

# The REMI Model: An Analysis of Coastal Resilience

Regional Economic Models, Inc.

*Dr. Peter Evangelakis, Vice President of Economics and Consulting*

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# Agenda

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Introduction

Defining resilience

AECOM study overview

How the REMI model analyses coastal resilience

Live model demo & notable results

Conclusion

Q&A

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# About Us

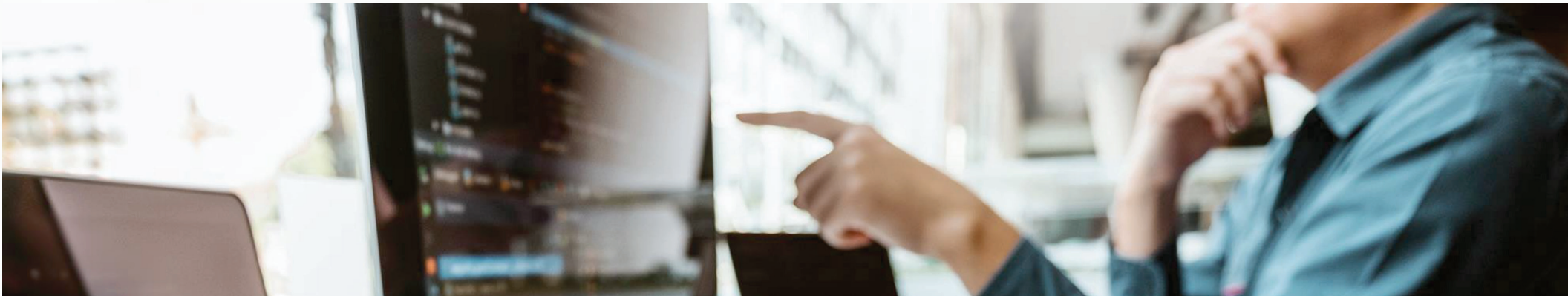


We are the nation's leader in dynamic local, state and national policy modeling.

From the start, REMI has sought to improve public policy through economic modeling software that informs policies impacting our day-to-day lives.

We were founded in 1980 on a transformative idea: government decision-makers should test the economic effects of their policies before they're implemented.

At REMI, we're inspired by a single goal: *improving public policies*.



*what does **REMI** say?*<sup>sm</sup>

# About Us



At REMI, we're inspired by a single goal: *improving public policies.*

Our models are built for any state, county, or combination of counties in the United States.

## Our Representative Clients

Our model users and consulting clients use REMI software solutions to perform rigorous economic analysis that critically influences policy.



McKinsey  
& Company



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Introduction

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# Defining Resilience



## Resilience:

*The ability to recover from or adjust quickly to a change in circumstances*



Natural disasters

Flood, wildfire,  
earthquake, etc.



Infrastructure failures

Power outage,  
bridge collapse,  
etc.



Economic shocks

Supply/demand  
shocks, cybersecurity,  
tech inventions, etc.



Recessions/  
industry shifts

Loss of  
manufacturing jobs,  
etc.

**what does REMI say?**<sup>sm</sup>

# Modeling Resilience



## *Why is it important?*

- Efficiency vs Resilience
- Economic modeling quantifies the value of creating and implementing resilient systems
- Making the case to invest in resilience
- Policy makers can be proactive when establishing policies to promote resilience at the local, state, and regional levels
- Resilience modeling informs and alerts decision-makers of the potential dangers of a non-resilient system

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# Coastal Resilience



| Planning for disaster                                                                                                                                                 | Disaster strikes                                                                                                                                                                           | Respond and recover                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ul style="list-style-type: none"><li>• Create and execute a plan for disaster</li><li>• Improving forecasts, collecting data, incorporating infrastructure</li></ul> | <ul style="list-style-type: none"><li>• Disastrous events can be expected or happen abruptly</li><li>• Sea level rise</li><li>• Coastal storms and hurricanes</li><li>• Tsunamis</li></ul> | <ul style="list-style-type: none"><li>• Community and economy damage appraisal</li><li>• Environmental and pollution assessment</li><li>• Distributing funds to rebuild and restore</li><li>• Provide data for analysis</li></ul> |
| Planning for coastal resilience reduces risk                                                                                                                          |                                                                                                                                                                                            |                                                                                                                                                                                                                                   |

