citizens who start or revitalize a community garden anywhere in the county.
City of Orlando	The City will provide funding from a $250,000 USDA grant for a non-profit, Fleet Farming, to build 10-15 new micro urban farms in residents' front yards and serve as a Community Supported Agriculture Source for neighborhoods of West Orlando.
Pasco County	The County's Urban Agricultural Ordinance amends the land development code to allow community gardens, market gardens, and community farms in the County. It also creates a garden plan permit system.

Encourage Green Transportation Choices[2]: *Other modes of transportation such as public transportation (e.g. bus rapid transit, light rail, commuter rail, etc.), bicycles, walking, running, or carpools are helpful in reducing travel and emissions. To promote these choices, streets need to be designed to account for safety. This means creating pedestrian-friendly sidewalks, safe bicycle lanes, and connected trails and roadways. Furthermore, promoting these choices means expanding the available options people have, especially in rural communities and areas with large transit inequities. To do this, governments need to develop new or expand upon existing transit systems and routes as well as create connected transportation paths (i.e. biking or urban trail corridors). Encouragement can also include providing bike racks around the city, showers and locker rooms for government employees, or incentivizing these choices through subsidies (i.e. parking cash out programs) or department competitions.*

Source: City of Orlando


Source: City of Key West

Clay County	The Jacksonville Transportation Authority expanded bus transportation services throughout Clay County in 2019. This service will provide convenient and easy transportation options for county riders.
Lake County	The County has a number of multi-use trails that connect communities and provide recreational benefits. These are outlined in its master plan.
Polk County	Polk Transportation Planning Organization has adopted a Complete Streets policy to promote safer traveling, support all modes of travel, provide convenient access to community land uses, and create a sense of place.
Sumter County	Sumter County coordinates shuttle routes for use by residents. Shuttle routes run a few times a week and are available by reservation and appointment.
City of West Palm Beach	The City offers employers a number of transportation management programs that can link commuters from home to work with alternative transportation options. Examples of these programs include a parking cash-out - where an employer offers their employees options to receive monthly public transportation passes or cash incentives for using alternative options – and a request a rack program – where businesses can request a bike rack and installation from the city.

Incentives for Fuel Efficient or Electric Vehicles[2]: *Many newer automobiles are built for fuel efficiency to save costs. Along with this, electric vehicles or hybrid ones are becoming more popular. This means that the amount of emissions is becoming more controlled and there is a trend towards cleaner energy. However, these options can be costly for individuals. Some local governments have enacted fees and incentives (i.e. home charging installation preferential rates and rebates) that encourage the purchase of these vehicles, as well as providing infrastructure (i.e. charging stations) for electric vehicles to promote such behaviors.*

Source: City of Boca Raton

City of Fernandina Beach	The City has one electric vehicle charging station that is free to use near the library. There are many other municipalities and counties that have this as well.
City of Jacksonville	The Jacksonville Electric Authority offers rebates for purchase or lease of new electric vehicles based on battery size. Similar rebates are offered by the Kissimmee Utility Authority and the Orlando Utilities Commission.
Sarasota County	The ChargeUP! Sarasota County program provides rebates to certain types of businesses, non-profits and local governments within Sarasota County to buy and install EV charging stations.

Greening Public Vehicles[3]: *Just as important as electric vehicles are for individuals, creating electric or clean energy vehicles for transportation and internal use is also important. This can help reduce the internal use of greenhouse gases. Examples of this include adopting electric vehicle fleets, solar powered buses, or hybrid powered buses. The fleet of vehicles used by local government employees provide many services to the citizens. However, they also cost a lot financially and energy-wise. Greening these fleets as well as public transportation options will help reduce the total fleet consumption, save money, and reduce polluting emissions.*

Source: City of Orlando

City of Coral Gables	In 2016, the City procured a new Green Fleet with 20 electric Nissan Leaf vehicles. Since then, it has continued to add more vehicles to its fleet with a goal of 78 electric vehicles by the end of FY2021.
City of Miami	The City has piloted four low-powered electric-assist e-cargo bikes that will be used for delivery operations across the community.
City of Tallahassee	The City's Alternative Fuel Program accepts cooking oil used in food preparation and converts it into biodiesel fuel for use by its fleet management.

Reducing Waste

Another large generator of GHG emissions is waste. As products are made, large amounts of energy are used to extract materials, produce items, and distribute them. Often, there is waste created during every step of the process. This waste as well as the final waste product created after the use of an item are sent to landfills where they are incinerated and slowly decompose. Both incineration and decomposition emit GHGs and also pollute the air. During incineration, fossil fuels are burned, which emits carbon dioxide. However, during decomposition, often biodegradable materials emit methane due to the anaerobic environment. Methane is also a harmful GHG, and landfills are the leading source of their emissions.[2] Thus, in this way, effective waste management is important for controlling emissions. *Also, note that natural disasters tend to increase waste materials, which means extreme weather events will impact the emissions and capacity to handle waste.*

The Environmental Protection Agency created the Waste Management Hierarchy to help understand best practices for managing waste. The top two suggestions - Source Reduction & Reuse and Recycling/Composting - focus on diverting materials from incinerators and decomposition, which reduces GHG emissions. Source Reduction & Reuse means encouraging products to be made with less material, last longer, and have people reuse it. It reduces the energy for extracting materials and manufacturing products. Recycling/Composting are strategies used for generated waste and attempt to create a closed-loop waste management system. Recycling means reusing waste materials to make new products, which requires less energy and produces fewer GHG emissions. Along with this, recycling paper products hinders deforestation efforts and increases carbon sequestration capacity. Composting controls the decomposition of biodegradable products, especially food waste, and recycles the decomposed material as a soil additive rich in nutrients. Depending on the approach, methane emissions are reduced and the capacity of soils to sequester carbon are increased by the use of compost. The third part of the hierarchy is a new approach that converts non-recyclable waste materials into energy. This generates renewable energy sources and reduces carbon emissions as well as methane generation. Examples of this include landfill gas recovery and anaerobic digestion. The fourth strategy is the one commonly adopted for waste, which is sending materials to landfills.

Creating policies to encourage or promote these zero waste ideals can be easier for some communities and more difficult for others. It depends on whether the local government controls or owns the waste facilities or has the available resources to expand waste management as well as the acceptance and understanding of the strategies by the community and its residents.

Update and Maintain Waste Facilities[2]: *Manage and update landfills, recovery centers, and other sites used for waste to ensure that emissions and energy production is reduced. This can mean encouraging onsite energy recovery efforts, such as the use of landfill gas (LFG) recovery to convert collected methane gas into renewable energy. Another option is to reduce the distance of transporting materials to the site by locating the facility near recovery operation or maximizing pick-up schedule efficiency.*

Source: Neel-Schaffer

Marion County	The County has a Landfill Gas to Energy Project that produces roughly 4 megawatts of electricity on a daily basis. It prevents the emissions produced from burning as well as the methane emissions from escaping and turns it into this energy.

Expand Waste Management Options: *Today, most communities in the United States have recycling options. However, the materials that can be recycled may vary. In a few communities, community-wide compost collections add another bin to the home or business waste management. It is important to consider what options can be expanded or added into your community, especially as populations grow. This can help prepare for future waste management.*

Source: Lakeshore Recycling Systems

City of Boca Raton	The City has a few different initiatives that expand the types of waste accepted and recycled including a Christmas Tree Recycling Program – converts trees to mulch – and a recycle program for aluminum signs and posts. It also promotes reuse of worn or outdated books by promoting a resale event through Friends of the Library.
City of Melbourne	The City is encouraging residents to compost in their backyard and divert food and yard waste through a rebate program. Customers can receive a $50 rebate for installing a composter that is at least a 30-gallon capacity.

Internal Waste Reduction Strategies: *There are a number of ways your government can lead in efficient waste management efforts. Some are small choices or options, such as replacing single-use water bottles with pitchers and reusable glasses. Others require more effort and guidance, such as creating a green purchasing policy that encourages purchasing items made from recycled, sustainable materials. Other options include replacing individual trash bins with recycling bins or placing composting receptacles in break rooms.*

Lee County	The County added an Environmentally Preferable Purchasing Policy to their Purchasing Manual.
City of Pensacola	The City created a water bottle initiative that encouraged employees to reduce plastic waste. All City employees were given a reusable water canteen, which can be refilled at water dispensers that track the number of plastic bottles saved from disposal. Along with this, the City has ensured all of its buildings have separate recycling bins and are eliminating Styrofoam products.
City of Plantation	The City has performed a number of efforts to reduce waste within its operations. Within the Development Services building, they recycle, reuse any waste they can, print and copy duplex when possible, use ceramic mugs and plates, save documents electronically rather than printing them out. Within the Building department, paperless correspondence and forms are promoted through online practices. Almost all departments recycle toner cartridges and other end of life office supplies as well as recycle scrap copy paper to make note pads.

City of Tarpon Springs	The City's IT department is spearheading efforts to move towards a paper free environment through GIS, training, digital recordings, etc.

Public Education and Outreach Activities for Reducing Waste: *Successful waste management heavily relies on the actions of individuals. It is vital that engagement efforts are consistently made with the community to understand current procedures and rules. This can range from clear signs indicating which bin to put a waste product to teaching at-home composting workshops to clean up events.*

Alachua County	The County offers free programs (e.g. tours of the waste center, presentations on reducing waste, and composting workshops) to community groups of all ages that are interested in learning about solid waste management practices.
City of Tampa	The City has a recycling coordinator and specialist that provides educational and outreach programming to students, community groups, and during events.

Climate Mitigation Plans

After reviewing and identifying mitigation techniques, some communities create a summarized document with recommendations for possible strategies. These strategies relate to the goals established in the GHG Inventory. Identifying them in this way narrows down the policies that will be considered for prioritization and implementation. A few of these plans go in-depth on the resources, timeline, and implementation actions for such strategies. However, the plans that tend to do this focus on Energy Efficiency and Conservation as related to the renewable energy and GHG emission reduction goals. Examples of such outlined strategic plans include Monroe County and Broward County.

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SUBSECTION 2.5.2 ADAPTATION STRATEGIES

The Definition, Goals, and Examples of Adaptation Strategies

Adaptation strategies are those that reduce short-term and long-term risks and vulnerabilities associated with changing climate conditions.[1] They are a key part in building a community's resilience by reducing exposures and sensitivities and increasing the adaptive capacity in both the immediate and future term. Rather than focusing on the causes of climate change (i.e. increased GHG emissions), adaptation strategies are made to dampen the direct and indirect environmental, social, and economic *effects and consequences* of climate changes. These changing conditions include extreme weather events (droughts, floods, storm systems), heat waves, natural disasters (wildfires, hurricanes), natural resources availability, sea level rise, and human behaviors and decisions. They are expected to impact a variety of sectors (e.g. transportation, utilities, public safety, insurance, real estate, waste management, public works, recreation, community development), plans and standards (e.g. land-use plans, disaster response preparations, building and engineering standards, hazard mitigation plans, natural conservation plans), and natural and built assets and infrastructure (e.g. airports, ports, landfills, roads, bridges, sewers, houses, buildings). Because of this range, adaptation strategies vary widely in their targets, scope (internal or community-wide), and implementation. They can include physical changes to the natural or built environment, policy changes to existing plans or strategies and proposals for building, developing, preparing, emergencies, and social programs, update changes to information, or budgetary changes to build economic resilience for natural disasters or climate related hazards. Also, hazard mitigation efforts have been integrated with adaptation strategies and vice versa.[i] However, the examples provided in this section will tend to focus on physical changes. Nonetheless, the strategies in this section will involve changes and considerations by all governmental departments and partnerships both within and between different levels of government. Vulnerability assessments guide the sorting and prioritization of adaptation strategies to best fit local community needs (See Section 2.3: Identifying Risks and Vulnerabilities).

A common tactic for choosing strategies is to first apply those that will avoid risks and impacts by preventing them or changing current standards. Then, prioritize those that will minimize risks that are unavoidable. Finally, choose options that will protect assets and populations that cannot be changed or moved. This process relates to the conventional goals for adaptation – Avoidance, Managed Retreat, Accommodation, and Protection. These strategic goals are explained below with exemplary policies adopted to achieve them.[2]

Note, the following will detail each type of adaptation goal. Within each goal there will be explanations of common mitigation policies and practices that can be adopted. There are also some case studies presented alongside these policies and practices to help you get an idea of what they can look like or accomplish. Reviewing the following will help you begin your strategy identification efforts as you find adaptation practices best fit for or needed by your community. These policies are not all the available options, but they do cover a wide range of them that can be implemented by any size or geographically located community. These practices apply to internal government operations, community-wide operations, or both.

[i] Note: The term hazard mitigation does not refer to mitigation as explained in Section. 2.5.1. Instead it refers to actions taken to reduce or eliminate long-term risks caused by natural and man-made hazards and disasters.

Avoidance Strategies

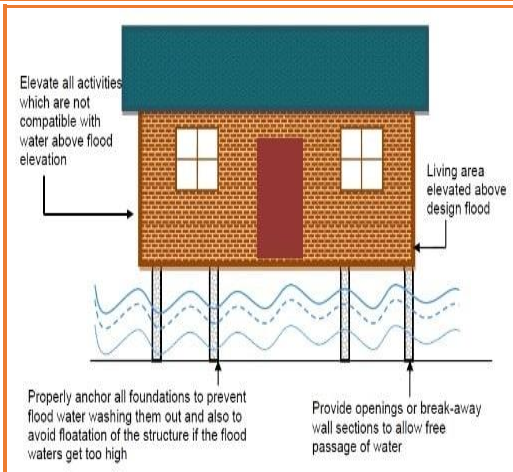
One way to adapt to a changing climate is to avoid as many risks as possible by taking precautionary measures through preparatory efforts. In this way, you can reduce the exposures in your community. There are a number of ways to accomplish this from adjusting planning regulations, conserving natural areas, encouraging new types and locations of developments, protecting the availability of natural resources, increasing stormwater capacity to prevent flooding, working with the community to encourage new behaviors, building capacity for understanding risks and preparing. Often, at the local level, avoidance strategies focus on guiding development and redevelopment away from areas that are subject to or expect to be subject to climate hazards.[3] This may involve incentives or development regulations, such as land trusts, zoning codes, overlay zones, and designated uses for low-density. It is applicable to both privately- and publicly owned assets (i.e. capital infrastructure). It is better to avoid early on in planning and developing processes. However, updating physical infrastructure or plans with avoidance strategies from newfound risks can be vital as well. Note, these efforts may allow for climate gentrification issues in the community if development pushes into lower-income areas and raises property prices. Building resilient structures may be unaffordable for lower-income properties. So, it is important to consider equity when planning avoidance strategies.

