

ANALYTICS AND OPTIMIZATION DESIGN APPLIED TO WATER AND ENERGY NEXUS

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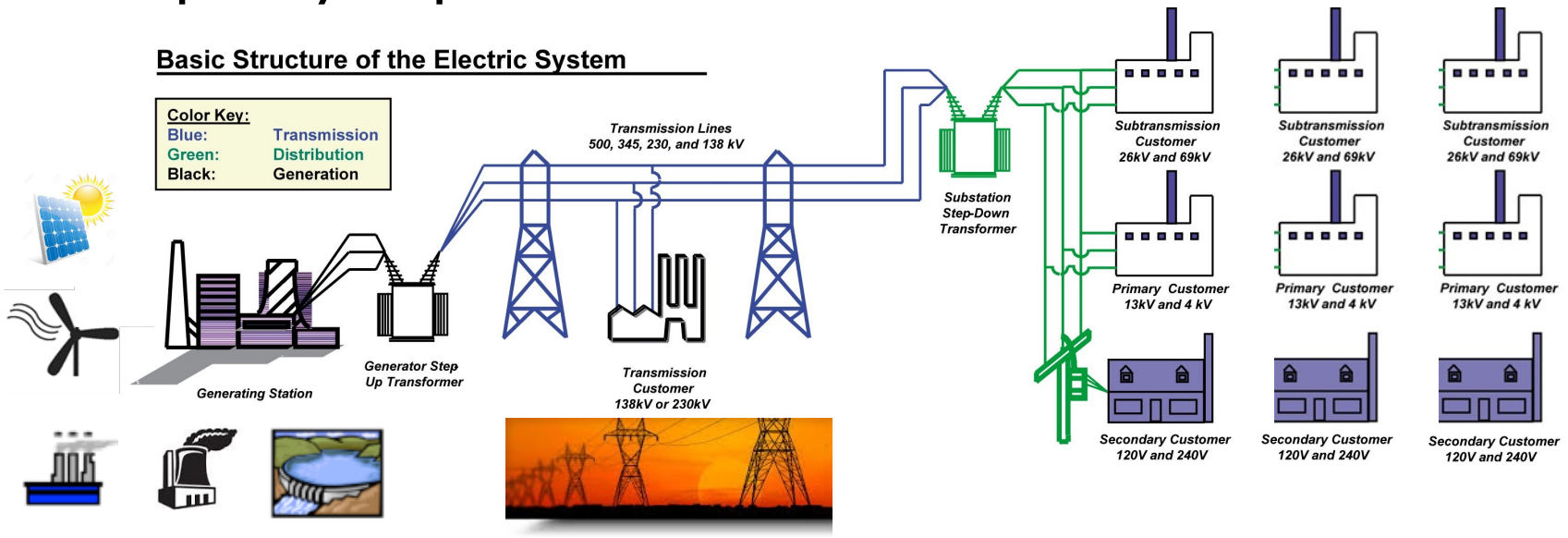
Clean Energy Research in The Triangle Roundtable

Introduction

- **Renewable power** sources became a key aspect around the world by **disrupting old frontiers**
- These energy sources are linked to **sustainable development** that is one of the main goals of the modern society these days
- **The raise of renewable power installed** capacity demands new studies about its effects
- **Optimization modeling and predictive analytics** are essential for operational and planning actions

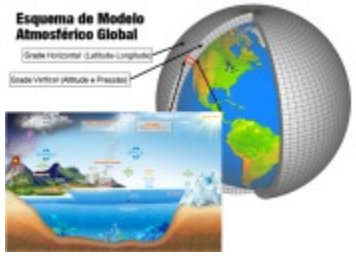
Power Generation Planning

- Generally, planning studies for power generation capacity expansion do not consider climate information



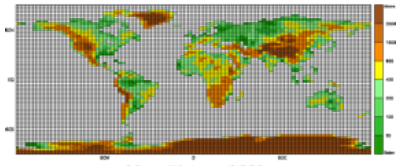
- System planners look at how the load will likely grow in the future and make decisions