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Introduction

Defining resilience

AECOM study overview

Potential impacts

Live Model Demo & Notable Results

Conclusion

Q&A

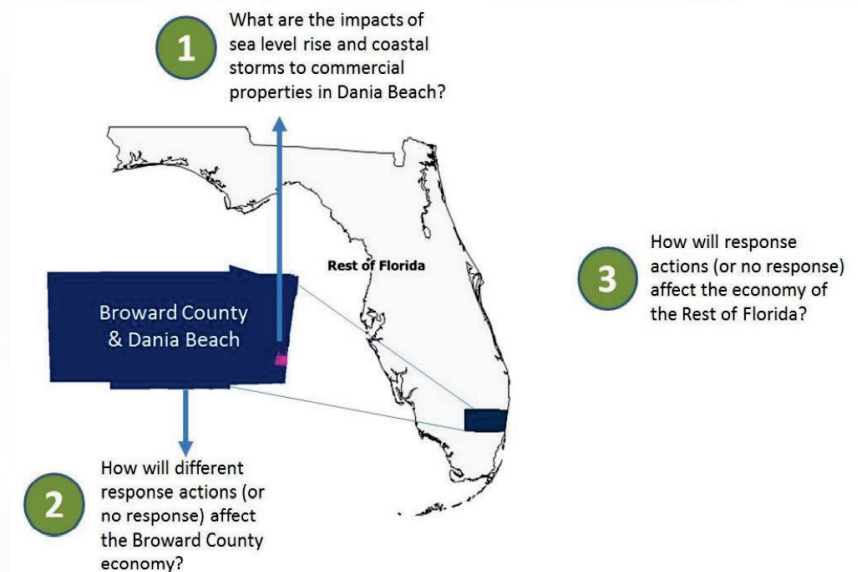
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# Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida



## Goal

- Developing an understanding of the economic effects from future climate conditions
- Inform decisions on protecting communities, businesses, and natural resources of Florida



This report aims to estimate the economic costs from failing to take action to protect Dania Beach's business community from future storm surge and sea-level rise impacts

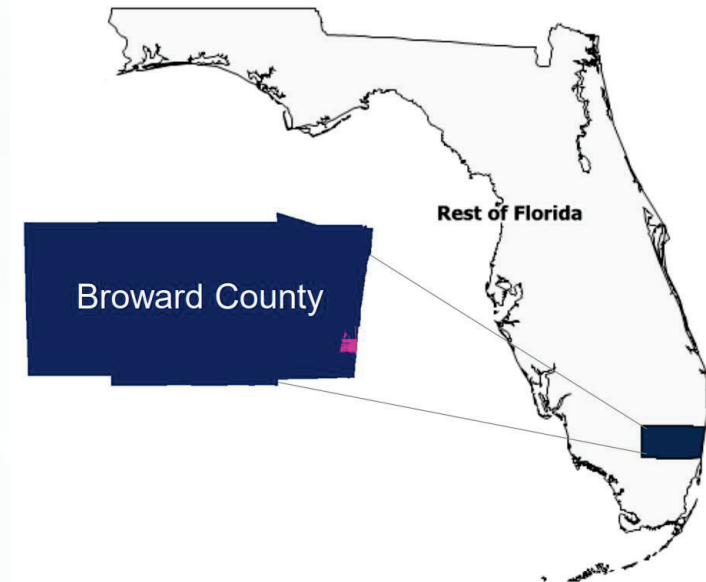
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# Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida



## Dania Beach, Florida

- Economy is highly dependent on beach tourism and marine-service industries that are vulnerable to coastal hazards
- Primarily comprised of small businesses that may have fewer resources and less capacity to plan for and adapt to future climate risks.