***Conditional Development*[4]:** *This is a regulatory requirement from a development permit a community imposes on a landowner for development or redevelopment. It can include dedicating lands for public purposes or conservation, impact fees and exactions for emergency costs, and designating a specified use for the land. Through these conditions, the community can regulate the building or property to be designed and developed with protective features or removed hazards.*

Lake County	3.01.00 – Zoning District Use Regulations
City of Pinellas Park	Section 18-1521 Conditional Use Regulations

Conservation Easements and Purchases of Development Rights[4]: *A purchase of development rights program allows willing landowners to sell their development rights to a local government. Through this, the government obtains a legal or conservation easement that permanently restricts development on the land. However, the landowner can use or sell the land for purposes specified by the easement including farming, hunting, timber production, or recreational purposes. The easement can apply to all or a portion of a property. Typically, it is done with properties that have significant conservation values so that the easement can serve a flood buffer, open space, or migration corridor.*

Alachua County	Alachua County Forever Conservation Easements Program



Source: The Constructor

Building Codes and Resilient Design Incentives[4]: *Local governments can create regulations and incentives to encourage the construction or retrofitting of buildings with resilient and resistant structures. Building codes include standards for structure, placement size, usage, foundations, requirements for resistance to extreme weather events in disaster prone areas, and other related design details. Because of this, these codes can require resilient designs to avoid future risks for new or existing buildings. Along with this, property owners can receive tax incentives or grants to implement resilient designs through local government and federal government programs. The designs can be related to building elevations, reduced densities and permitted uses, smaller, resilient structures, resilient foundational placement and material, climate-resilient construction materials, and the form and function of natural resources (i.e. wetlands), technical and safety requirements, and specific standards provided by different agencies and professional organizations (i.e. Florida Building Code). One way to enforce this is to deny permits until specific climate-related risks have been addressed.*

Examples of language in codes or plans can be found in Section 2.6

Managed Retreat Strategies

Related to avoidance, managed retreat strategies relocate existing or damaged development, infrastructure, and community resources to less risky, safe areas. When enacting retreat strategies, citizens and government officials must accept the unavoidable impacts of climate change to work past the idea of abandoning residences. The term "retreat" can deter stakeholders, so it may be better to use other terms like "managed relocation", "realignment", or "assisted migration".[3] It mainly involves physical changes (i.e. demolition or relocation) to privately- and publicly-owned facilities that cannot be made resilient or expect to survive climate risks. However, it can also involve environmental, social, and fiscal policies, such as changes to real estate and insurance regulations and preserving natural resources and land-uses. The relocation efforts can be voluntary, incentivized, and/or involve gradual increases of setbacks.[4,ii]

To accomplish efforts like this, lands may need to be transferred from private to public ownership through acquisitions or buyout plans for at-risk properties. If a community chooses to gradually transition relocation efforts, they may plan for eventual retreat and allow people to live in vulnerable areas but start divesting assets to these areas. Also, during relocation efforts, people may begin moving out of more vulnerable communities, especially coastal Florida, to less vulnerable, mostly inland. Because of this, the less immediately vulnerable communities need to plan and prepare for increased population by ensuring it is addressed in plans. These plans should encourage sustainable and responsible development (i.e. compact development), protection of agriculture and environmental resources from urban and suburban encroachment, social services that help migrants adjust, expand utilities and other services, and have mitigation and adaptation plans for climate change preparedness.[2] At the same time, the vulnerable communities experiencing out-migration will need to share a positive vision for the future through community engagement while overcoming the challenges, such as of a declining tax base, economic constraints, and issues with property abandonment.[2] To help with this positive message, planners and decisionmakers can review neighborhood planning actions that kept up the quality of

[ii] Note: Eminent domain is less frequently used to encourage relocation as the efforts do not often fit the criteria for such rule.

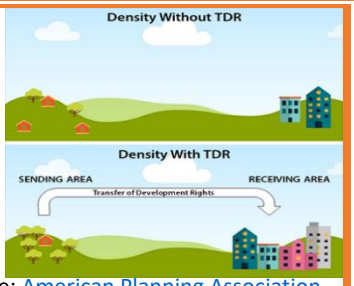
the area despite disinvestment and vacancy.[2] Either way, relocation efforts also mean changes to post redevelopment plans, land-use plans, development and building codes, economic development plans, and other similar plans.

Again, because of the nature of these strategies, climate gentrification poses an issue. Relocation will disrupt existing communities. However, local governments need to keep those existing communities and properties aware of the efforts and help them keep their homes affordable. This will involve working with community partners, such as real estate agents, state and federal agencies, and non-profits.

Rebuilding Standards[4]: *Rebuilding standards limit or prohibit damaged and destroyed properties from being redeveloped on the same land. In this way, it is a preemptive policy that prevents the reoccurrence of property damages from climate hazards, especially flood plains. These standards exist federally, in the Florida Building Code, and are often found in local floodplain management ordinances.*

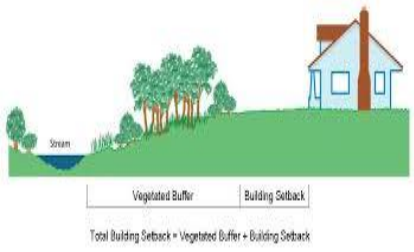
Bay County	Homeowners living in floodplains must meet higher code standards and raise their foundations if their hurricane damage repair costs exceed a certain threshold. This is as stated in the Federal Emergency Management Agency's National Flood Insurance Program, which the county has participated in since 1981.

Transfer of Development Rights[4,6]: *This is a market tool used to redirect new development from vulnerable areas to high density, less vulnerable areas and reduce the development density within vulnerable areas. It works by allowing the landowner of the vulnerable property to exchange their development right for compensation with a landowner in a less vulnerable area who wants to increase their rights. The vulnerable property's land will be preserved, and the less vulnerable area can increase intensity or density. This tool provides an incentive to both landowners. However, it only works if development permits are in high demand and limited, which is why the tool should be paired with strict development standards.*



Source: American Planning Association

Monroe County	The County's transfer of development rights program transfers only residential and hotel development rights at a one-to-one ratio. The proposed sending site must have equal or lower code-permitted density and a more ecologically significant land use classification than the proposed receiving site. It is Outlined in Article 3 of the County Code.
City of Tallahassee	The Environmental Management Ordinance in the Land Development Code encourages density transfers on sites situated within areas zoned as conservation and requires them in areas zoned as preservation. However, if there is no room for density transfer, development is allowed only at very low densities.
Town of Yankeetown	The town established a transfer of development rights program in the comprehensive plan and in its codes (Chapter 18 – Land Development Code).



Source: Montana FWP

Setbacks and Buffers[4]: *Setback requirements are those that establish a specified distance between the rear lot line or edge of a developed property to an established baseline, usually ecological (i.e. shoreline, vegetative line, streams, wetlands, dunes, seawall, mean high water line). They can be established through zoning, subdivision codes, floodplain codes, or conservation easements. A buffer zone is an area within the setback that must be undeveloped and preserve ecological functions. Buffer zones protect the function of the natural feature as well as provide benefits such as ecological corridors and rights-of-way for flora and fauna movement. Together, these requirements control access and prevent encroachment by developers. During redevelopment, local governments can establish or encourage increases to setbacks within vulnerable areas to gradually increase relocation efforts.*

Acquisition and Buyout Programs[4]: *Buyouts can begin voluntary relocation efforts for at-risk properties, both residential and commercial, and can reduce future emergency response costs for areas with repetitive damages. They involve purchasing properties for demolition or relocation. The property's land must remain undeveloped forever as a permanent open space and be maintained by the local government. Communities that cannot burden the responsibility of maintenance have the option of transferring the title to another government agency or non-profit organization (i.e. conservation land trust). These programs can be partially funded through the Federal Emergency Management Agency (FEMA). However, communities should weigh the costs of losing tax revenue from buyout properties with the benefits of potential uses.*

Hillsborough County	The Environmental Land Acquisition and Protection Program (ELAPP) is a voluntary program established for the purpose of identifying, acquiring, preserving and protecting endangered, environmentally-sensitive and significant lands in the county. The program involves both the acquisition and management of these lands. A similar program exists in Flagler County.
Town of Jupiter	In 2019, the town approved a $20 million bond referendum to fund the Land Acquisition Program. The goal is to acquire land that is environmentally sensitive, waterfront, archaeological, historic, or recreational, provides open space, or for traffic mitigation.
Rebuild Florida Voluntary Home Buyout Awards are administered by the Florida Department of Economic Opportunity. This list provides an overview of the municipalities and counties awarded funding in 2019. An example of an application for this award is provided here from Miami-Dade County.	

Accommodation Strategies

Accommodation strategies are ones that allow the continued use of high-risk areas that cannot be avoided or moved with changing climate condition. They focus on reducing the sensitivity, or response level, of human assets and natural features to climate impacts (i.e. floods, heat waves, droughts, invasive species, sea level rise). So, instead of eliminating or preventing risk entirely, they only tend to minimize the risk to an acceptable level. These are the more common strategies used in adaptation efforts because they do not restrict landowners or involve moving or reconstructing large parts of the community. Instead, they tend to retrofit existing systems and procedures with resilient ideas.

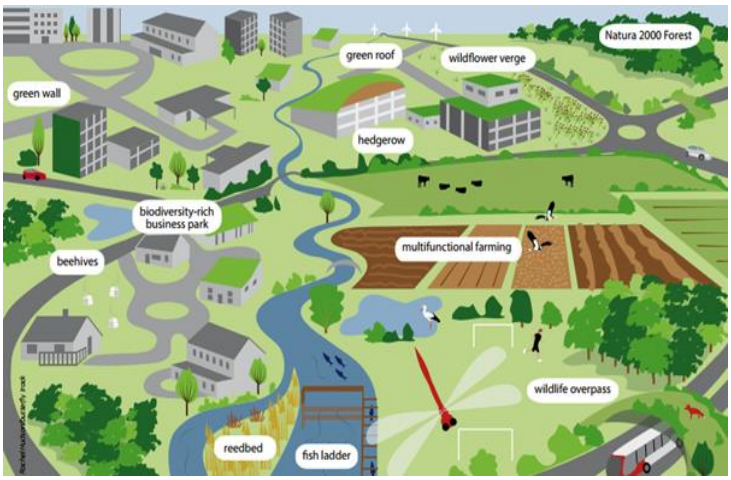
Retrofitting often occurs by altering physical structures in the natural and built environments. However, it can also involve changes to procedures, especially those regarding emergency and disaster planning or hazard mitigation, as well as updating natural areas to incorporate greater diversity in plants and animals due to species redistribution. For the most part though, it involves creating and codifying design elements that increase resilience and improve public capital/infrastructure and private land, such as vertical elevation, drainage, and stormwater improvements, floodproofing, bridges with higher vertical spans, and green infrastructure/low-impact development. When providing for accommodation strategies, equity issues should be accounted for especially since retrofitting can be costly on low-income areas and improvements in infrastructure tend to go to these areas last.

Updates to Emergency Preparedness and Hazard Mitigation Planning and Response[2]: *Emergency preparedness and hazard mitigation plans are a vital aspect of adapting to climate change because a changing climate will bring about intense and frequent emergencies. So, it is important to update emergency evacuations that account for climate impacts in the future, ensure proper signage for routes, install solar power and batteries for traffic lights to prevent power outages, identify the climate vulnerable populations that will need to be prioritized during hazardous events and emergencies. It is also important to raise awareness about expected emergencies or hazards so that community members can prepare themselves for new circumstances or events they haven't experienced. For example, Florida is no stranger to hurricanes. However, climate models predict a trend of more intense hurricanes that is uncommon for residents in Florida. So, changing messaging on emergency dangers, like hurricanes, and the impact of climate change on them will lead to a more educated community.*

Source: Florida Atlantic University

See Section 2.6 for examples of local governments that have updated their emergency response plans to include climate change information.

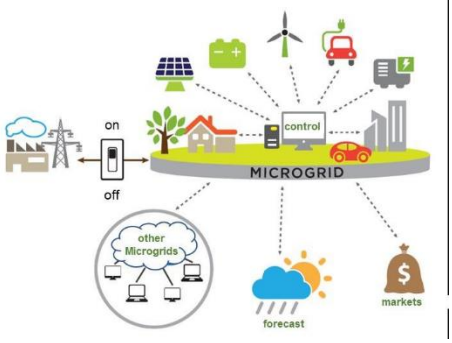
Green Infrastructure/Low-Impact Development[2]: *Green infrastructure uses the natural environment to manage stormwater, reduce urban heat island effects, sequester carbon, improve water and air quality, enhance aesthetics (streets, parking lots, and pavements) and provide open space while promoting economic development and other sustainability goals. In this way, green infrastructure uses soils, vegetation, and natural processes to restore or builds ecosystem services in the community while also retrofitting existing infrastructure. By doing this, it expands the capacity of a community to handle climate impacts without having to rely only on costly "gray" infrastructure (i.e. storm sewers or pipelines) improvements. Also, green infrastructure correlates with mitigation efforts through protection of open spaces for carbon sequestration and green building policies that improve energy efficiency. Governments can incorporate green infrastructure into community planning efforts (i.e. land use and development plans), capital improvement projects, transportation improvements (i.e. accessibility and safety for bikes and pedestrians), public works projects, as well as recreational area (i.e. parks and open spaces) designs. Along with this, governments can offer incentives to businesses and commercial property owners to install these elements in the form of grants, reimbursements, tax credits, awards or recognition, reduced stormwater fees, etc. Common green infrastructure techniques include: Green Roofs; Cool Roofs; Permeable Pavements; Cool Pavements; Bioretention and Bioswales; Rain Gardens; Green streets, Alleys and Parking Lots; Urban Forestry; Constructed or Restored Wetlands; Maintained and Acquired Natural Areas; Sand Dunes; and Oyster and Coral Reef Protection and Restoration. Often, areas that are most prone to climate risks and have poor infrastructure are lower-income communities and communities of color. So, when implementing green infrastructure, address gentrification and equity issues. This includes identifying and prioritizing these areas for green infrastructure, engaging the local neighborhoods on the design and structural elements, and preventing unaffordable pricing that may displace residents and businesses. This can include both informational and feedback engagement.*



Source: Biodiversity Information System for Europe

Alachua County	The County has a comprehensive green infrastructure program that integrates community investments in private and public green assets. The program involves the Comprehensive Plan, Alachua County Forever land acquisitions, and a unique governance structure.

City of Orlando	The Orlando Wetlands Park is a 1,220 acre man-made wetland treatment system that processes 35 million gallons of reclaimed wastewater daily. The reclaimed water makes a 40-day journey through a variety of habitats and eventually arrives at the two outfall structures for the wetland system, leading into the St Johns River. While providing reclaimed water, the wetlands also provide recreational space and natural habitats.
City of Winter Haven	The City has three nature parks that integrate green infrastructure elements. They also have a few rain gardens implemented throughout the city to improve water quality and quantity.



