

Bridging the Water-Energy-Food Gap:

Transitioning towards Sustainable Resource Management

Given the need to maintain water, energy and food security and combat environmental challenges in the face of population growth and global warming, today's water management approaches should bridge the gap between the three sectors. To meet these challenges, there needs for a paradigm shift to integrated water resources management that seeks to close the loop between water, energy, and food systems—the water-energy-food (WEF) nexus—a central goal of sustainable development. The inextricable linkage between these critical domains requires a fully integrated approach to ensure food and water security, public health, sustainable agriculture, and energy production.

At the Department of Environmental and Civil Engineering at U.A. Whitaker College of Engineering faculty and students are working toward an optimal water-energy-food (WEF) system that convert wastewater and food waste into biogas and recycled water for fertigation.

This project has two parts: (1) Construction of a full scale WEF system at the Emergent Technologies Institute (ETI); (2) Development of a Virtual Reality (VR) systems model to simulate input (waste) and output (energy, natural fertilizer and recycled water) and creation of an educational module where students can adjust input concentrations to determine impact on output results.

The physical full scale WEF systems have been constructed at ETI and the VR model has been created in the VIPER Lab at U.A. Whitaker College of Engineering. Students are involved in the planning, design, implementation and maintenance of both physical and VR Systems.

1. Full Scale WEF System



Figure 1: Students building the WEF systems (from left to right, Christian, Josie, Alisha, Amy, and Jesse next to hydroponic system)



Figure 2: The WEF system during construction phase



Figure 3: Grill powered by the biogas produced from wastewater and food waste



Figure 4: Plants using nutrient reach recycled water

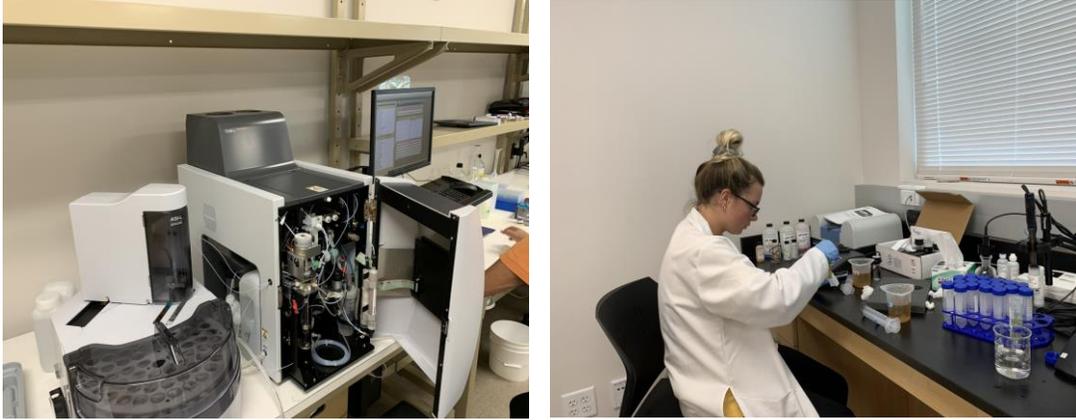


Figure 5: Testing of the unfiltered and filtered samples for fertigation



Figure 6: Full scale WEF systems at ETI

2. Virtual Reality based Educational Platform and Simulation Model for Water-Energy-Food Nexus

Virtual Reality based Water Energy Food Nexus (VR-WEF) is developed by the Civil and Environmental and Software Engineering Department at U.A. Whitaker College of Engineering, in collaboration with the Patel College of Global Sustainability at the University of South Florida. The facility in the Virtual Immersive Portal for Engineering Research (VIPER) Lab located at U.A. Whitaker College of Engineering is used to create the VR-WEF tool where students can adjust input concentrations to determine impact on output results.

VR-WEF is a powerful immersive tool that places students at the center of an alternative virtual world making it easier for them to experiment and learn complex engineering concepts effectively and understand the consequences of different engineering decisions. VR-WEF can be used to mimic the natural process (anaerobic digestion) of converting wastewater and food waste into renewable energy (biogas), fertilizer, and nutrient-rich recycled water. Through its functionalities, the tool provides an immersive and interactive environment, can increase student interest and engagement, and provides immersive visualizations that are not possible in the traditional classroom. FGCU Software Engineering and Civil and Environmental students developed the VR-WEF platform shown in figure below.



Figure 8: 3D Virtual Reality Model for Water Energy Food Nexus