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# Physical Scenarios Evaluated



## Temporary Event Based Coastal Storm Impacts

- 3-year coastal storm, king tide and 1 foot of sea level rise (~5.5 feet total water level NAVD88) in 2030 and 2040
- 3-year coastal storm, king tide and 2 feet of sea level rise (~6 feet total water level NAVD88) in 2060 and 2070
- 20-year coastal storm, king tide and ~2 feet of sea level rise (~6 feet total water level NAVD88) in 2050

## Permanent Progressive Sea Level Rise Impacts (MHHW)

- Mean higher high water with one foot of sea level rise in 2030
- Mean higher high water with two feet of sea level rise in 2060



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# Study Simulation:

Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida



**How will different response actions, or no action, affect the Broward County economy? How will they affect the rest of Florida?**

Tool: REMI PI<sup>+</sup>

## Inputs & Outputs

- Inputs
  - Response actions
    - Beneficiaries and Physical Impacts, Costs and Sources of Funds, Involved Industries, Timeframe
- Outputs
  - Impacts to Broward County and the Rest of Florida
  - Reported results: Employment, GDP, and Population changes

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## Selected Inputs: Response Actions



| Response Actions | Description                                                                                                                          |
|------------------|--------------------------------------------------------------------------------------------------------------------------------------|
| No Action        | Nothing is done to mitigate future SLR and coastal storm conditions, but structures subject to storm damage are rebuilt post event   |
| Relocate         | Low lying businesses subject to tidal inundation from SLR relocate to higher ground in Dania Beach or outside of the City boundaries |
| Fortify          | Construct a seawall to prevent low lying business from being subject to tidal inundation from SLR                                    |

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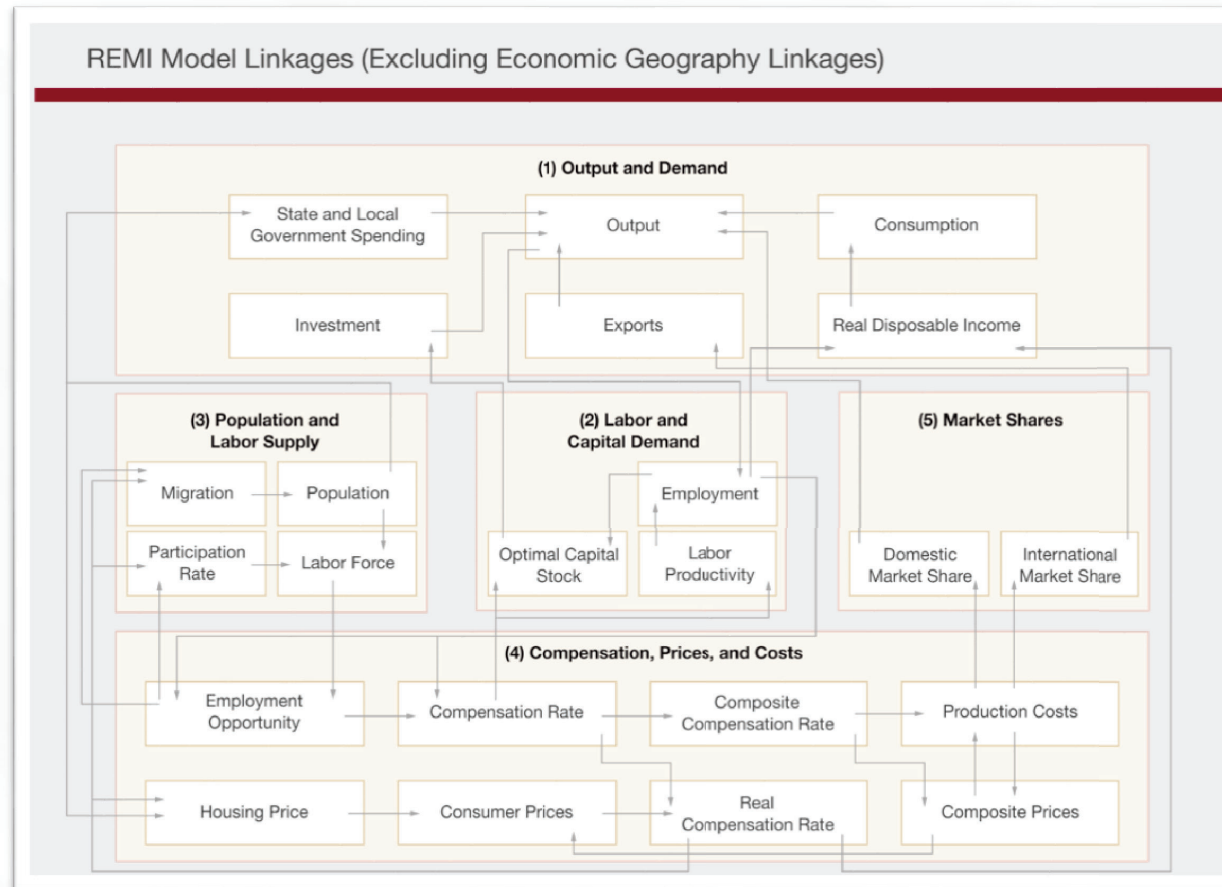
# REMI Modeling Framework for Dania Beach



