



INSTITUTE FOR A SECURE &  
SUSTAINABLE ENVIRONMENT

# ISSE Annual Conference

September 15, 2022



INSTITUTE FOR A SECURE &  
SUSTAINABLE ENVIRONMENT

# **History, Current, and Future**

## **Institute for a Secure and Sustainable Environment**

### **(ISSE)**

**Mingzhou Jin**

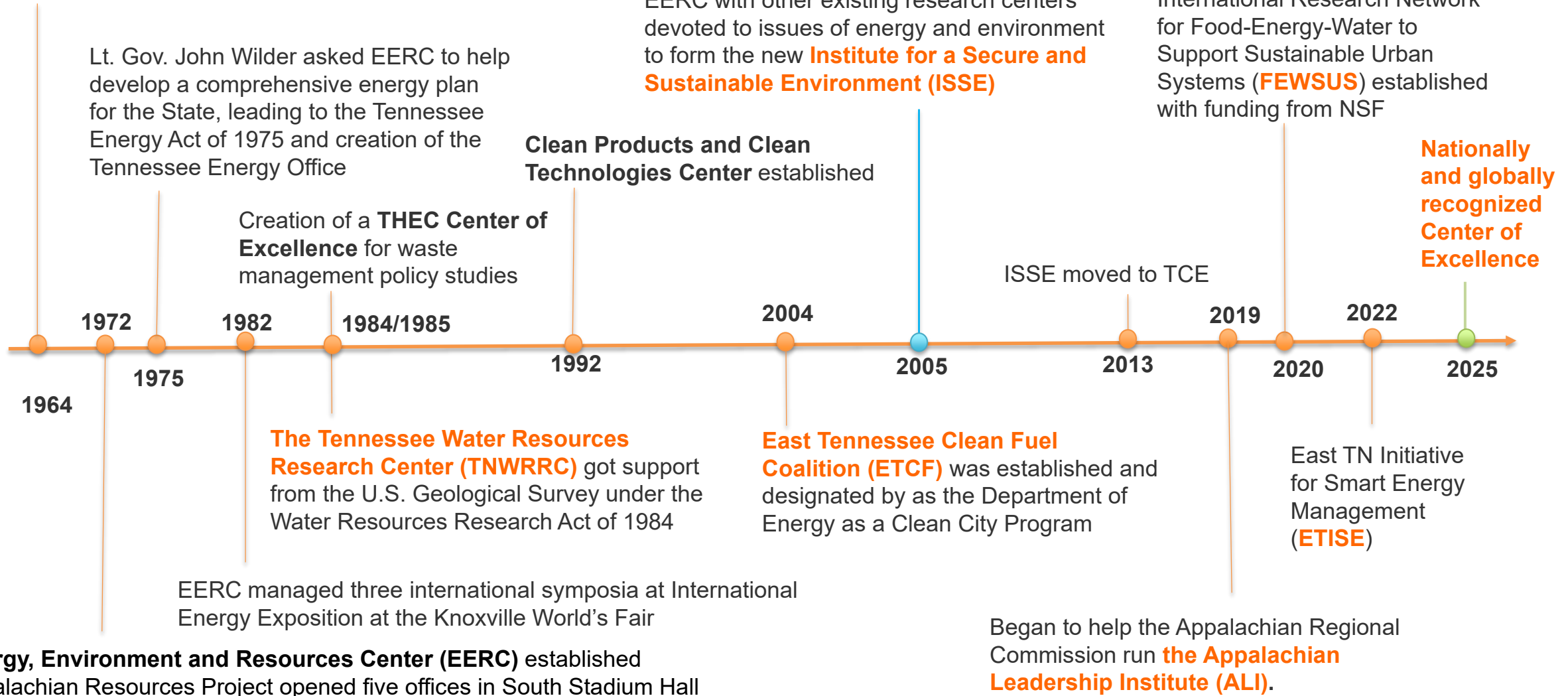
**John D. Tickle Professor**

**ISSE Director**

**September 15, 2022**

# ISSE History

**Water Resources Research Center** created

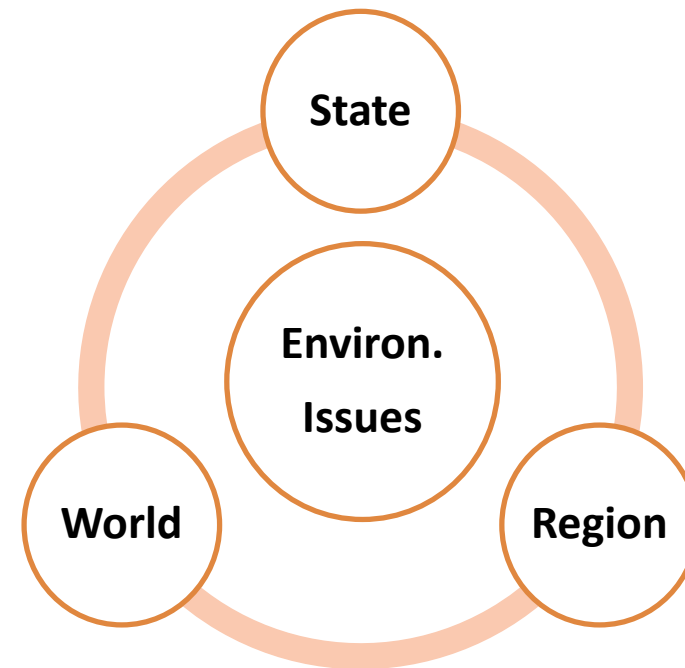