Source: LBNL, USDOE (2019)

Diversifying Energy and Water Supplies[5]: *For areas where water and energy supplies are threatened by climate hazards, diversifying these essential services is necessary. Investing and creating multiple sources, especially renewable, and back up plans for energy supply provide options for doing this. Microgrids, a local energy grid that can disconnect from the traditional grid and operate by itself, can be useful in emergencies, cut costs, create energy independency, and be more environmentally friendly. This can help improve resilience for peak demands during more frequent high temperature days and extreme weather events. In the case of water supplies, there are many threats to water resources including increased demand, saltwater intrusion, and pollution. In Florida, water supplies are coordinated by the Water Management District. These districts will have to make tough decisions in the future concerning allocation of water resources. This will affect energy supply as well. So, it is important that communities look at ways to conserve water, reduce use, and supply other sources. This could mean enlarging or adding reservoirs for groundwater wells, establishing emergency interconnections with nearby water and power utilities, building desalination plants, and using reclaimed water. Florida has many desalination plants that are used to remove salts and other minerals from seawater or brackish groundwater. Along with this, water reuse programs are often found in outdoor facilities, agricultural uses, wetlands, and industrial (i.e. energy) reuse. Communities can encourage properties owners to invest in on-site systems that separate graywater from blackwater. It is important that equity concerns are also addressed when deciding the placement, costs, and availability of supplies.*

Source: National Park Service

City of Altamonte Springs	pureALTA is a potable reuse pilot demonstrating energy-efficient technologies that will create a safe and sustainable water supply for the future. Mainly, the pilot focuses on reclaimed water purification.
City of Bonita Springs	The City encourages property owners to utilize on-site wastewater and water reuse technologies in its Water Conservation Codes.
City of Coral Gables	The City is developing solar-powered microgrids into their electrical system, to continue to power emergency public safety services when the broader grid goes down during coastal storms or natural disasters.
City of Pompano Beach	The "I Can Water" Program connects single family homeowners to reclaimed water that can be used for irrigation.
Tampa Bay Water	This regional water supplier has improved its drought and sea-level rise resiliency by making major capital investments in water infrastructure. These investments include a reservoir to store surface water and a desalination plant that could supplement freshwater during especially dry periods. By doing this, the utility has access to three water sources (surface, groundwater, and desalinized water).

Protection Strategies[2]

Protection strategies are another type of strategy that reduces the extent of climate impacts and maintains use of existing, high-risk areas. Rather than changing the structure of the vulnerable asset, these strategies provide physical defensive measures that protect vulnerable structures that cannot be altered or relocated (i.e.

downtown centers, historical properties, energy systems, asphalt) and vulnerable populations from climate-related consequences. They can include hardened defense mechanisms that often use gray infrastructure. Examples include seawalls, revetments, levees, emergency shelters, and cooling hubs. There are also softened defense mechanisms that use natural elements. Examples include living shorelines, tree canopies, and beach nourishment efforts.

Cooling Centers: *As high temperature days become more frequent, vulnerable residents will be put at higher risk if they do not have a working HVAC system. Community members will need a sheltered place to escape extreme heat events that are a threat to their health. Establishing cooling centers and shelters in public buildings that remain open is one way to help accommodate for this issue. However, considerations for transportation access and geographic distribution of these centers are necessary to ensure that those at great risk can access them.*

Source: USDN

Resilience Hubs[7]: *These are community-serving facilities that support residents, coordinate communication, distribute resources, and reduce carbon pollution. They connect climate preparedness, adaptation, mitigation, and equity efforts. They meet several goals and purposes during non-emergency times, disruptive or disaster incidents, and recovery periods. During normal times, they are used as places for workshops, events, meals, and training opportunities that relate to resilience. During a disaster, they become centers for preparedness and response by providing supplies, information, and support. During recovery, they are the centers for resource deliveries and distribution, access to support and assistance, services related to physical and mental health, conducting needs assessments, and being a place where external partners gather and support recovery efforts. To perform these efforts, the hubs are located in existing well-used and well-trusted sites near vulnerable areas, have a cost-effective onsite power system that can overcome power outages, and have access to food, ice, refrigeration, charging stations, and medical supplies.*

Miami-Dade County	In June 2020, Miami-Dade County deployed its first Community Resilience Pod. Transformed from a 40-foot shipping container, the interactive and mobile space increases resident awareness of local threats, such as extreme heat, flooding, sea level rise, food security, etc. The Pod will move throughout the region.
City of Orlando	The City is working with the University of Central Florida to design a series of resilience hubs that would help the city respond to disasters.

Hardened Structures[6]: *Hardened structures can protect existing development and critical infrastructure from flooding, heat events, erosion, and storms. The structures can prevent the loss of these assets and the need for redevelopment efforts. Hardened structures include levees, seawalls, revetments, and emergency shelters. However, the use of hardened structures is not always recommended because they can cause problems for natural elements and require maintenance. So, they are sometimes limited from being built. Nonetheless, in areas where it is not possible to build softened structure or where hardened structures exists, governments can regulate and oversee that they are engineered with consideration for future climate impacts.*

Source: Miami Beach Times

Broward County	The County adopted regional standards for seawalls and flood barriers to create consistency and protect the community from future sea level rise conditions. The proposed standards can be found here.
City of Cape Canaveral	In March 2020, the Public Works Services Department began installing semi-permanent flood barriers at the City's Water Reclamation Facility. These removable aluminum barriers are 42 inches wide by 36 inches tall. When a flood event is predicted—such as a hurricane—these barriers can be put into place via mounting racks set on either side of doorways. The barriers are then tightened, creating a water-tight seal. These barriers can also be used for one's home or business as well.

Softened Structures: *Highly recommended and preferred by environmental scientists are softened structures that mimic or restore natural buffers. Examples of these structures include living shorelines, dunes, restored wetlands, and nourished beaches. These structures are often connected to green infrastructure efforts because they maximize the use of natural elements that already provide protective benefits. Local governments should encourage the use of these techniques, when and where feasible, to lessen the environmental impacts of hardened structures.*

Source: Florida Sea Grant

City of Cedar Key	The Living Shoreline Suitability Model was used to recommend environmentally and structurally sound erosion control interventions at a local scale. The Living Shoreline Master Plan Map was created from this.
Flagler County	The County is working with the Army Corps of Engineers on 2.6 miles of beach nourishment projects in Flagler Beach. Currently, they are obtaining easement permissions to restore private property dunes.
Martin County	The Living Shorelines project is purposed for restoring historic oyster populations while creating storm and erosion protection. The restoration of oyster reefs in Martin County occurs mainly along the St. Lucie Estuary and Indian River Lagoon. These restored shorelines also serve educational purposes.
City of Miami Beach	The City of Miami Beach created a Dune Management Plan to help foster and maintain a healthy, stable, and natural dune system. The plan calls for both restoration and protection actions. These dunes provide storm protection, erosion control, and a rich habitat.
City of Satellite Beach	The City's Living Shorelines Homeowner Incentive Pilot Program incentivizes Satellite Beach homeowners who live along the Indian River Lagoon to build living shorelines and stormwater retention areas on their property. Selected homeowners receive a matching funds grant between $100 -$500.

Climate Adaptation Plans

As a basis for recommendations, some communities in Florida have created Adaptation Plans that build on vulnerability assessments. These plans present responsive adaptation actions for identified risks and suggest steps for integrating them into the local governments planning and budgeting process. Typically, it does not prioritize the actions or access the feasibility of performing such actions. In other words, it is just a list of possible adaptation actions that communities have identified and for which there is potential. The state of Florida's

Department of Economic Opportunity and NOAA helped a few Florida communities develop these plans. Examples of communities and their plans include the City of Clearwater, the City of Carrabelle, Dixie County, Escambia County, Miami-Dade County, the Northeast Florida Regional Council, the City of Punta Gorda, the City of Sarasota, the City of Satellite Beach, the City of St. Augustine, FL, and the City of Titusville.

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SECTION 2.6 THE STEPS OF IMPLEMENTATION

While mitigation and adaptation strategies accomplish different goals, they must be implemented in a logical way to effectively create a climate-resilient and ready community. So, once you have your wide-ranging, diverse list, you need to assess their similarities and differences and how they relate to the priority goals established from the Climate Vulnerability Assessment and Greenhouse Gas Inventory. This will help in creating an effective plan for implementation, which is important as policy implementation varies widely based on the policy's purpose, intended audience, stakeholders, timing, scope, and scale. Some can be integrated into existing plans and policies, while others can be part of an entirely new strategic plan, policy, or procedure. Moreover, some strategies are for internal guidance, while others are applied community wide. To figure out the best form of implementation overseen by the leadership, these policies will need to be evaluated alongside the established resources available, especially funding. This section will review the steps for creating and executing an implementation or climate action plan.

GOAL AND LEARNING OBJECTIVES

GOAL:

To understand the processes for prioritizing, planning, and implementing climate action strategies.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Refine your list of possible solutions according to resource availability and relevance to goals.
- Rank and Assign priority levels to identified climate strategies according to various criterion.
- Outline necessary details for each strategy to create an implementation plan.
- Know the two main methods of implementing strategies.
- Identify examples of existing local government policies or plans that can integrate climate information.
- Define the purpose and elements of a climate action plan.
- Write an implementation or climate action plan.

Step #1: Define Resource Limits.

Before you can prioritize and plan for implementation, you must define the boundaries of your resources. This means identifying possible partners, technical staff available, and, most importantly, the amount or sources of funding you can use to fund activities. Since many projects involve physical changes, there are large costs associated with adaptation and mitigation efforts. However, there are funding sources that can contribute to or incentivize policy options as well as current or future assessments for vulnerability and greenhouse gas emissions, staffing, and engagement opportunities. There are several climate financing options for local governments including:

- **Taxes, Bonds, and Fees** – Cities can allocate taxes, bonds, or fee revenue from existing sources to finance climate mitigation and adaptation strategies or other actions. Existing sources include the Local Option Tourist Development Tax, Infrastructure Surtax, Communications Services Tax, Small County Surtax, Charter County and Regional Transportation System Surtax, stormwater management fees, impact fees, electric

franchise fee or utility fees, revenue bonds, general obligation bonds, and property taxes. Along with this, new types of taxes, bonds, or fees related to specific physical structure updates or voluntary property assessments can be made as well to either be collected or provide tax credits to properties or citizens. Examples of this include energy efficiency rebates, Property Assessed Clean Energy (PACE) programs, ad valorem and non-ad valorem assessments, public benefits funds (i.e. those placed on utility bills to fund projects, Municipal Service Taxing Districts, Municipal Service Benefit Units, improvement bonds, and refunding bonds. A case study of this is in St. Lucie County, which has a Sustainability District that finances energy efficiency and renewable energy improvements on residential and commercial properties in the county through non-ad valorem assessments. Also, there are several municipalities and counties that have adopted a PACE program.

- **Fines, Penalties, and Violations** – This is especially applicable to building and development codes, where people who do not follow it or impose on current natural resources can be penalized and the money allocated towards climate action projects. Also, if certain regulations or bans (e.g. single-use plastic ban, etc.) are enacted with fines and penalties, then that money can also be allocated to sustainability/climate projects.
- **Loans** – Banks, credit unions, community groups, and state (i.e. FL Department of Environmental Protection) and federal agencies (i.e. US Housing and Urban Development and FEMA) provide a number of loans that can be used for climate adaptation and mitigation projects, especially those related to updating infrastructure. For example, the state of Florida has a revolving clean water fund that has been used by local governments for adaptation projects; and, FEMA's Community Disaster Loan Program allows local governments to offset the loss of tax or other revenues from major disasters. Resources to find these can be found in "Additional Resources".
- **Grants** – Similar to loans, there are many state (i.e. FL Department of Environmental Protection and FL Department of Economic Opportunity) and federal agencies (i.e. NOAA, the EPA, US HUD, FEMA, and the USDA Natural Resources Conservation Service) as well as business organizations that provide grants for communities that can be used for climate adaptation and mitigation projects, including those that relate to disaster preparedness. Examples of these grants include the Community Development Block Grant Disaster Recovery program, the FEMA's Hazard Mitigation Grant Program, EPA's Smart Growth Implementation Program, FL DEP Coastal Partnership Initiative, and FL DEO Community Planning Resiliency Technical Assistance Grants. A case study from Florida using some of these grants was the City of Titusville, which was awarded a grant from the Florida Department of Environmental Protections' Florida Coastal Management Program and NOAA to develop a resiliency plan in 2018. There are many online resources that can notify you about available grants from federal and state agencies for climate action projects. In "Additional Resources", you will find resources with lists of grants, those that have grants available, and those that send notifications.
- **Internal Funding Options** – Sometimes budget options become available as communities implement energy efficiency and water conservation strategies related to mitigation because they save costs in the long run. This may free up some budgets to allow for allocation towards new projects related to climate adaptation and mitigation.

Step #2: Prioritize Options.

Once you have determined available sources of money and possible funding options as well as other resources (i.e. timing and staff), you can and begin categorizing and prioritizing the strategic options on your list. Considering all possible options and their costs and benefits will help in determining the implementation plan and timeline as well as keep options you were interested while not having to use them now (i.e. "no-regrets strategy"). There are different approaches for prioritizing strategies. The approach mainly depends on the criteria your leadership thinks matters most for choosing options, which commonly includes the urgencies or focus areas (according to established needs, risks, and goals) that will be addressed by the solution, community and social acceptance, and whether it is cost or resource effective. Other criteria and considerations include whether the policy will help avoid future damage costs (i.e. is it precautionary), the extent it could enhance adaptative capacity (if applicable), the types of technical training or capacity it involves (is it technically feasible?), legal concerns that might arise from implementing the solution, any environmental advantages or challenges, other non-climate change objectives or community goals that it addresses, the ability of it to be implemented with other projects, timeframe of implementing the option (short-term or long-term), political windows to implement it, additional research and development that may be needed, and how it achieves equity goals.

A common approach for prioritizing these options is to create a tiered plan of options that differentiates the timing of proposing and implementing strategies and ranks them according to the criteria you chose. The ranking correlates to the expected value of each action and will help you place them into a tier. Generally, there are three tier options. However, your team can choose to have more. Tier 1 options are those that can be feasibly implemented, address immediate concerns, and/or can be easily integrated into existing governance. Tier 2 options are ones that could be implemented now or in the future and address more impactful climate concerns but require additional information, resources, or authorities that are not immediately available. In this way, they are potentially feasible. Lastly, tier options are those not feasible with existing resources and do not address the immediate priorities, but they would be useful for future efforts.