| Elements                   | Description                                                                                                                               |
|----------------------------|-------------------------------------------------------------------------------------------------------------------------------------------|
| Building Damage            | Businesses subject to damage from coastal storms and sea level rise                                                                       |
| Output Loss                | Direct output loss resulting from building, content, and inventory damage                                                                 |
| Employment Change          | Employment loss due to disruption, gains from recovery efforts to rebuild or relocation of vulnerable businesses                          |
| Population Change          | Combination of direct loss from damage, indirect loss from employment loss and other migration                                            |
| Government Spending        | Funding for rebuilding or relocating businesses has some boosts to the economy, but may be offset by cuts in other public services        |
| Government Revenue Sources | Simulate increases to property taxes, sales taxes, and tourist development taxes, but may be offset by decline in other consumer spending |

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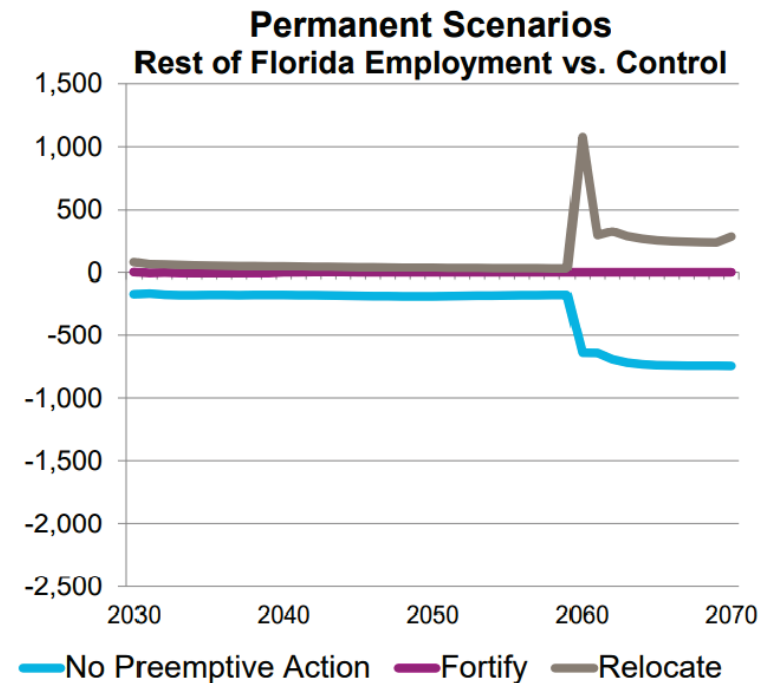
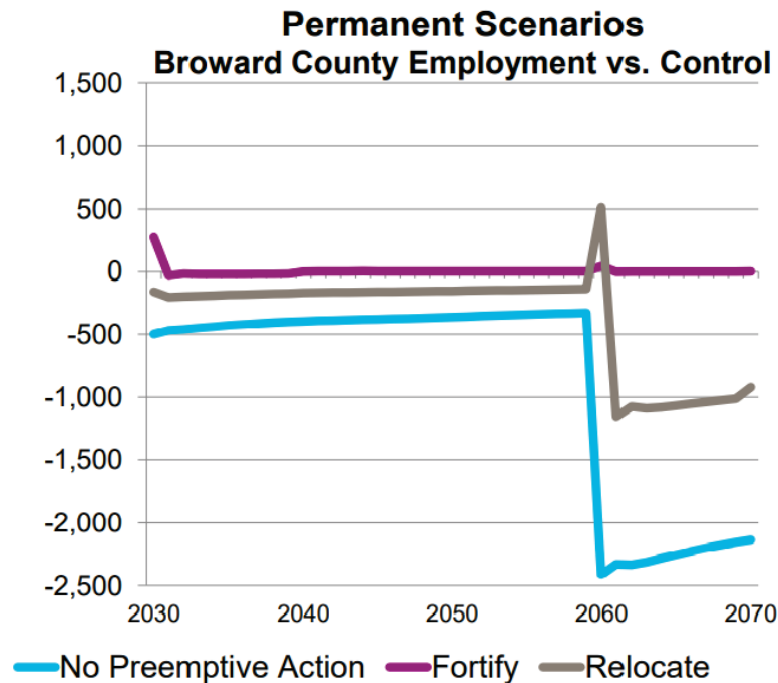
# REMI Model Structure



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## Study Results:

### Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida



- \*No Preemptive Action: Nothing is done to mitigate future SLR and coastal storm conditions, but structures are rebuilt post-event
- \*Relocate: Low-lying businesses subject to tidal inundation from SLR relocate to higher ground in Dania Beach or outside of the city
- \*Fortify: Construct a seawall to prevent low-lying business from being subject to tidal inundation from SLR

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## Study Results:

### Economic Impacts of Sea Level Rise and Coastal Storms in Dania Beach, Florida



#### Key Takeaways

##### Public Sector Recommendations

- Prioritize phased adaptation investments with an eye toward long-term risk
- Invest in regional strategies
- Establish an accessible data platform to identify vulnerabilities
- Expand assessment of projected damages
- Have standards in place to build back stronger in the event of disaster
- Evaluate tradeoffs of response actions (e.g., built vs. natural environment)

##### Private Sector Recommendations

- Develop business continuity plans
- Work with others in the same industry to develop industry-wide preparedness and limit duplicate efforts
- Work with public sector for data needs
- Work with public sector to ensure business continuity is a key consideration in adaptation strategy development