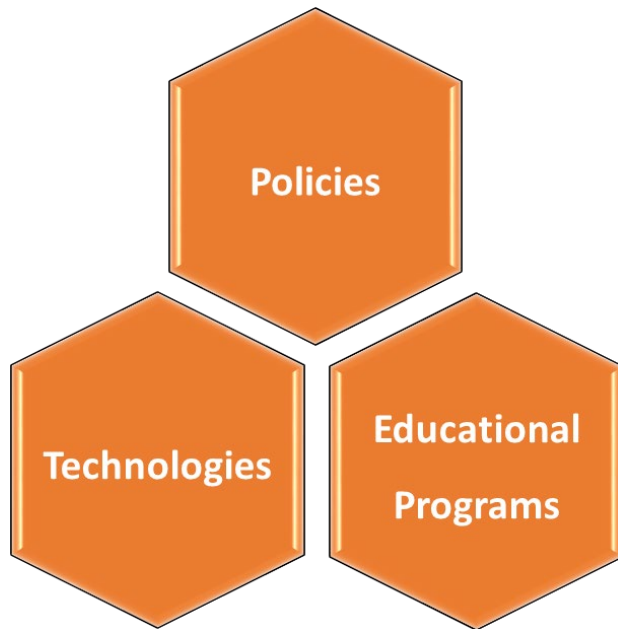


**Energy, Environment and Resources Center (EERC)** established  
Appalachian Resources Project opened five offices in South Stadium Hall

Began to help the Appalachian Regional Commission run **the Appalachian Leadership Institute (ALI)**.

# ISSE Mission

As a THEC Center of Excellence, ISSE promotes the development of policies, technologies, and educational programs in response to pressing environmental issues facing the state, the nation, and the world.