To help you perform this ranking and decide the level that the policy meets for each criterion, there are a few tools and analyses available. For those with little time and staffing resources to invest in evaluating each option, simple Excel spreadsheets or fillable worksheets may be helpful to organize thoughts, notes, and rankings. Example templates that your community can use include an Excel spreadsheet from the U.S. Climate Toolkit and a feasibility worksheet from NOAA's Digital Coast. Along with this, input from the community and internal departments/operations is needed to determine some criterion, especially since these two stakeholders will be following and enforcing the policies, respectively. However, if your leadership team has the capacity to go more in-depth, they can perform other types of analyses with private partners, such as quantitative or qualitative cost benefit analyses, climate model analyses, strategic equity analyses, and other tools used in the vulnerability assessment to identify possible options. All of these provide a more in-depth look at the criteria you chose.

Step #3: Outline Implementation Details for the Strategies.

The next step involves outlining details for the policy actions you identified as highest priority (i.e. Tier 1). If you have found resources and time, you may also want to include Tier 2 approaches. Doing this, will help you narrow your feasibility lists by denoting an unintended consequences or issues prior to approval. In this way, you are still able to change the priority status of strategies if you find there are more costs than benefits. In order to

create this plan, you will have to work with implementors and community stakeholders to decide specific details and obtain feedback on the plan. You should also use any analyses or notes written during the prioritization stage. Once you have done this, you will be able to create a timeline with a logical chain of actions that should be use for the strategy or groups of them.

One of the most important details to consider when implementing strategies is the way in which it will affect equity building goals. In many ways, the goals related to building equitable practices can be coordinated with climate adaptation efforts. Especially with strategies related to adaptation, where land use changes are prevalent, climate leaders need to consider how this will affect disadvantaged communities that tend to be more inland. As economic development is encouraged towards these areas and updates are made to expand infrastructure capacity, it is important that leaders discuss ways to integrate the existing communities with new ones without imposing on historic properties and the economic affordability in the area. Some ways in which communities can make areas resilient and maintain or build equity include: investing in resilience projects in the low-income and underserved areas first, helping those in the area obtain jobs related to constructing and maintain resilience projects (i.e. local hire policies), creating land-use and development codes that protect against gentrification, building social cohesion and resilience through engaging community members in efforts (See Section 2.2), building open spaces and green infrastructure in these communities, use inclusionary zoning and other regulations to maintain affordable housing options.[1]

The following table provides details on the basic information that should be included in the outlines of strategies.

Type of Information	Why this matter and what it entails
Goals and Metrics	It is important to categorize each strategy you have identified under one or more of the overarching goals because that ensures that it is applicable, and it can help see if any strategies are duplicative. Along with this, you should also identify a quantitative or qualitative performance metrics that can help evaluate the success of the policy (See Section 2.8 Monitoring and Evaluating).
Scope and Scale of Implementation	The scope of the project can vary from a *pilot project*, *phased*, or *wide-scaled* implementation. Pilot projects are good for communities unable to get approval for full investment in a project or idea. Phased can help roll out the project and ease the community into it. Wide scale create rapid change. The scale of the policy can also vary from those for *internal actions* to those implemented for the *whole community*. Internal actions, such as green purchasing policy, can serve as a role model for climate actions. They also involve incorporation of climate change into departmental strategic plans as well as training staff for climate expertise. Those that are implemented community wide may also include internal actions.
Location (if applicable)	For certain projects that are piloted or phased into, choosing specific locations to update infrastructure or start programming is important. It is recommended to start implemented in the vulnerable and low socioeconomic areas because they are at greatest risk to climate impacts.

Audience/Affected Stakeholders	You should identify the stakeholders that will be affected by or contribute to the policy both internally and externally. These policies may affect other current procedures used in certain departments or force the community to change behaviors. Doing this here will help as you continue to engage and update the community on climate efforts.
Legal or Policy Considerations	Denote any local, state, and federal laws that interfere with the policies implementation or require approval before implementation as well as determine the specific policy language to use.
Relation to Other Goals, Objectives, Policies, or Procedures	Identify any other current efforts (policies, plans, procedures, operations) for which this strategy may be integrated with or applicable. Doing this may help eliminate the difficulty of starting a policy entirely from scratch.

Step #4: Identify the Method of Implementation and Actionable Steps

After outlining the details for at least your highest priority items, you can identify the method for implementation. The method will determine the actionable steps, actors, and resources for employing the strategy successfully. To do identify the method, you must first characterize the existence of the strategy within government or community operations. Generally, strategies are policies, which means they can exist as resolutions, ordinances, codes, etc. However, strategies can also exist as physical structures or new procedural processes that departments must use in their work.

Once this is done, you can identify the method(s) for creating this strategy. These methods, or processes, can include those for developing guidelines, reporting or proposing policies to the legislative or departmental leadership, writing policies, amending existing regulations, constructing physical structures, assigning new responsibilities to a department, updating policies or regulations, monitoring and assessing progress, etc. Often, these methods can be generalized to two types of methods: (1) those that create new policies or (2) those that use and integrate strategies into existing governing document and operations. The purpose of using the first type is to establish functions, goals, or foundations that do not already exists to implement a climate strategy. For example, if the local government does not have a natural resource management department, then they may need to specify various conservation policies or create new infrastructure to do so.

It is this second option of existing governance that is commonly used for mitigation and adaptation strategies. In both Subsections 2.5.1 and 2.5.2, there were many strategies that referenced adjustments to existing codes or regulations – mostly those related to building, development, or land-use. This option is more resource effective as it uses already existing governing and operative infrastructure to implement climate strategies. Even if a local government does not have a foundational aspect for the strategy, they find themselves expanding or using an existing function to complete it. For example, a local government that does not have a sustainability or environmental department/program can still implement a water conservation program through its public works or other similar department. The benefit of using existing governance is that they are already an accepted and used avenue, which means internal employees or community members who must follow them already know how to and may adjust to any newly added strategies quicker. Also, most governing documents or operations already have implementation, enforcement, and monitoring procedures set up within them.

Types of Existing Plans, Policies, or Operations to Integrate

There are many different governing documents, procedures, or operations that can incorporate climate change goals, actions, and language. Typically, these are ones that have overlapping goals or functions with the climate strategy or depend on climate-related information. It is also important to integrate these strategies within governance that is not flexible, contribute to high vulnerability or low adaptive capacity, or have requirements and decisions based on the past.[2] Including climate change language into these types of governance can create a more adaptive, climate prepared government. **Table X.X** below describes common plans, policies, or procedures found in Florida communities that can integrate climate change as well as some case studies in Florida that have done so. However, there are many other plans and policies that can consider climate change not included on the list, such as strategic or procedural department plans, natural resource management plans, and floodplain management plans or ordinances.

Plan and Description	Case Studies
Comprehensive Plan - A local comprehensive plan guides counties and municipalities for future growth and development and is required for all local entities under state law. The goals, objectives, and policies within each of its diverse sections influence regulations, codes, projects, land use decisions, and facility expenditures made by the current governance with future issues and impacts in mind. Because of its focus on future growth and development, integrating climate resilience in comprehensive plans that use longer time horizons can allow for consideration of long-term benefits and costs for decision-making and investments. This is the reason for the passage of the "Peril of Flood Act" in 2015 by the state legislature, which requires all coastal communities in the state to include sea level rise planning in their comprehensive plans. Also, the primary focus of integrating climate change with comprehensive elements is on strategies or goals related to risk or vulnerability reduction. To integrate climate resilience and climate change consideration into a comprehensive plan, each element of the plan must be analyzed for potential overlap with climate action goals or strategies. Typically, sections of a comprehensive plan are amended to include climate action elements, such as those concerning land-use, transportation, housing, recreation and open space, conservation, stormwater management, infrastructure, historic preservation, coastal management, intergovernmental coordination, solid waste, capital improvements, and outreach and education. Changes to these elements will be reflected in related plans, policies, or procedures as shown by others on this list. However, a whole new climate element can be created as part of the plan (see examples). Climate elements can be implemented through a variety of comprehensive plan mechanisms. This includes: in goals or objectives related to considering climate change impacts; data management through vulnerability assessments, greenhouse gas inventories, maintaining current and credible information, and ongoing monitoring of conditions or impacts; direct mitigation or	• Broward County – Chapter 19: Climate Change Element • Village of Pinecrest - Chapter 10: Climate Change Element • City of Satellite Beach – Infrastructure Element 1.1.6-1.1.12 (Adaptation Action Area) • Yankeetown – 2015 Amendment to Conservation and Coastal Management Element • City of Marathon – 2019 Amendment to Goals and Objectives 4-1 Conserve, Manage, Use and Protect Natural and Environmental Resources • Charlotte County – Future Land Use Element (Smart Growth Strategies) • Town of Davie – Chapter 4: Parks, Recreation, Open Space & Conservation Element Policy 3.1.7 Tree Canopy Coverage • Wakulla County – Housing Element Policy 6.1: Incentives for green Building Guidelines

adaptation responses that include policy revisions to other plans, programs, or ordinances; vague language that refers to a wide range of potential mitigation or adaptation responses; or, those that encourage collaboration internally, externally, and with other agencies for information development, capacity building, or coordination. *Land Development Regulations, Codes, and Zones* While the language can vary, it typically remains vague in the comprehensive plan to allow for flexibility. It becomes more specific in the policies, ordinances, and regulations that are informed by the comprehensive plan – mainly land development regulations. This is the wide category of codes that include those related to planning, zoning, development, and building. Subsections 2.5.1 and 2.5.2 described some changes to these codes that could implement climate strategies, such as incentivizing green building development or allowing community gardens and urban farms in the city. Along with this, Florida's Community Planning Act in 2011 allowed the creation of Adaptation Action Areas for coastal communities, which allows them to prioritize funding and capital improvements for adaptation strategies. Essentially, it creates a zone in the city, which is outlined in both the comprehensive plan and the land development regulations.	
Sustainability Action Plan – Sustainability Action Plans are action frameworks for achieving "green" goals. These green goals typically include energy and water conservation, natural resource protection, social equity, resilient development and infrastructure, green jobs and transportation access, and others. These goals overlap with climate action goals. So, many communities that already have sustainability action plans include goals, pillars, or actions that reflect climate mitigation and adaptation goals. It can be more effective to do this rather than creating a separate climate action plan. Overall, these sustainability plans guide departmental actions and internal governance to promote many of the strategies discussed in the handbook.	• Islamorada, Village of Islands – Environmental Sustainability Plan 2016 • Lee County – completeLEE: Sustainability Plan • Leon County – Integrated Sustainability Action Plan • Monroe County – Sustainability Action Plan • City of Orlando – Municipal Operations Sustainability Plan • City of St. Petersburg – Integrated Sustainability Action Plan • Volusia County – Sustainability Action Plan
Local Mitigation Strategy (LMS) – Local Mitigation Strategies address ways to risks for natural and manmade disasters. In Florida, the plan is developed collaboratively at the county level with other jurisdictions (i.e. municipalities). Within the strategy, existing and potential hazards are identified, and actions are proposed to mitigate the losses with those hazards. This idea is very similar to the adaptation strategies that aid in hazard mitigation. Also, the risks identified in a climate vulnerability or risk assessment could be added to these strategies to better prepare for climate related disasters. In general, the fact that this strategic plan focuses on preparing for disasters that will be affected by a changing climate makes it necessary for local mitigation strategies to integrate climate data, hazards, and adaptation actions	• Broward County LMS 2017 • Clay County LMS 2015 • Manatee County LMS 2019 • Miami-Dade County LMS 2018 • Monroe County and Incorporated Municipalities LMS 2015 • Osceola County LMS 2015 • Palm Beach County LMS 2020 • Seminole County LMS 2015-2020 • City of Tallahassee LMS 2020

into their plan. By integrating this information, it will inform other policies and procedures that are directed by the local mitigation strategy, such as *floodplain ordinances*, *natural area management plans*, *stormwater regulations or plans*, and other *emergency management plans*. All of these will need to consider climate change and incorporate climate strategies.	
Post-Disaster Redevelopment Plan (PDRP) – After a natural or man-made disaster occurs, local governments are involved in both short- and long-term emergency efforts. A post-disaster redevelopment plan is one that guides decision-making for long-term recovery efforts after a natural or man-made disaster. It is a requirement for all Florida coastal counties and municipalities and is encouraged for inland communities. The topic areas commonly found within these plans include sustainable land use, housing repair and reconstruction, economic redevelopment, infrastructure restoration and mitigation, long-term health and social services support, environmental restoration, and financial capacities. The plan lays out policies, operational strategies, and roles or responsibilities in these topic areas that can aid in recovery while also build resilience for the future of the community. This common goal of resilience makes it a relevant plan to integrate climate action efforts. These disasters are going to be influenced by a changing climate and make communities unprepared for changes. Also, climate adaptation strategies that focus on redevelopment and hazard mitigation can be useful as communities are forced to rebuild. Lastly, climate vulnerability assessments can be useful in identifying at-risk structures, populations, and assets. Thus, forming these plans with climate change in mind can increase the adaptive capacity of communities and make them more prepared for future disasters.	• Alachua County PDRP 2010 • Hillsborough County PDRP 2010 • Indian River County PDRP 2013
Water Resource Management Plans (e.g. Stormwater Master Plans, Water and Sewer Policies, Water Supply Facility Work Plans) – Water resources include groundwater sources, stormwater, wastewater, and natural bodies of water – coastal, estuarine, or freshwater. These resources all contribute to a watershed that is typically larger than one municipality or one county. So, local governments may collaborate on plans or programs that aid in providing accessible and clean water for sustainable use throughout the area. Generally, these plans focus on reducing pollutants from storm- or wastewater, prevent flooding hazards, maintain groundwater supply, preserving natural bodies of water and their ecosystem functions. The idea is that this plan will help meet future water resource needs while providing for today. However, as mentioned in Section 1.2, these water resources are being threatened by a changing climate through increased stormwater, flooding, sea-level rise, and variability of drought and precipitation events both in intensity and timing. Thus, these plans need to include climate change predictions for ensuring future water supplies. Along with this, they need to include or call for mitigation strategies – those	• Broward County Integrated Water Resource Plan 2019 Update • Broward County Water Supply Facilities Work Plan 2014 • Central Florida Regional Water Supply Plan • City of Miami Beach Stormwater Management Master Plan • City of Pompano Beach Stormwater Master Plan (Integrated Sea-Level Rise Information) • South Florida Water Management District Upper East Coast Water Supply Plan 2016 • Winter Haven's Sustainable Water Resource Management Plan