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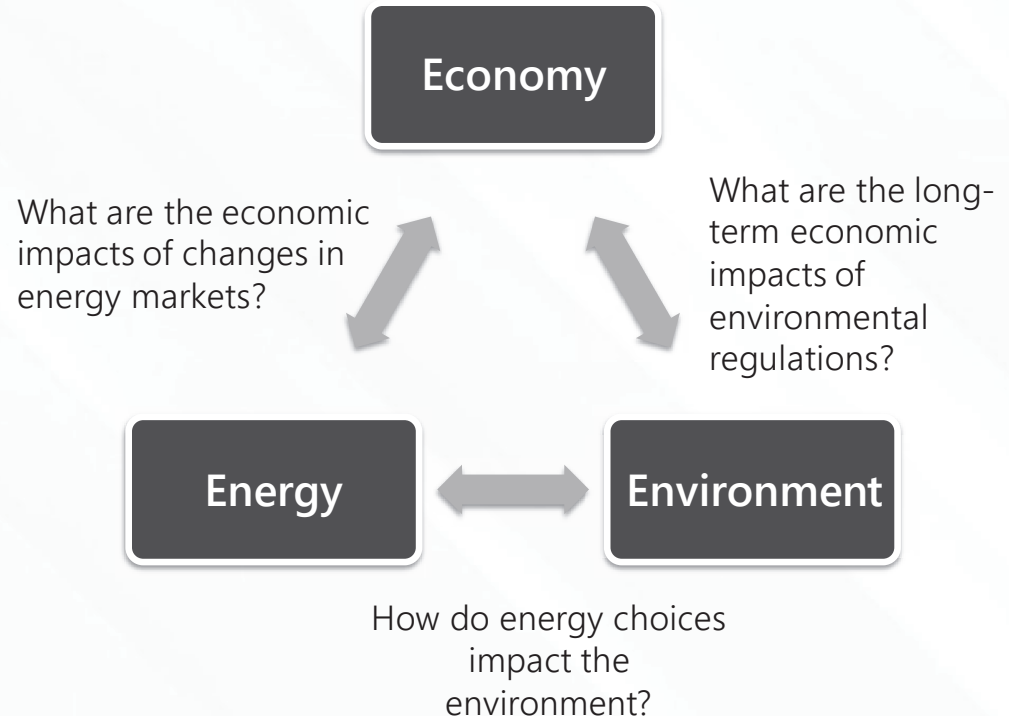
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# REMI E3<sup>+</sup>: Energy, Environment and the Economy



E3<sup>+</sup> is the premier software solution for analyzing the macroeconomic and demographic impacts of any initiatives related to the energy and environmental sectors.

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# REMI E3+: Disaster Resilience



## Evaluate

E3+ can evaluate the effectiveness of multiple disaster recovery and mitigation plans

## Calculate

E3+ can produce an automatic calculation discussing resilience by comparing a no-action baseline disaster scenario to a resilience investment scenario



## Insights

Aims to help users design and implement plans that improve the resilience of their economies in the face of a disaster

## Inform

Results focus on three aggregate economic indicators: Output, GDP, and Employment



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---



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# Model Simulation: Variables and Levers



## Disaster Baseline Control

- Capital Losses
  - Losses of property value (2031-2040)
  - Decrease capital stock
- Sales Losses
  - Annual reoccurring sales losses (2031-2040)
  - Decrease output for all industries

## Resilience Scenario

- Seawall Construction (2028-2030)
  - Increase sales for construction industry that will be building the seawall
  - Assume that half of the total project cost will be paid for using property and sales taxes
  - Assume that the other half of the project cost will be funded by the federal government
- Resilience Measures (2031-2040)
  - Increase capital stock to account for avoided losses
  - Increase output for all industries

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---



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# Conclusions



## Dania Beach Study

- Dania Beach properties are vulnerable both to coastal storm flooding and sea level rise impacts
  - There will be 36,400 fewer jobs and a nearly \$5 billion decrease in GDP in sea level scenarios
- For vulnerable properties, a seawall that eliminates exposure to sea level rise provides the most protection and economic benefits to Broward County
  - County employment increases by 200 and GDP increases by \$20 million
- The rest of Florida has a positive gain in employment (5,080 new jobs) and a total GDP increase of \$720 million in the Relocate scenario

## Resilience Measures

- Resilience investment is necessary to protect coastal communities and sustain economic growth
  - Significantly reduce the cost and increase the speed of recovery
  - Create opportunities for economic and environmental progress when underlying risk is reduced
- E3+ resilience module is a valuable tool to provide comprehensive evaluations of the economy in response to disasters

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**Thank you for attending!**

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