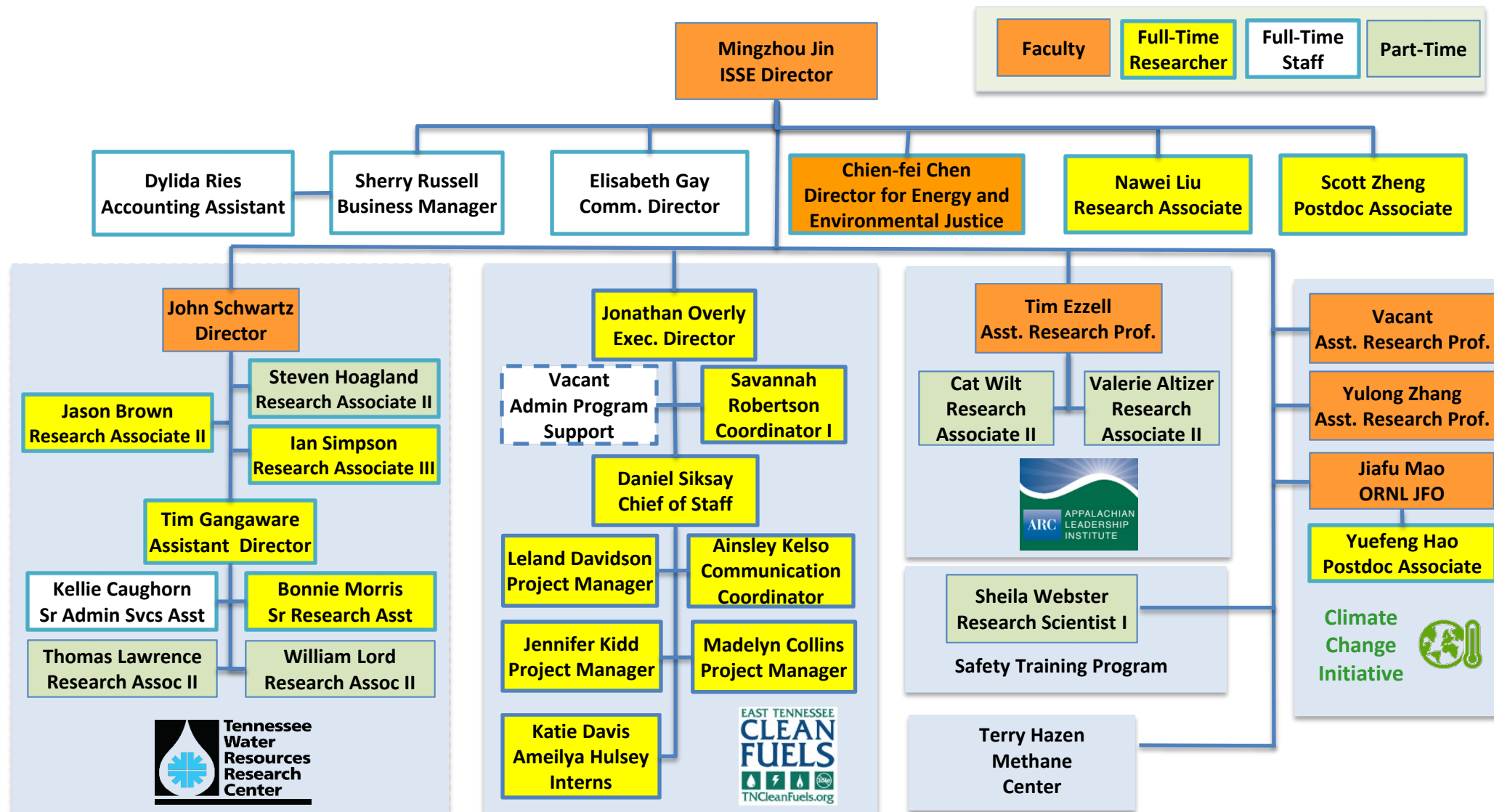


# ISSE Visions

ISSE will become a premier environmental research institute:

- Our associated **faculty** are recognized and sought out as premier environmental researchers to provide sustainable and secure solutions.
- Our cutting-edge **convergent research** enjoys an international reputation for its **quality** and **significance**.
- Our **engagement and partnership** with various stakeholders characterize challenges, define research directions, and deliver system-based solutions to make a relevant impact at the regional and national level.