related to water conservation - and adaptation strategies – those that expand the adaptive capacity of water infrastructure or prevent water resources from damaging current development.	
Floodplain Ordinances and the Community Rating System Program: The National Flood Insurance Program (NFIP) is administered by the Federal Emergency Management Agency (FEMA) and provides federally back flood insurance to property owners in participating communities. To participate in NFIP, communities must agree to pass a floodplain ordinance that establishes and enforces minimum regulations designed to help prevent and minimize flood damage. The program offers these communities an opportunity to decrease the cost of NFIP coverage for the community's citizens through the Community Rating System (CRS) Program. The CRS program rates communities according to implementation of strategies that have demonstrated value in reducing flood losses. The more flood loss reducing activities a community implements and documents, the more points the community earns in the CRS. These points then translate into an overall rating for the community between 1 and 9, with one being the best or highest rating and 9 the lowest rating in the program. Each step up equals a 5% decrease in NFIP premiums for *every* NFIP policy in the community, thus saving you money if you have flood insurance. For a more complete overview of the CRS program, see here. Florida Statutes encourage local governments to participate in CRS. If your community is not currently participating, evaluate whether your community would like to join the CRS. Note that the administrative burdens of CRS participation have led some communities, particularly those below 10,000 inhabitants, to choose not to participate in the CRS program. If your community participates in the CRS program, you should evaluate ways to increase your CRS score through amendments to floodplain ordinances and other related activities. The Florida Department of Emergency Management provides resources and assistance to communities that want to improve their CRS score or want to join the CRS.	NOTE: As of July 2020, only 9 Florida communities do not participate in the NFIP.
Capital Improvements Plan – Addressed in the comprehensive plan as well as mitigation and recovery strategies, capital infrastructure (e.g. water, wastewater, transportation, schools, recreational facilities) needs to be updated and improved over time. Since local government budgets cannot provide for updates and improvements at the same time, infrastructure needs to be prioritized and updates for it to occur on a spending schedule. The Capital Improvements Plan takes identified priorities from the Comprehensive Plan and guides investments and improvements. This plan recognizes actions related to rebuilding degraded infrastructure, protecting or reducing hazards from impacting infrastructure, improving the adaptive capacity of infrastructure, and encouraging development and infrastructure away from hazard areas. In this way, the plan can adopt climate adaptation strategies that prevent rebuilding or promote protection of	• City of Largo – Capital Improvement Plan Scoring Criteria (The criteria evaluates its overlap with sustainability goals.) • Miami-Dade County – Recommendation for and Enhanced Capital Plan (This report explains how to consider climate change in the capital planning process.) • Pinellas County - "Guidance for Incorporating Sea Level Rise into Capital Improvement Programs" and associated multi-sheet spreadsheet "Guidance for Incorporating Sea Level Rise into Capital Planning in Pinellas County" (This report shows how to consider SLR vulnerability,

infrastructure. It can also incorporate climate hazard information to prioritize less vulnerable infrastructure and identify designs to build resiliency. Furthermore, the plan can include improvements that promote energy or water conservation.	risk, and adaptation planning within capital planning projects.)
Historic Preservation Plan – Historic preservation plans are created to enhance and protect the integrity of properties that hold significance to a community. Unfortunately, many historic buildings and sites are in areas subject to climate hazards (e.g. flooding and sea level rise), especially in coastal communities. So, it is necessary to assess these historic sites and outline adaptation strategies that reduce damages from climate impacts in the plan.	• City of Fort Pierce Sustainable Historic Preservation Assessment & Design Tool • City of Naples Sec. 16-116. – Historic building. • City of St. Augustine Historic Preservation Master Plan • City of Titusville Historic Preservation Plan
Economic Development Plan – An economic development plan sets policy direction for economic growth in a community. It identifies strategies, programs, and projects that can improve the economic conditions and develop a community in a resilient way. These plans can be useful for promoting climate action goals in several ways. One, they can encourage investment and economic activities in areas that are less vulnerable to climate impacts, which may make migration efforts easier. Two, the plan allows local governments to strategies ways to green the local economy while building resilience in the community. For example, construction projects that build adaptive structures create a need for jobs. Another example is the government promoting or encouraging green industries, like solar providers or zero waste shops. Three, it can promote social equity by investing in communities that are economically disadvantaged and most vulnerable to climate impacts. The plan can provide for ways to maintain housing affordability while expanding this economic investment.	• City of Ormond Beach Strategic Economic Development Plan 2012-2014 • Panama City Economic Development Plan 2019 • Pasco County Economic Development Plan 2013-2025

Once the method is identified, you should set steps according to the processes used in the method (e.g. research and writing policy proposal, etc.) as well as to achieve enforcement or action (e.g. training staff on new policy, etc.), and to continue monitoring and evaluating (e.g. scheduled review sessions, etc.). See Section 2.8 on the actions steps for monitoring and evaluation that should be established early on in the process. Along with establishing steps, you must identify resources (i.e. funding, technical expertise, and time) to complete such steps and define their availability and accessibility before, during, and in maintaining the project or policy. Lastly, you can indicate the actors that will be overseeing the process, contributing to it, or providing resources for implementation. Generally, you should have a point person from your leadership team to oversee specific groups of strategies or projects and a point person/implementer/enforcer from an internal department or team to oversee the specific strategy.

Step #5: Develop an Implementation Plan or a Climate Action Plan.

Now that you have identified action steps, resources, and actors, you can create an implementation plan. This plan reduces duplicity, ensures effectiveness, and allows for successful monitoring and evaluation (See Section 2.8 Monitoring and Evaluation). By creating this plan, you will establish a logical sequence of actions that can reduce the most concerning risks and set the stage for future action. In this way, the plan creates a timeline for actions. This timeline on a time scale of typically 5 to 10 years should order high priority strategies according to

goals, level of ease in implementation, and achievability. It should indicate milestones with specific status goals for various strategies. This timeline must account for time needed to receive resources, such as funding, as well as contingencies and alternatives to make the plan flexible under changing circumstances and information.

The implementation plan can be a stand-alone document for a few actions at a time or be integrated into a 'climate action plan' (CAP) – sometimes referred to as a *resiliency plan/strategy*. A climate action plan is a comprehensive document that outlines recommendations and implementation plans for a group of mitigation and adaptation strategies. They are great investments for ensuring your community meets its goals of reducing emissions and increasing resilience. However, your community may prefer to only implement one project at a time or test a few climate policies before fully committing resources to a climate action plan. Standalone implementation plans are less time consuming, but only account for a few high priority items at a time. CAPs account for all mitigation and adaptation strategies identified regardless of priority level.

The main difference between a CAP and other environmental plans (i.e. sustainability plans) is that it is only focused on the issue of climate change, while other plans address a mix of environmental issues (e.g. water quality, pollution, habitat destruction, etc.). Although, sometimes climate action plans are integrated into existing plans because mitigation strategies tend to have benefits for other areas of sustainability. Generally, CAPs are created as a separate governance document to ensure effective climate action is taken. It is used as a guide by the leadership team, local government departments, and community stakeholders. The steps to make the climate action plan are the ones that have been mentioned throughout this handbook. It uses the GHG emissions inventory and the Climate Vulnerability Assessment to define climate goals based on local priorities and outline implementation strategies for achieving goals. So, it is best to think of the CAP as a culmination of the leadership formation, assessments, engagements, as well as strategy research and planning.

The elements and sections of a climate action plans typically include the following:[3]

- An Executive Summary – This summary provides a brief overview of the whole document including information on the local and global significance of climate change, the benefits of the CAP, as well as the CAP's goals, focus areas, and major initiatives
- Introduction – This part explains who is writing the plan and for what reasons (i.e. the vision for the leadership team and goals of these efforts). Often, it includes information on the basic science of climate change and the local climate change impacts that affect or are expected to affect the community.
- Current Climate Protection Initiatives – This section summarizes existing efforts related to climate change made by the local government. In this way, it identifies active committees or leadership for climate action efforts, acknowledges past studies, plans, or actions relating to climate change, and summarizes participation in any pledge commitments.
- Baseline Assessment for Local Government and Community – This section indicates the key takeaways from the GHG emissions inventory, the Climate Vulnerability Assessment, and engagement opportunities to create a baseline for local government operations and communities. In doing this, it establishes the starting point to compare metrics for future evaluations and validates goals and targets set in the next section.
- Goals/Targets – Here, the main goals and topic areas of the plan are outlined. The methodology for developing these goals and targets are explained, which includes information on the formation of the leadership or advisory team, the climate vulnerability assessment, the GHG inventory, and the outcomes of public workshops and meetings. Examples of common topic areas for which goals are set include: GHG

emission reduction goals, sustainable land management, transportation planning, water supply and management, built infrastructure, natural systems, agriculture, energy and fuel, solid waste and recycling, economic risk reduction and emergency management, monitoring emissions and vulnerabilities, climate justice/equity, public policy coordination, and outreach education.

- Climate Action Plan Initiatives – This is the main section of the governance document. It identifies the strategies and objectives for each goal previously mentioned. Typically, this is the priority list you identified previously. So, it includes all levels of priority and identifies them within this section. Some of examples of how this looks are provided below.
- Implementation Plan – Sometimes this section is combined with the initiatives section. It is the part where the implementation plan established in the previous step is outlined with the timeframe, staff or leaders, metrics, resources/costs, and action steps. Sometimes, this is made into a table that splits these details into columns.
- Next Steps/Conclusion – In the final section, the above information is summarized and steps for a specified time period (e.g. 5 or 10 years) are identified. These steps include details on the process, timing, and measurements for monitoring and evaluating implementation progress as well as the process for updating the climate action plan and future engagement opportunities.

Examples of Climate Action Plans from Florida communities include: City of Boynton Beach Climate Action Plan, Broward County Climate Action Plan, City of Cape Coral Climate Change Resiliency Strategy, Lee County Climate Change Resiliency Strategy, City of Miami – Miami Forever Climate Ready Strategy, Monroe County Climate Action Plan, City of Oakland Park & City of Wilton Manors Climate Action Plan, City of Pensacola Climate Mitigation and Adaptation Task Force Report, Village of Pinecrest Climate Action Plan, Southeast Florida Regional Climate Compact Climate Action Plan, and Town of Surfside Climate Crisis Report and Action Plan. You can look at these as templates for writing your own climate action plan. Do note that some of these plans have all the elements and sections described above, while others have only a few of them or do not follow the same order. The depth of implementation descriptions and outlines depends on the purpose of the document as established by the leadership team.

Step #6: Get approval and implement.

If your community is implementing a climate action plan, then this is the step where you publish the final plans and distribute it to internal and external stakeholders. Once you get approval for the climate action plan or implementation plan(s) by the legislative body, you can begin overseeing the work of departments and community partners in proposing or amending policies, building or upgrading infrastructure, starting programs, etc. At this point, your main task is to keep the plans relevant and updated through engagement opportunities, monitoring and evaluating, and researching or proposing new plans.

CHECKLIST OF ACTIONS

- ☐ Research or consult on funding opportunities that can make climate strategies more affordable for your community. Also, note any access you have or could possibly have to technical experts, climate information, or community involvement and support.
- ☐ Reduce your list of possible strategies from Section 2.5 to those that are possible with available resources, legal issues, and stakeholder acceptance.
- ☐ Prioritize your list of strategies. Perform cost-benefit, equity, or other analyses to help you as you prioritize. Or, use worksheets that can help you rank your list.
- ☐ Determine the actions, actors, and resources needed for at least high priority strategies. First, you will need to outline the details for these strategies, and then determine the way this strategy will exist within the governance.
- ☐ Write your implementation plan(s) or climate action plan according to the details, actions, actors, and resources you identified. Use templates from other local governments to help you.
- ☐ Get approval for the plans (if needed) and start taking the actions identified in your plan.

References

[1] Georgetown Climate Center. "Opportunities for Equitable Adaptation in Cities: A Workshop Summary Report". https://www.georgetownclimate.org/files/report/GCC-Opportunities_for_Equitable_Adaptation-Feb_2017.pdf/.

[2] ICLEI Local Governments for Sustainability. "Preparing for Climate Change: A Guidebook for Local, Regional, and State Governments." https://icleiusa.org/wp-content/uploads/2015/06/Preparing-for-Climate-Change-Adaptation-Guidebook.pdf

[3] New York State Climate Smart Communities. "Climate Action Planning Guide." https://cdrpc.org/wp-content/uploads/2015/05/CAP-Guide_MAR-2014_FINAL.pdf.

Additional Resources

Climate Policy Initiative. *This organization advises governments on opportunities to drive economic growth while addressing climate change with experts in finance and policy.*

National League of Cities Sustainability Team website. *This team provides training and peer-learning opportunities to help local governments in sustainability and resilience efforts.*

TRAINING: Planning Effective Projects for Coastal Communities – NOAA Digital Coast. *This interactive training course teaches project planning practices that can be applied to implementation planning for various strategies. The course teaches how to conduct an assessment, use a logic model to plan a new project or reassess a current one, and prepare an evaluation.*

RESOURCES FOR FINANCING CLIMATE SOLUTIONS

"Appendix 6.2 Funding Opportunities – Adaptation Planning Guidebook" – FL DEP. *This appendix shows a list of non-profit, private, local, state, and federal grants.*

"Clean Energy Financing Programs: A Decision Guide for States and Communities" – EPA. *This guide reviews the types of financing programs and components of them for local governments who*

"How to Incorporate Sea-Level Rise Adaptation Assessment Tools and Resources into Local Planning" – Florida Department of Environmental Protection. *This guide provides suggestions on tools that can be used to incorporate climate considerations in local planning efforts – many of which were identified in this section.*

"Integrating Sea Level Rise Adaptation in Local Mitigation Strategies" – Florida Department of Economic Opportunity. *This guidebook provides a framework for updating their local hazard mitigation plan to include risk analyses and adaptation strategies – mostly specific to sea level rise.*

"Integrating the Unified Sea Level Rise Projection into Local Plans" – Southeast Florida Regional Climate Change Compact. *This document reviews how sea level rise projections have been added to local planning efforts in South Florida. It provides some language for doing this as well as a list of local governments that have done.*

Resilient Rural America Project website. *This project has a few modules and expert advice on integrating resilient land use strategies into comprehensive plans for rural areas.*

need funding sources for energy and renewable energy strategies.
Creating a financing program

FRCP Resilience Grant – Florida Resilient Coastlines Program. *This website explains some of the grants available through the FL Department of Environmental Protection.*

Grants.Gov website. *This website provides a database of federal funding opportunities.*

Kresge Environment Program. *This group funds projects related to making key urban infrastructure climate resilient through loans, guarantees, linked deposits, or equity investments.*

"Sea-Level Rise Adaptation Financing at the Local Level in Florida" by Thomas Ruppert and Alex Stewart – Florida Sea Grant. *This white paper reviews the feasibility of various financing mechanisms to use for climate strategies.*

RESOURCES FOR INTEGRATING INTO EXISTING GOVERNING DOCUMENTS

Tool: Community Goals Scorecard – NOAA Digital Coast. *This scorecard assesses how well existing regulations help to implement the community's goals. Once filled out, you should have a better idea of where changes can be made.*

"Sea Level Rise Ready: Model Comprehensive Plan Goals, Objectives, and Policies, to Address Sea-Level Rise Impacts in Florida" – University of Florida Conservation Clinic. *This PowerPoint reviews strategic language for comprehensive plans that can address adaptation strategies for sea level rise impacts in Florida.*

"Tackling Barriers to Green Infrastructure: An Audit of Local Codes and Ordinances" – Wisconsin Sea Grant. *This guide provides an audit assessment to see whether your community codes support the adaptation strategy of green infrastructure. Through this audit and guide, you can develop a plan for revising or amending your local codes and ordinances to implement this strategy.*

RESOURCES FOR CLIMATE ACTION PLANS

RCAP 2.0 – Southeast Florida Reginal Climate Change Compact. *This web-built platform allows municipal staff (and others) to search both by who you are (planner, public works) and what topic are you are interested in (natural systems, energy). It provides research based best practices, case studies and policy examples for adoption at the local level and is a great first step for any community in Florida.*

ClearPath. *This is an online software platform that can help complete climate action plans for your community.*

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SECTION 2.7 MONITORING AND EVALUATING

The last step of the policy process is to monitor and evaluate the policies and plans created to prepare the community for changing climate conditions and combat those change. Although this step is usually an afterthought or rarely performed, it is vital for tracking progress, holding leadership accountable, enhancing community support and awareness, identifying areas for improvement or expansion, and making informed decisions about future policies, goals, and actions. From monitoring and evaluating, communities can demonstrate to their stakeholders the ways in which climate action is making them more resilient. Typically, these processes are overseen by the assigned climate leadership team. However, they may involve those implementing the program to perform the actual evaluations and report to the team as a whole. To monitor and evaluate progress effectively, the team needs clear lines of communications with the various departments involved. This section will briefly explain how to monitor, evaluate, and communicate or readjust plans according to

GOAL AND LEARNING OBJECTIVES

GOAL:

To understand the usefulness of monitoring and evaluation systems for climate policies.

