350 PPM PATHWAYS FOR FLORIDA

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EVOLVED ENERGY RESEARCH

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Executive Summary

This study evaluates multiple scenarios to radically reduce the greenhouse gas emissions that result from Florida's energy system, and can serve as a tool to inform statewide energy system decisions.

We detail five technically and economically feasible pathways to reduce carbon dioxide emissions and remain within a small enough "carbon budget" to enable a return to 350 parts per million of carbon dioxide in the atmosphere by 2100, a level identified by scientists as a safe limit necessary to preserve a stable climate. These scenarios limit emissions while providing the same energy services for daily life and industrial production as the Department of Energy's long-term forecast.

This study builds upon the research conducted by Evolved Energy Research and the Sustainability Development Solutions Network (SDSN) and published on May 8, 2019, titled *350 PPM Pathways for the United States.*

Scenarios

This study evaluates five energy decarbonization[1] scenarios for the energy system of Florida:

Central: The least constrained scenario, this uses all options to decarbonize the energy system.

Low Biomass: This scenario reduces the development of new biomass feedstocks[2] by 50%.

Low Electrification: This scenario assesses the impact of a delayed adoption of electric vehicles and heat pumps.

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[1] "Decarbonization" is the process of removing sources of carbon dioxide (and other greenhouse gases) from a system – in this case, removing fossil fuel emissions from Florida's energy system.

[2] Biomass feedstocks are plant-based and animal-based sources of fuel, like trees, grasses, or animal fats, for example.

100% Renewable Primary: This scenario describes an energy system based solely on biomass, wind, solar, hydro, and geothermal sources by 2050.

No New Regional Transmission (TX): This scenario limits the development of new electricity transmission lines between regions within the U.S.