Water-Energy Nexus Under Changing Climate



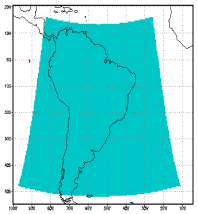
Global Models

Scenario A1B
(HadCM3 ~400kmx300km)



Regional Model

Eta 40-20 km



Climate I

Eta 40km – Min
Eta 40km – Med
Eta 40km – Ctrl
Eta 40km – Max
Eta 20km

Climate II

Global I
Global II
Global III
Global IV
Global V
OLAM

Climate Variables

Climate Variables

Hydrological Models

Natural Water Inflows

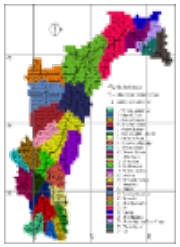
Natural Water Inflows

Assured Energy

Energy

Water Demand

Soil & Land Use



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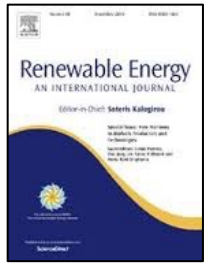
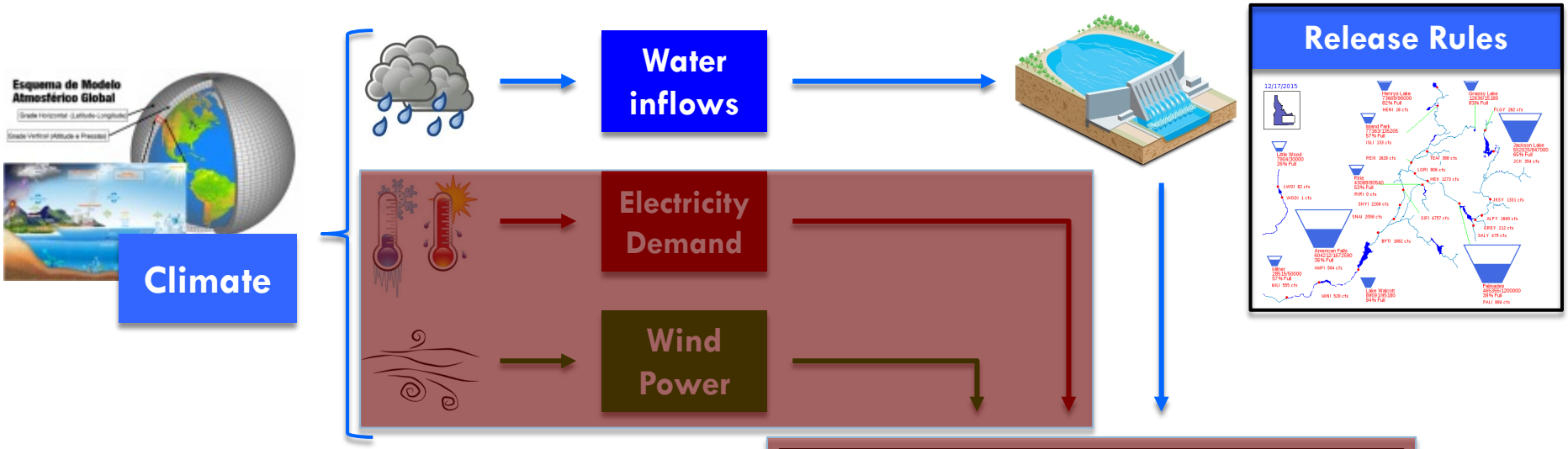
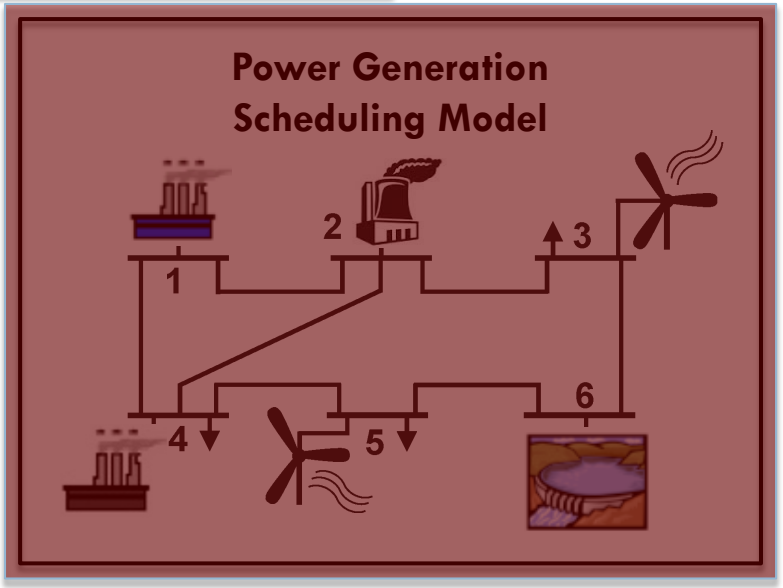