LEARNING OBJECTIVES:

By the end of the section, you will be able to:

- Describe the process for monitoring and evaluating climate policies.
- Create a consistent system for monitoring and evaluating implemented climate policies.
- Take the next steps to continue the policy process – communication and adjustment of plans or policies.

Monitoring

As one part of the continual process, monitoring is done throughout the implementation process, and, for some projects, involves consistent review to ensure the product is working. It is usually a task assigned to those implementing a project or policy. These implementers should review and keep record of the actions taken to form their policy, project, or program during set up, implementation, and completion. However, those on the leadership will need to ensure that it is occurring and should check in on the status of projects for their own reports. This ensures accountability to make sure actions are seen to completion or do not slip through the cracks. As they monitor, they will revisit timelines and track the progress of multiple scheduled actions to make sure the timeline is still feasibly achievable. Generally, it is performed on an annual basis.

Although monitoring does not involve a complete review of a project or policy, it is still useful for adjusting plans as needed. If you are monitoring the progress as related to social/equity-, environmental-, or economic- related indicators, you can adapt the strategies to achieve those where it might not be meeting performance metrics and criteria. Those who are monitoring can revise current or planned actions to make a timeline more achievable or change the dedication or resources for projects that have more community support. This community support plays a large role in monitoring because monitoring should also involve checking in with implementors as well as affected stakeholders to see the perceived level of completion or satisfaction with a policy.

Evaluations

The other half of the process involves evaluating. It can occur for different aspects of the climate policy process, at several points in the process (i.e. alongside monitoring, milestone points, completion of projects), and through a variety of methods. First off, evaluation can happen for specific actions and projects that are completed or done with one of their phases, a check up on current strategies that may be adjusted or are not meeting their goals and metrics, climate action plans as a whole based on past success and failures, reviewing the feasibility of implemented Tier 2 and Tier 3 policies with newer available resources, revisiting Climate Vulnerability Assessments, and Greenhouse Gas Inventories, reviewing methods and basic assumptions related to the goals and objectives, and engagement methods and opportunities. With the wide variety of topics relating to climate actions that can be evaluated, there will be a different set of actors and stakeholders that should contribute to the process and report. Also, depending on the topic, the timing of evaluation may occur at different points. Generally, it occurs at annual intervals. However, strategies may be strategically outlined for longer timescales that requires longer intervals. This is the reason for noting monitoring and evaluation efforts in the timeline of strategies. Along with this, some strategies involving climate financing may be required to have an evaluation when the funding is up for renewal. It will also depend on other factors such as the nature and timescale for the expected vulnerabilities and risks, the planning and administrative timescales, and the budget cycle. Nonetheless, it is important to regularly evaluate, whether it is individual strategies or the entire plan.

Evaluating mainly involves checking whether the project or strategy has met its established goals and metrics. The output is typically a report on the project details, processes, data collection methods, findings, and final recommendations. In general, the steps[i] for evaluation are: [1]

1. **Determining the Evaluation Questions.** - In essence this is the project's purpose and will determine whether the focus is on the process, outcome, or impact. Depending on the focus of the evaluation, the evaluation questions that guide the methodology will differ. They can be posed by those implementing the project, overseeing it, or affected stakeholders. Also, they are usually interposed with a decision that is based on the outcome of the evaluation. After these questions are decided, there should also be an established deadline to complete such evaluation.
2. **Contextualizing the Project and Identifying Influences.** – In this step, those evaluating will be informed on all aspects of the findings to help with recommendations. Context includes existing conditions related to political, social, economic, and cultural aspects; external and internal issues; activity specifics (i.e. project details, inputs, processes, and outputs); target population and stakeholders; and the rationale for the project/relation to climate action. To help in finding this information, evaluators should review needs assessments, logic models, strategic plans, grant proposals, and outreach material. Based off the information found during contextualizing, evaluators should inventory the internal and external influences (i.e. mandates/regulations, alternative choices, environmental conditions, social and cultural conditions, economic conditions, and resources) that have effects on the outcome of a project. Knowing this earlier, will

[i] Note: Although these are the general steps, evaluations can occur at a smaller, less resource intensive scale depending on the scope and purpose of a project, policy, or plan.

help them formulate their data collection methods and see some of the disadvantages with a project or policy.

3. **Establishing and Using Performance Measures.** – In the implementation stage, the metrics for a project or policy should have been established alongside its goals. Knowing these outcomes or efficiency measures will help in determining the methods for data collection and whether the project has been performed effectively, timely, or within the expectations of other criteria. However, some evaluations may need to create performance metrics for receiving specific answers related to the evaluation method. Nonetheless, the metrics should be a direct representation or proxy of the desired outcome as well as specific enough for repeated evaluation. To create the metrics, baselines are established as references for the goal and qualitative or quantitative indicators are selected to see the extent of the changes from the baseline, whether that is a percentage, numeric, or defined increase/decrease. These indicators, which normally involve multiple data points across a range of scales and sectors, can be used as a proxy, related to processes or outcomes, or focused on changing contextual information or meeting requirements such as equity and adaptive capacity. Examples of indicators can be found in "Additional Resources".
4. **Data Collection.** – Determining the methods for collecting data is important because they influence the analysis and conclusions of the report. Depending on the metrics and indicators needed, there are several data sources, both quantitative and qualitative, that can be used in evaluation. This also means that there are multiple collection methods that can be used to evaluate, such as interviews, observations, existing data, etc. (See "Additional Resources" for more ideas). It is recommended to draw from multiple perspectives and data sources to reduce biases and increase confidence in the findings. For example, after finding quantitative data that leads to an important conclusion, evaluators can validate this with qualitative interviews with different socioeconomic populations to see first-hand experience of a project or policy and determine its level of improvement for social equity or other factors. Also, the data drawn should be reliable, useful, cost- and time-effective, and adequate to answer the response. It is important to ensure that before collecting you are complying with data collection regulations and after collection you validate your methods. Validating results ensures that you have collected all the needed data to make adequate analysis and findings.
5. **Analyze the Collected Data.** – As you analyze the data, you should be noting any unintended or unexpected consequences, noticeable successes and failures, and – most importantly – relating the data to achieving objectives and intended results. To do this, you will want to combine the contextual information and influences with the data, which can be very strenuous and time-consuming. Nonetheless, this way you can get a complete picture to make conclusions.
6. Conclude and Make Recommendation. – Based on the analysis, you will have key finding that need to be reported to leadership or community stakeholders. Along with this, these findings should be the foundation for future recommendations that concern the current policy, development of other similar ones, or the overarching climate action plan.

Next Steps: Communicating Successes or Failures and Readjusting Plans

After a policy has been reviewed for monitoring or evaluation, the results should be communicated, and plans readjusted. Whether the results show successes or failures, communication with external and internal stakeholders is key to maintain transparency, trust, and community support for overarching climate goals. Successes will give stakeholders reasons to support future funding and policy efforts related to that policy or

other climate actions. Lessons learned from failures in projects can give stakeholders hope for better future responses by local governments to climate change. Moreover, if you are honest with your community, they will trust that the actions are in the best interest for climate preparedness rather than other rationales. The way you communicate these successes or failures is important and must be adjusted to the intended target audience. For decisions with large consequences and in-depth details, evaluation or monitoring reports with full details may be necessary. For updates on the progress of policies or projects, only short, bulleted highlights from these reports will be needed. On the other hand, if you are trying to maintain transparency with external communicators developing an open data online platform that shares the monitoring and evaluation updates and data can be helpful. Although the most common way that communities communicate their results is through a page on the website detailing accomplished actions.

Not only should these results be communicated, they need to be used. If the findings and recommendations show faulty methods in the climate policy implementation, then future policies should be changed to different methods that may be more effective. Similarly, if there are recommendations that suggest the goals are not being met in the allotted time, then the timeline may need to be readjusted. In this way, the failures in current policy processes can be stopped for future plans and policies. Most importantly, the findings can help inform existing climate policies that need to incorporate new climate science or policy information, especially for those plans outlined in Section 2.6. Doing these updates to policies alongside monitoring and evaluation efforts creates a useful opportunity that does not normally come up in the typical 5-year evaluation cycle of the existing plans. Thus, monitoring and evaluating can ensure both the community and policies are updated with the most current information.

CHECKLIST OF ACTIONS

- ☐ Creating a monitoring schedule for the policies and strategies that are set in progress.
- ☐ Establish points of evaluation for policies, strategies, climate action plans, and implementation schedules.
- ☐ Create a communication strategy for coordinating monitoring and evaluating efforts. This includes collecting and reporting data. Establish the main source for communicating successes to external and internal sources, such as a website page or newsletter.

References

[1] NOAA's Office for Coastal Management. "Planning for Meaningful Evaluation". https://coast.noaa.gov/digitalcoast/training/meaningful-evaluation-guide.html .

Additional Resources

"Common Data Collection Methods for Evaluation" – NOAA Office for Coastal Management. *This document summarizes the purposes, advantages, and challenges of some of the most commonly used data collection methods for evaluation.*

"Evaluation Report Checklist" – NOAA Office for Coastal Management. *This checklist can be used to assess and edit evaluation reports before they are finalized.*

EnergyStar Portfolio Manager. *This online energy management system from the EPA allows you to measure and track the energy and water performance of a building over time. This can help in seeing improvements in water and energy efficiency/conservation efforts.*

"Equity in Building Resilience in Adaptation Planning" – NAACP. *This guide provides indicators that measure the consideration and impact on equity building of climate policies.*

Climate and Energy Resources for State, Local and Tribal Governments: Track & Report – EPA. *This webpage explains the steps for monitoring and evaluating climate related policies.*

METRICS AND INDICATORS:

Coastal Resilience Index. *This self-assessment guides you to find your community resilience index.*

"Measuring Community Resilience with the STAR Community Rating System" – STAR Communities. *This guide provides information on metrics and best practices for measure community resilience.*

"Urban Adaptation Assessment: indicator list (2017)" – ND GAIN. *This document provides a set of indicators that assess urban climate risks and readiness indicators.*

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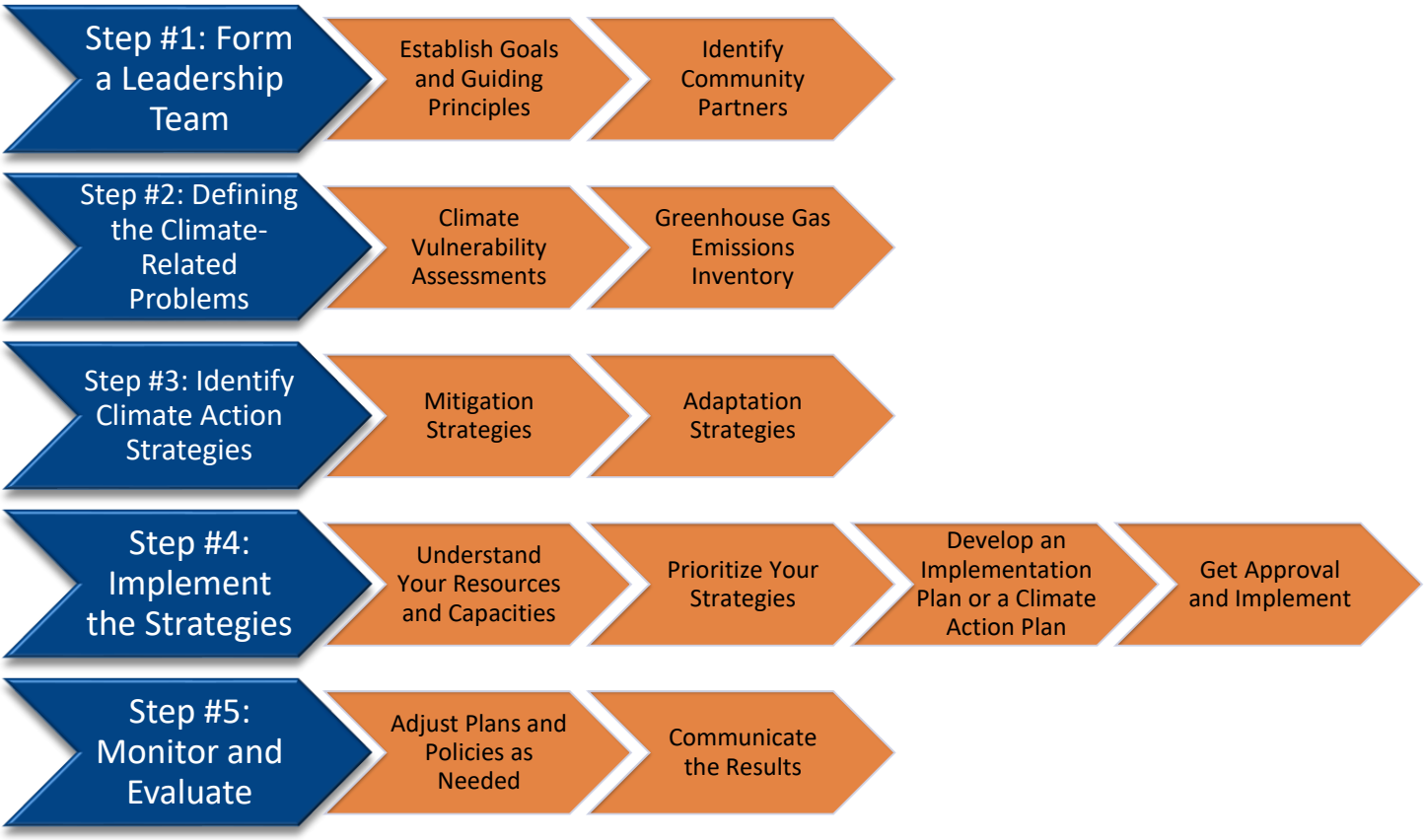
Final Words

The scientific consensus on climate change is notable and Florida is being threatened by a number of changes to the climate, such as sea level rise, flooding, and extreme heat. However, your community can protect and prepare itself by taking the steps laid out in this handbook – as shown in the graphic below.