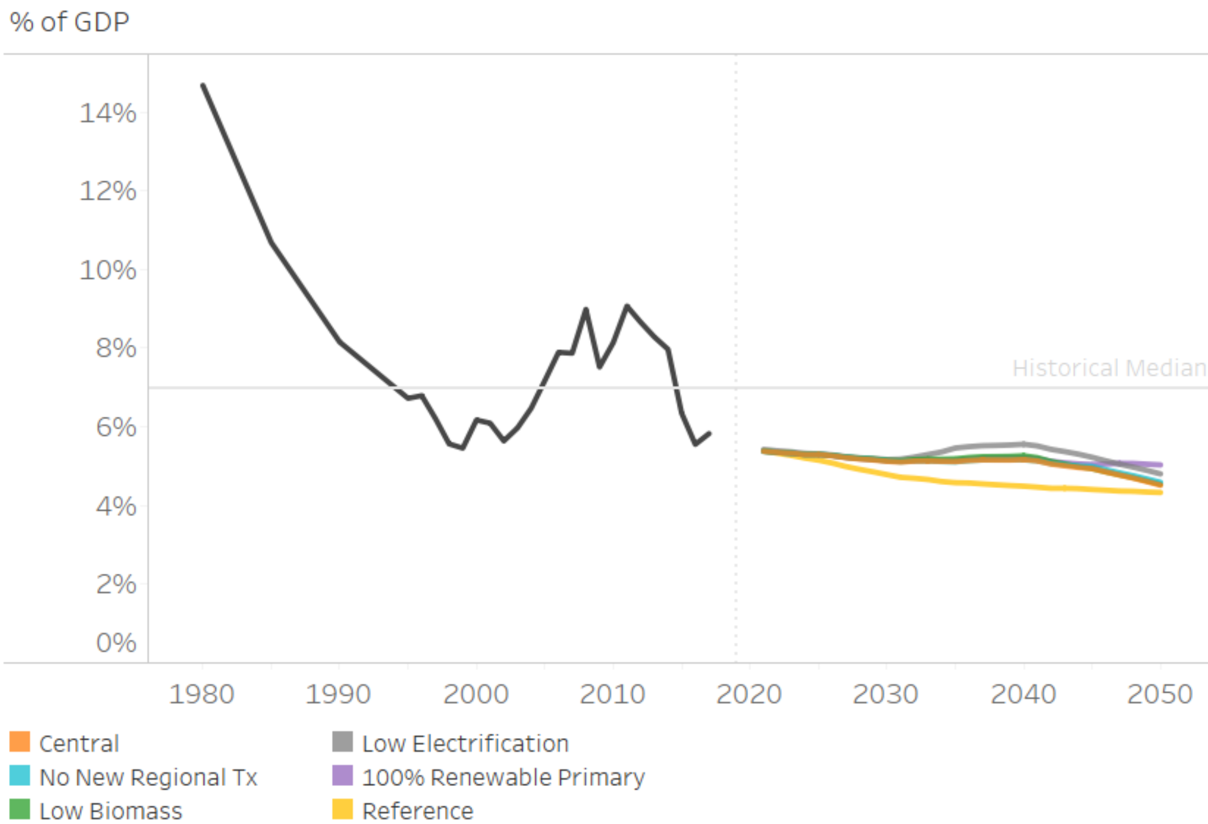
Florida Energy System Results

Energy decarbonization in Florida relies on four principal strategies: (1) **Electricity decarbonization** requires reducing the amount of fossil fuels used for electricity generation, thereby reducing the amount of greenhouse gas emissions from every unit of electricity delivered by about 95% by 2050; (2) **Energy efficiency** is the reduction in energy required to provide energy services such as heating and transportation, and energy use per unit GDP is reduced by about 50% below today's level; (3) **Electrification** involves switching energy uses including transportation and building heating off of fossils fuels and onto low-carbon electricity, and (4) **Capturing carbon** that would otherwise be emitted from power plants and industrial facilities – with the captured carbon either stored permanently (sequestered) or used to create fuels like synthetic natural gas or synthetic diesel, by combining the carbon with renewably-generated hydrogen.

Figure 1 shows historical and projected energy system costs as a share of State Gross Domestic Product (GDP). All scenarios evaluated in this study are in line with historical energy costs in Florida and, even with decarbonization, energy system costs are anticipated to decline as a share of GDP. The highest cost scenario is the 100% Renewable Primary pathway due to the emphasis on displacing *all* fossil fuels by 2050, rather than continuing to use some small amount of the lowest-cost fossil fuels and capturing and storing the associated carbon. The lowest cost scenario is the Central scenario, which allows for the most flexibility in terms of key decarbonization strategies.

Note that the costs within this chart do not reflect any of the macroeconomic benefits of transitioning off of fossil fuels, including improved air quality, avoided climate impacts (like avoided sea level rise), reduced energy price volatility, and energy independence, which could equal or exceed the net costs shown here.

Figure 1. Total energy system costs as percentage of GDP, historical and projected for Florida



Key Actions by Decade

Achieving the transition described above is not expensive but requires significant changes in public policy. Some of the **key policy challenges** that must be managed in all scenarios include: a) managing tradeoffs between using land for low carbon electricity generation (like wind farms and solar arrays) and improving natural carbon storage in forests and soils ; b) electricity market designs that maintain natural gas generation capacity for reliability while using gas generators very infrequently; c) developing electricity rates that incentivize customers to flex their energy use to better match periods of electricity surplus and shortage that come with intermittent renewables like wind and solar; d) encourage the development of carbon capture industries that can leverage periods of excess electricity generation ; e) coordination of planning and policy across sectors that previously had little interaction, such as transportation and electricity; f) coordination of planning and policy across jurisdictions; g) mobilizing investment for a rapid low carbon transition; and e) investing in ongoing modeling, analysis, and data collection that informs both public and private decision-making. These topics are discussed in more detail in *Policy Implications of Deep Decarbonization in the United States.*

Achieving this transformation in Florida by mid-century at lowest cost requires an **aggressive deployment of low-carbon technologies**, including:

2020s

- Begin large-scale transition to electric technologies in key sectors; moving to electric light duty vehicles and electric heat pumps.
- Use coal fired power plants only when absolutely necessary, prioritizing all other sources of electricity generation first. Begin retiring coal assets.
- Ramp up construction of renewable electricity generation and upgrade electricity transmission where needed.
- Allow strategic replacement of natural gas power plants to support rapid deployment of low-carbon generation. These power plants must be financed with the understanding that they will run very infrequently to provide capacity, not as they are operated today.
- Maintain existing nuclear power plants.
- Pilot new technologies that will need to be deployed at scale after 2030.
- Stop developing new infrastructure to transport and process fossil fuels.
- Begin building carbon capture for large industrial facilities.

2030s

- Maximum build-out of renewable electricity generation.
- Nearly 100% of new vehicle sales and new building heating systems using electric technologies.
- Begin large-scale production of biodiesel and bio-jet fuel.
- Large scale carbon capture on industrial facilities.
- Build out electrical energy storage.
- Deploy new natural gas power plants capable of 100% carbon capture if they exist.
- Maintain existing nuclear power plants.
- Continue to reduce generation from gas-fired power plants.

2040s

- Complete the transition to electric technologies for key sectors; virtually 100% of light duty vehicles and building heating systems run on electricity.
- Produce large volumes of hydrogen for use in freight trucks and fuel production.
- Use synthetic fuel production to balance and expand renewable generation.
- Fully deploy biofuel production with carbon capture.
- Further limit gas generation to infrequent periods when needed for system reliability.