Cyber-Enabled Water and Energy Systems Sustainability Utilizing Climate Information (CyberSees)



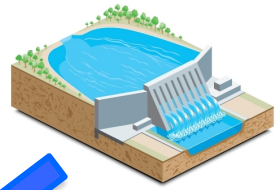
- Multiple operational aspects
- Multi-stage problem
- Underlying uncertainties
- Complex decision process

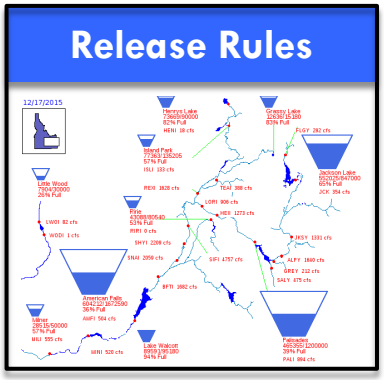


Cyber-Enabled Water and Energy Systems Sustainability Utilizing Climate Information (CyberSees)

Climate

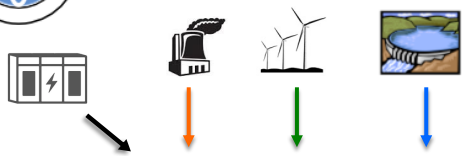
Water inflows





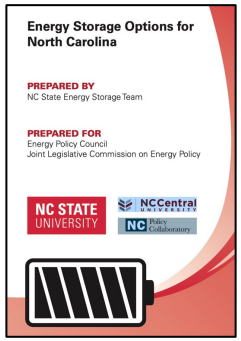
The TEMOA Project

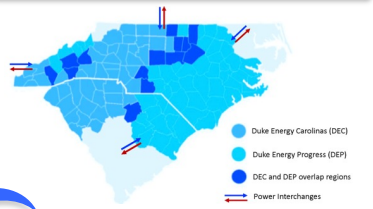
Tools for Energy Model Optimization and Analysis



Electricity Generation

Electricity Demand





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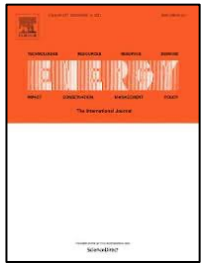
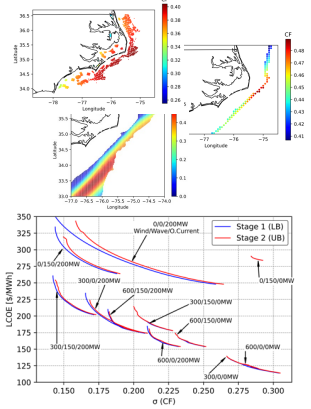


Economics of Offshore Renewable Energy in NC



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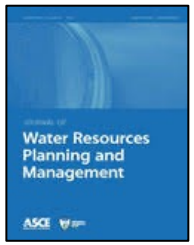