These steps will build your community's resilience, increase climate knowledge within your government and the community, and set up a system for which your community can incrementally implement a comprehensive action plan. Although it may seem overwhelming to address climate change in this manner, the pace and methods for completing these steps can be retrofitted to the needs and available resources for your community.

Overall, we hope that you found this handbook useful to begin your climate action efforts. We encourage you to stay up to date on climate projections and best practices. UF/IFAS Extension and Sea Grant can provide your communities with other resources that go beyond the scope of this handbook. So, please reach out or provide us feedback on other way we could be assistance to you as your community becomes more climate prepared..

Appendices

Appendix A: Summary of "Needs Assessment Survey" - This appendix briefly summarizes the data we collected on the needs of local governments for overcoming barriers to climate policy implementation. We used this information to formulate the handbook.

Appendix B: Examples of Climate Leadership - This section contains two lists of climate leadership that are referred to in Section 2.1.

Appendix C: Vulnerability Assessment Tools – This is the extended list of vulnerability assessment tools referred to in Section 2.3.

APPENDIX A: SUMMARY OF "NEEDS ASSESSMENT SURVEY"

Background

To prepare this handbook, the Climate Smart Florida: Climate and Sea Level Rise Work Action Group conducted a needs assessment survey. It was designed to gauge interest in a handbook and identify key content relevant for local municipalities. In this way, it was a way for the team to validate the work of putting this handbook together and to make sure it is useful to our local government stakeholders.

Methodology

In May 2020, the survey entitled "Florida Local Government Climate Policy Needs Assessment" was created and administered via the Qualtrics platform for both county and incorporated municipal governments. The survey contained 24 questions that were split into several sections including: (1) socioeconomic and geographic characteristics, (2) climate science knowledge, level of concern, and level of preparedness, (3) types of climate policy actions and level of implementation (e.g. beginning, in process, or completed), and (4) challenges to taking climate policy action and (5) the interest in a how-to guide for local government action. These questions served as a baseline assessment of the general attitudes and practices within local governments around the state.

The survey was first distributed through email lists including the Florida League of Cities, Florida League of Counties, Florida Sustainability Directors Network, UF/IFAS County Extension Directors, etc. Two weeks after this initial distribution, respondent data was analyzed to see that the distribution was reaching a variety of communities, both geographically and demographically. Respondents were grouped according the Regional Planning Councils jurisdictions. Based on the analysis of geographic location, there was little diversity and some parts of Florida had no representation. So, the survey was redistributed to the same email lists as well as via direct mail to governments in underrepresented regions. This was to increase the diversity of the respondents. For a month and a half after the initial round, distributions were resent every two weeks.

Results

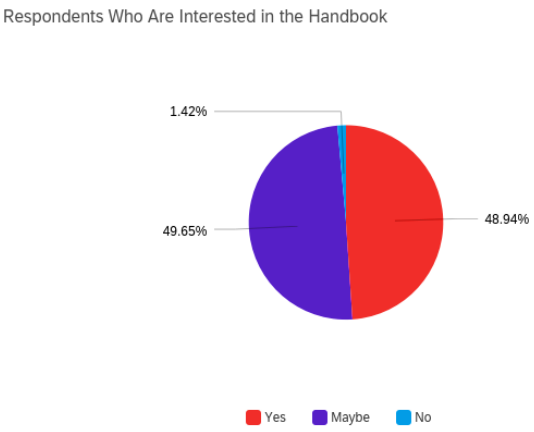
In total, 128 counties and municipalities responded to the survey. The distribution goal of 30 county and 75 municipality was almost met with representatives from 29 counties and 99 municipalities completing the entire survey. Every region had at least one county and one municipality respond. The majority of the surveys were filled out by those in the East Central, Tampa Bay, and Southeast regions. Demographically, the respondents ranged from communities and municipalities with populations of 0 to 500 or greater than 1,000,000. Most respondents were from communities of small populations (1,001 to 5,000) and medium populations (40,001 – 100,000). Furthermore, most responses came from communities with large urban populations, although there were quite a few from mainly rural areas. The survey was filled out by government

employees from a range of departments (e.g. zoning/building/planning, utilities, finance, public works, growth management, natural resources/environmental services, strategic initiatives, community development, etc.) and positions (city/town/county manager or clerk, sustainability/resiliency coordinators, mayors and legislative body members, grants coordinators, utility directors, facilities managers, coastal managers, etc.). The survey represented a diverse group of local communities from around the state and several different perspectives of climate change within local governments.

Of the X number of incorporated municipalities and counties, 128 completed the survey. There were over 10 surveys with partial responses and a few surveys were completed by different employees in the same local governments. These were not able to be taken out of the data set and did count towards the results. Moreover, because the survey was mainly filled out by one person to represent the views towards climate change within their government, there is an inherent bias to the survey since the one person cannot fully represent all the views within a government. Nonetheless, this bias and skewing is accounted for in the analysis and use of the data.

Key Takeaways

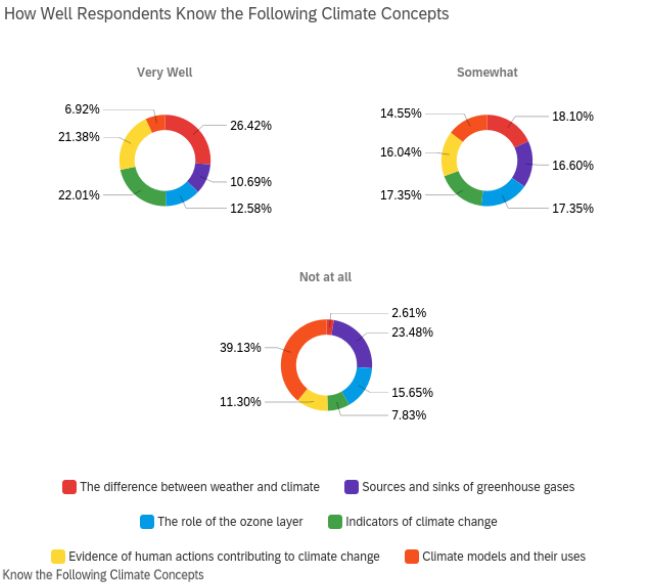
#1: Most of the respondents were interested in using the handbook.



As shown in the figure on the left, most of the respondents want to or are interested in a handbook focused on…. With only a few responses rejecting the handbook, the survey indicates a large request for it. Thus, there is validation in creating the handbook. The reasons for the interest in the handbook can be linked to other key takeaways explained below.

#2: There is a baseline level of understanding of climate science concepts within governments.

When asked the general level of understanding of climate science concepts (i.e. weather v. climate, greenhouse gases, climate change indicators, evidence of a changing climate, climate models and their uses, and the ozone layer), most of these concepts are "somewhat" understood. The one that seems to be best understood is 'the difference between weather and climate'. While the least understood concept is 'climate models and their uses'. This led to the review of climate change concepts in this handbook, especially for climate models. The related question on interest in learning more on this information indicated high levels of interest for all concepts. In some of the text entry questions, government officials indicated a need for more Florida specific, science-based information that can help them explain climate change and its importance to the community members and government officials. So, the work action group could possibly create other Extension resources that can go more in depth on these concepts than this handbook allows. These resources could be one- or two-page documents explaining concepts, a workshop that reviews climate science information and communication, and being a resource to teach these concepts at community meetings.

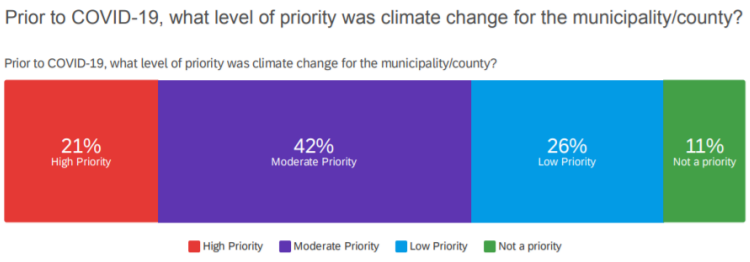


How Well Respondents Know the Following Climate Concepts

#	Field	Very Well		Somewhat		Not at all		Total
1	The difference between weather and climate	29.58%	42	68.31%	97	2.11%	3	142
2	Sources and sinks of greenhouse gases	12.78%	17	66.92%	89	20.30%	27	133
3	The role of the ozone layer	15.27%	20	70.99%	93	13.74%	18	131
4	Indicators of climate change	25.55%	35	67.88%	93	6.57%	9	137
5	Evidence of human actions contributing to climate change	25.56%	34	64.66%	86	9.77%	13	133
6	Climate models and their uses	8.21%	11	58.21%	78	33.58%	45	134

Showing rows 1 - 6 of 6

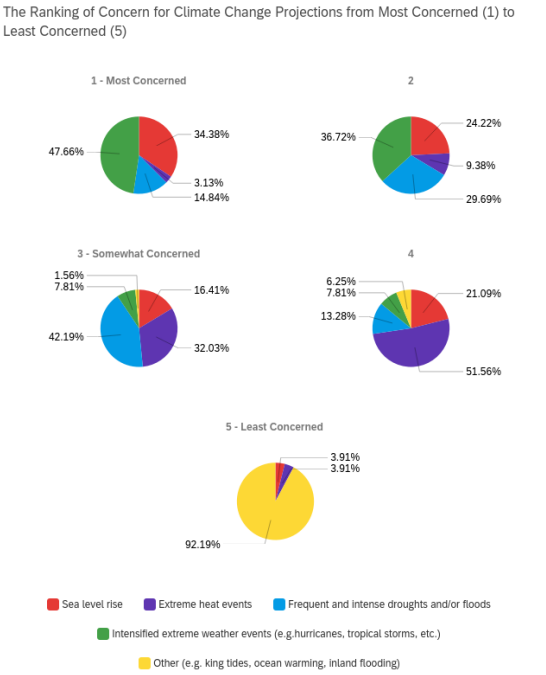
#3: Prior to the COVID-19 pandemic, climate change was a priority issue for many local governments.



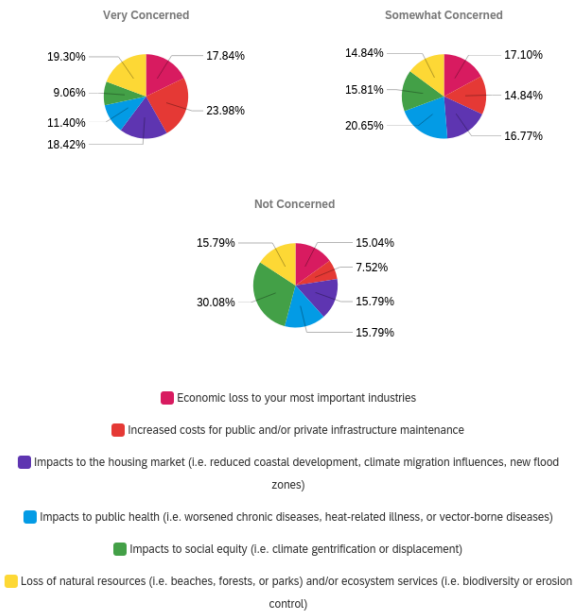
As shown in the figure to the left, climate change was a moderate to high priority for over half of the responding governments. A small percentage (11%) did not consider climate a priority. These numbers indicate that there is a large consideration for climate change and its impacts amongst communities in Florida. Again, this validates the need for the handbook. However, it is unknown at this time of writing how COVID-19's political, economic, and social consequences will influence the priority of climate change in the future.

#4: There is a large concern over climate change projections, such as sea level rise and intensified extreme weather events, and its impacts, especially increased infrastructure maintenance costs and loss of natural resources or ecosystem services.

Survey participants were asked to rank their concern of climate change projections. According to the figure on the right, the two main climate projections of highest concern are intensified extreme weather events and sea level rise. Considering this survey was answered by many coastal communities, the high concern for rising sea levels is not surprising. However, the concern for extreme weather seems to be higher, which seems to indicate the concern for climate change is more widespread than just in coastal communities. Also shown is that the next concern is for variations in the intensity and frequency of droughts or floods from the occurrence of precipitation or lack thereof. The projections of least concern are those related to other projections that seem to be more area specific and extreme heat events.



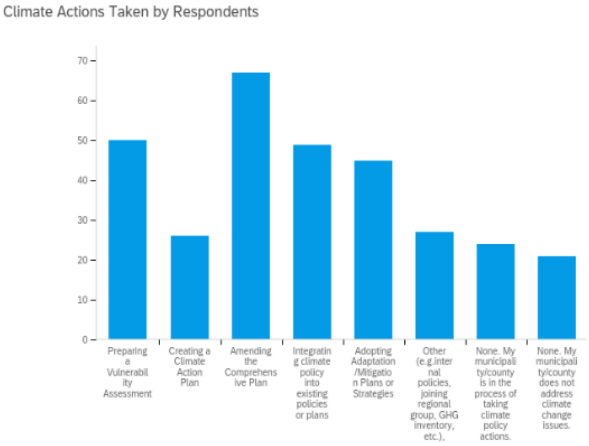
This second figure below shows the level of concern over social, economic, and environmental impacts from a changing climate. Those of highest concern are 'increased costs for public or private infrastructure maintenance' and 'loss of natural resources and/or ecosystem services'. However, impacts to the housing market, the local economy, and public health are also identified as important concerns. The impacts of least concern are those to social equity. This is not entirely surprising as climate gentrification and displacement are relatively new concepts.



For the purpose of this handbook and our work as a team, this takeaway gives us two main insights. First, the handbook should focus on strategies that address the high concerning issues identified in the survey. Second, there needs to be explanations of the other projections and impacts that are just as important but less known or understood (i.e. extreme heat impacts).

#5: Comprehensive plan amendments are the most common form of climate action taken by local governments.

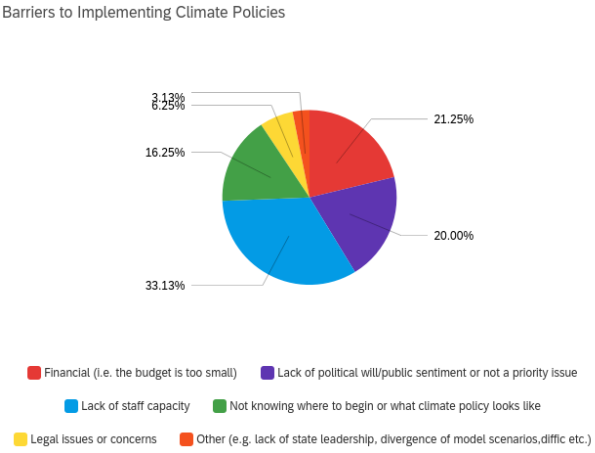
As shown in the figure, most actions consist of comprehensive plan amendments, vulnerability assessments, and integrating climate change into other governing plans. A small portion of respondents indicated that their government does not address climate change at all. These data guided the types of policies exemplified in the handbook.



Other survey questions show that communities are preparing for climate impacts by…. Howwever, most communities have not fully implemented climate actions. In some text entry responses, the communities indicated that they are planning to take these actions but are waiting to receive funding, further direction, or for results from local studies. Along with this, many plan on adding climate change elements to existing plans or comprehensive plans with scheduled updates. The trend seems to be that a number of communities are taking the beginning steps or are in the process of finding strategies to implement. In this way, the handbook could be useful by showing them how to oversee these actions from start to finish and give ideas of other strategies to include in their efforts.

#6: The main hinderance of implementing climate actions or beginning efforts is the lack of staff capacity.

As depicted in this figure, the largest barrier to implementing climate policies is the lack of staff capacity. Other barriers include little political will or public sentiment as well as financial costs for projects. These barriers were also outlined in many text entry responses. The main concern for many governments not already actively involved in climate efforts was the lack of options for small communities with little resources. In this way, it seems that the biggest issue is that these communities do not know how to participate in climate efforts when resources for this effort are limited. This handbook should mainly address climate actions that can be implemented by those with less resources and how this can be done. Also, it should show ways to overcome other barriers by providing strategies and additional resources that are there to help communities begin efforts.



APPENDIX B: EXAMPLES OF CLIMATE LEADERSHIP

These two extensive lists outline examples of sustainability and/or resiliency leadership. They are referred to in "Section 2.1 Establishing Leadership". Note, the parentheses in each table include the names of the program and positions that differ from the typical sustainability or resiliency names.

Table 1. List of Local Governments with Sustainability/Resiliency Staff Positions or Officers

STAFF POSITION ONLY	OFFICE ONLY	BOTH STAFF POSITION AND OFFICE	
City of Apopka	Broward County (Climate, Energy, and Sustainability Program)	Alachua County	North Miami (Sustainability Administrator; Sustainability Division)
City of Boynton Beach	Town of Casselberry (Green Up Casselberry)	City of Boca Raton	Orange County (Chief Sustainability and Resilience Officer; Sustainability Program)
City of Cape Canaveral (Sustainability Analyst)	City of Coral Gables (Sustainable Public Infrastructure Division)	City of Deerfield Beach (Sustainability Coordinator; Department of Sustainable Management)	Palm Beach County (Climate Change and Sustainability Coordinator; Office of Resilience)
Charlotte County	City of Delray Beach	City of Hallandale Beach (Green Initiatives Coordinator/Program)	City of Sarasota
City of Clearwater	City of Fort Lauderdale (Sustainability Division; Green Team)	City of Hollywood (Environmental Sustainability Coordinator; Sustainability Department)	City of St. Petersburg
City of Coral Springs (Environmental Coordinator)	Manatee County (Division of Energy and Sustainability)	Leon County	City of Tampa (Sustainability Officer; Green Tampa)
City Dunedin (Sustainability Program Director)	City of Margate	City of Miami	City of Tallahassee (Resilience Office and Officers)
Village of Key Biscayne	Martin County (Resilient Martin)	City of Miami Beach (Environment and Sustainability Director; Sustainability Division)	Volusia County (Sustainability and Resilience Manager; Green Volusia)
Monroe County	City of Miramar (Sustainable Planning Program)	Miami-Dade County (Green Print)	City of West Palm Beach
City of Oldsmar	City of Orlando		
Pinellas County	City of Stuart (Sustainable Stuart)		
Town of Surfside	City of Winter Park (Sustainability Program)		

Table 2. Examples of Committees, Boards, Taskforces, or Commissions in Florida

Town of Bay Harbor Islands (Sustainability and Resiliency Committee)	Miami -Dade County (Climate Change Advisory Task Force)
City of Boca Raton (Sustainability Advisory Board)	City of Miami Springs (Ecology Board)
Broward County (Climate Change Task Force)	Monroe County (Climate Change Advisory Committee)
City of Cocoa (Sustainability Advisory Committee)	North Bay Village (Sustainability and Resiliency Taskforce)
City of Cocoa Beach (Sustainability Committee)	City of North Lauderdale (Community Sustainability Board)
Cooper City (Green Advisory Board)	Orange County (Sustainability Advisory Board)
City of Coral Gables (Sustainability Advisory Board)	City of Palm Bay (Sustainability Advisory Board)
City of Dania Beach (Green Advisory Board)	Palm Beach County (Green Task Force on Environmental Sustainability and Conservation)
City of Delray Beach (Green Implementation Board & Rising Water Task Force)	City of Pembroke Pines (Environmental Advisory Board)
Village of El Portal (Sustainability and Resiliency Taskforce)	City of Pensacola (Climate Mitigation and Adaptation Task Force)
City of Fort Lauderdale (Sustainability Advisory Board)	Sarasota-Manatee Counties Climate Council
City of Hallandale Beach (Sustainability and Flood Mitigation Advisory Board)	City of Satellite Beach (Sustainability Board/Climate Ambassador Committee)
Hillsborough County (Environmental Protection Commission)	City of St. Augustine Beach (Sustainability and Environmental Planning Advisory Committee)
Highlands County (Natural Resources Advisory Commission)	City of St. Petersburg (Health, Energy, Resiliency, and Sustainability Committee)
City of Hollywood (Sustainability Advisory Committee)	St. Lucie County (Sustainability Advisory Board)
City of Jacksonville (Special Committee on Resiliency)	City of Surfside (Sustainability and Resiliency Committee)
City of Key Biscayne (Green Committee)	City of Tarpon Springs (Sustainability Committee)
City of Miami Beach (Resiliency and Sustainability Taskforce)	City of Titusville (Environmental Commission)
City of Melbourne (Beautification and Energy Efficiency Board)	City of Treasure Island (Sustainability Committee)
City of Melbourne Beach (Environmental Advisory Board)	City of West Palm Beach (Sustainability Advisory Committee)
City of Miami (Climate Resilience Committee)	

APPENDIX C: VULNERABILITY ASSESSMENT TOOLS

The following are additional vulnerability assessment tools as referred by Section 2.3.

Climate Change Specific	
CRiSTALTool.org	This tool helps users design activities that support climate adaptation. It assesses the impacts of a project on vulnerability and exposure. It requires training and expert knowledge to use.
Local Climate Analysis Tool	This tool helps communities understand local climate variability and its impacts. It requires registration.
NatureServe Climate Change Vulnerability Index (CCVI)	This Excel-based tool identifies plants and animals that are vulnerable to the effects of climate change. It could be helpful for natural resource management as well. It requires knowledge on natural resource indices and understandings.
OpenNSPECT (Nonpoint Source Pollution and Erosion Comparison Tool)	This tool created by NOAA's Office of Coastal Management. investigates potential water quality impacts from climate change and development to other land uses. It can simulate erosion, pollution, and the accumulation from overland flow in both coastal and noncoastal communities. It does require MapWindowGIS and some training on how to use the software.
NOAA's Climate at a Glance	This tool provides regional, county, and city level climate data for Florida. It is used to show historical trends that may help indicate future projections. It requires minimal expert knowledge.
U.S. DOT Vulnerability Assessment	This is an Excel-based tool that helps transportation planners assess the vulnerability of their transportation systems to climate stressors based on indicators. The goal is to prioritize assets based off these indicators. It requires medium expert knowledge.
Risk Assessment	
Hazus	This is a methodology from the Federal Emergency Management Agency (FEMA) that contains models for estimating potential losses (physical, economic, or social) from earthquakes, floods, and hurricanes. It uses GIS to identify high-risk locations. It is mostly used as part of the risk assessment. However, it can be used to improve hazard mitigation.
Sea Level	
Beach-fx	Designed by the U.S. A.C.E., this tool provides a framework for accurately evaluating the physical performance and economic benefits and costs of shore protection projects. It does require medium expert knowledge, but there are trainings available if needed.
CanVis Tool	This tool is for coastal communities to visualize future changes related to sea level rise, storm surges, and flooding as well as evaluate the visual impacts of adaptation options. It was developed by the U.S. Department of Agriculture and NOAA. The tool works by importing photographs from a place in the community. Then, users are able to view the potential impacts of rising sea levels in that specific area. Planners may incorporate docks, buildings, rising waters, and other objects into the photo to see potential scenarios. This tool requires minimal expert knowledge.
Climate Central Surging Seas Viewer	This tool has an interactive Risk Finder, which shows populations, infrastructure, and community assets exposed to sea level rise and coastal flooding for coastal communities. There are also other tools on this website that provide interactive maps for visualizing sea level rise under different emissions and warming scenarios. This tool requires minimal expert knowledge.

Coastal Adaptation to Sea Level Rise Tool (COAST)	Developed by Blue Marble Geographics and New England Environmental Finance Center (NEEFC), this software helps users answer questions about costs and benefits of actions and strategies to avoid damages to assets from sea level rise or coastal flooding. This tool does require some technical knowledge. There is consulting assistance available if needed.
Coastal County Snapshots	Developed by NOAA, this tool provides charts and graphs that describe complex coastal data, including information on flood exposure, wetland benefits, and ocean jobs. It helps to provide context for coastal and inland counties in Florida. It requires minimum expert knowledge.
Coastal Resilience Mapping Tool	Developed by the Nature Conservancy, this tool incorporates science and local data to visualize the risks imposed by sea-level rise and storm surge on people, economy, and coastal habitats. This tool is available for communities in **Southeast Florida** to support decision making. It also identifies nature-based solutions for increasing resilience and reducing risks. Minimal knowledge is needed for this tool.
U.S.G.S. Digital Shoreline Analysis System (DSAS)	This tool is an add-in for the ArcGIS software. It allows users to calculate changes in shorelines due to measurements of coastal erosion and accretion. It can help identify areas that are most vulnerable through visualized data and written explanations. It requires expert knowledge for use.
FDOT Sea Level Scenario Sketch Planning Tool –	This tool was developed by the University of Florida GeoPlan Center with funding from the Florida Department of Transportation. The purpose of this planning tool is to help identify transportation infrastructure vulnerable to current and future flood risks. The tool includes a web map viewer, GIS data layers, and an ArcGIS calculator Tool.
NASA Flooding Days Projection Tool	This tool allows decision makers to assess how sea level rise and other factors affect the frequency of high-tide flooding in the future. It can help in identifying relevant planning horizons and see changes from decade to decade. It requires minimal expert knowledge to use.
NOAA Coastal Flood Exposure Mapper	The online visualization tool assesses coastal communities hazard risks and vulnerabilities. The tool creates a collection of maps that shows these vulnerabilities. It also provides guidance on using these maps to engage community members. IT requires minimal expert knowledge.
NOAA Inundation Analysis Tool	This online tool is used to create scenarios of increased sea level rise. The tool provides summary statistics of the number of high tides and total hours of inundation experienced during a specific time period. It is compared against historical data. It requires minimal expert knowledge
NOAA Sea Level Rise Viewer	This web-based map provides federal, state, and local coastal resource managers and planners with a brief look at sea level rise and coastal flooding impacts. The tool illustrates the scale of flooding by using a mean higher high-water sliding tool on the side. It also provides photo simulations for certain communities with local landmarks that show how future flooding might impact it. It is recommended to only use as a screening-level tool for management decisions as it does not provide in-depth information. Minimal knowledge is needed for this tool.
NOAA Sea Level Trends	This tool represents regional sea level rise trends around the United States. This can be used to generally view expected changes for areas around Florida. However, since they are based on tide gauges in specific locations, the information is not available for all Florida municipalities. It requires minimal expert knowledge to use this tool.
Northeast Florida Regional Council's Regional Resilience	This innovative map tool allows those in Northeast Florida to determine if a specific resource will be exposed to coastal flooding. It is intended to function as a base-line resource to begin engaging stakeholders.

Exposure Tool (R2ET)	
Sea Level Affecting Marshes Model (SLAMM)	This mathematical model uses digital elevation data and other information to simulate potential impacts of long-term sea level rise on wetlands and shorelines. Additional data related to dike locations or other protected areas, accretion rates, erosion rates, and other factors can be included within the model as optional factors. In order to use the model, you must have ArcGIS for viewing outputs in a map form and software, like Microsoft Excel or Word, to view it in text or tabular form.
U.S. A.C.E. Sea Level Change Calculator	This tool calculates the amount of predicted sea level change for various locations along the U.S. Coast. The results are shown as a graph. It requires minimal expert knowledge on its use.
U.S. A.C.E. Sea Level Tracker	This tool uses analyzed historical sea level trends and compares them to projected sea level change curves for numerous locations around the U.S. It requires minimal expert knowledge.
U.S.G.S National Assessment of Coastal Vulnerability to Sea Level Rise	This tool maps the Coastal Vulnerability Index (CVI) through a data layer. This expresses vulnerability due to sea level rise, geomorphology, and shoreline erosion rates. It requires a medium level of knowledge.
Databases	
Digital Coast Tools	This provides data and tools that can aid coastal communities.
Gulf TREE	This interactive decision-support tree helps local governments identify the right climate tools for specific purposes. NOTE: It is specifically for those in areas along the Gulf Coast of Florida.
U.S. Climate Resilience Toolkit	This illustrates tools that are available to help you manage climate-related risks and opportunities.

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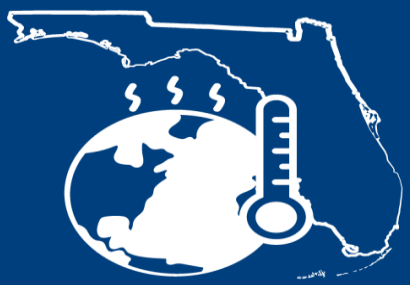

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