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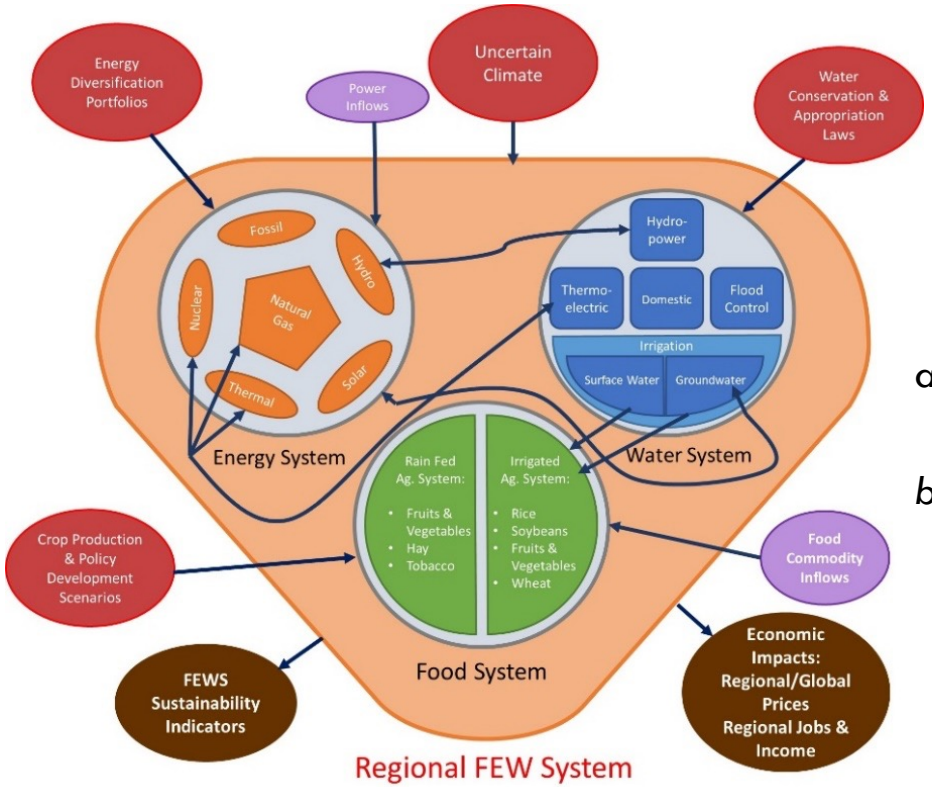
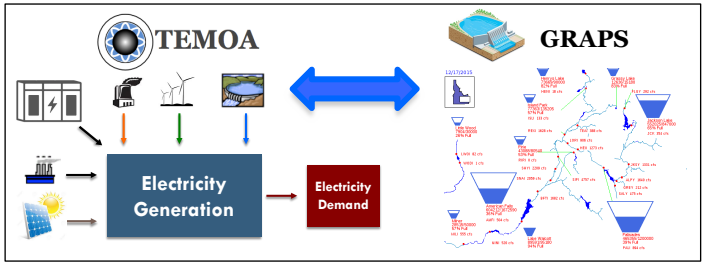
Improving the regional FEW system sustainability over the SEUS and NCP: A cross-regional synthesis under potential climate and development scenarios

- This **Food-Energy-Water (FEW)** System research aims to develop a synthesis on **understanding the FEW impacts due to uncertain climate and development scenarios** over the Southeast US (SEUS) and North China Plain (NCP)



Conceptualization of the Regional Food (green) –Energy (orange) –Water (blue) System Nexus across South-East US. Inflows (purple), external factors (red) and potential impacts (brown) of the system are also indicated

*Co-Optimization of Reservoir and Power Systems (COREGS) for Seasonal Planning and Operation

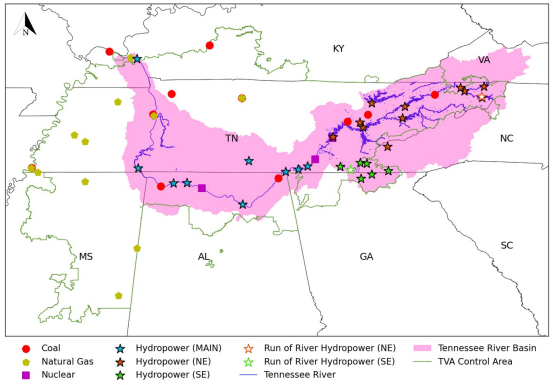


a) *How does the regional **FEWS resiliency change under potential climate change scenarios?***

b) ***What are the regional co-benefits and tradeoffs?***

TVA TENNESSEE VALLEY AUTHORITY

NSF



THANK YOU !

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