# ISSE Organizational Chart



# ISSE Affiliated Faculty and Advisory Board



Charles Sims

Baker Center  
for Public Policy



Andrew Muhammad

Agricultural  
Economics



Sean Schaeffer

Biosystems Engineering & Soil Science  
UTIA



Walker Forbes



Joe Zhuang

Ecology &  
Evolutionary Biology



Paul Armsworth



Robert Jones

Sociology



Michael Galbreth

Haslam College of Business



Wendy Tate



Joshua Fu



Jon Hathaway



Terry Hazen



Qiang He



John Schwartz



Shuai Li



Nick Zhou



Anahita Khojandi



Jiafu Mao

Civil and Environmental Engineering

Industrial & Systems Engineering



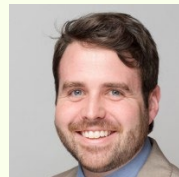
Stan D.  
Wullschleger  
ALD, Energy and  
Environmental  
Sciences, ORNL



James Parks  
Section Head,  
Energy Efficient  
Manufacturing  
Sciences, ORNL



Rebecca Tolene  
VP Environment,  
Chief  
Sustainability  
Officer, TVA



Matthew K.  
Taylors  
Deputy Director  
of Sustainability  
Office, TDEC



Brian Blackmon  
Director,  
Office of  
Sustainability,  
Knoxville



Jay Price  
Sustainability  
Manager, UTK



Chris Cox  
Head, CEE, UTK



Tim Rials  
Associate Dean UTIA

ISSE Advisory Board



# ISSE Research Overview



## Clean Energy and Energy Efficiency

- East Tennessee Clean Fuels Coalition led by J. Overly
- Methane Center led by Dr. T. Hazen
- EV Charging (DOE, TDOT, TVA) led by Drs. M. Jin and Y. Zhang
- Manufacturing Energy Efficiency led by M. Jin

## Regional Sustainability

- Appalachain Leadership Institute led by Dr. T. Ezzell
- NSF FEWSUS iRCN led by Dr. J. Zhuang
- NSF SRS Planning Grant led by Drs. M. Jin and T. Ezzell

## Climate Change

- ORNL collaboration and NSF-sponsored research led by Drs. J. Mao and M. Jin
- Projects funded by USGS



## Water Research and Training

- TN Water Resources Research Center (an EPA and USGC Center) led by Dr. J. Schwartz
- Green infrastructure led by Dr. J. Hathaway

## Building Environment



- Building energy and health led by Dr. S. Li

## Sustainable Food

- UTIA Collaboration
- Food Supply Chain project funded by NSF
- Various funded projects (ORNL)

## Broad Sponsors



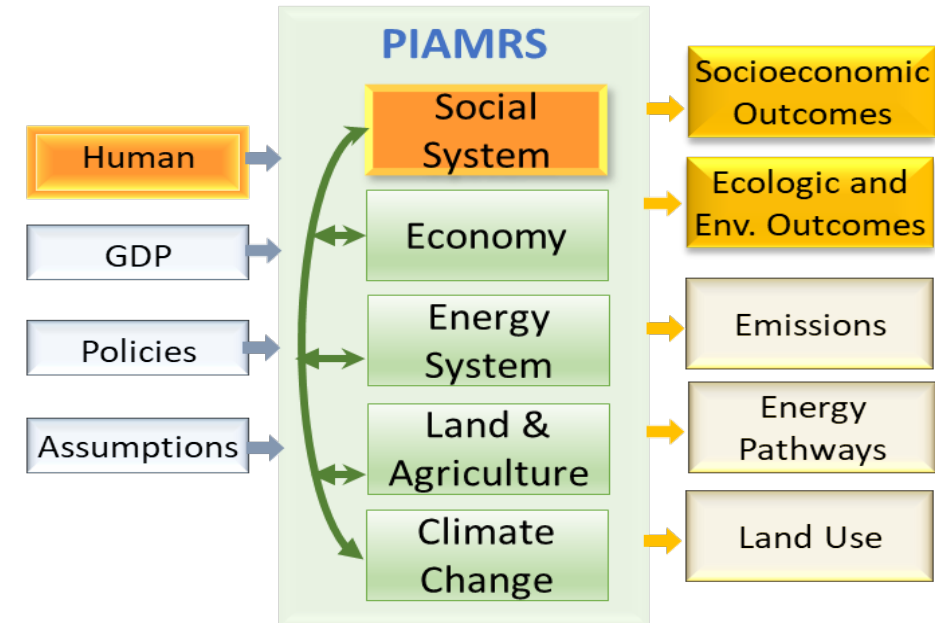
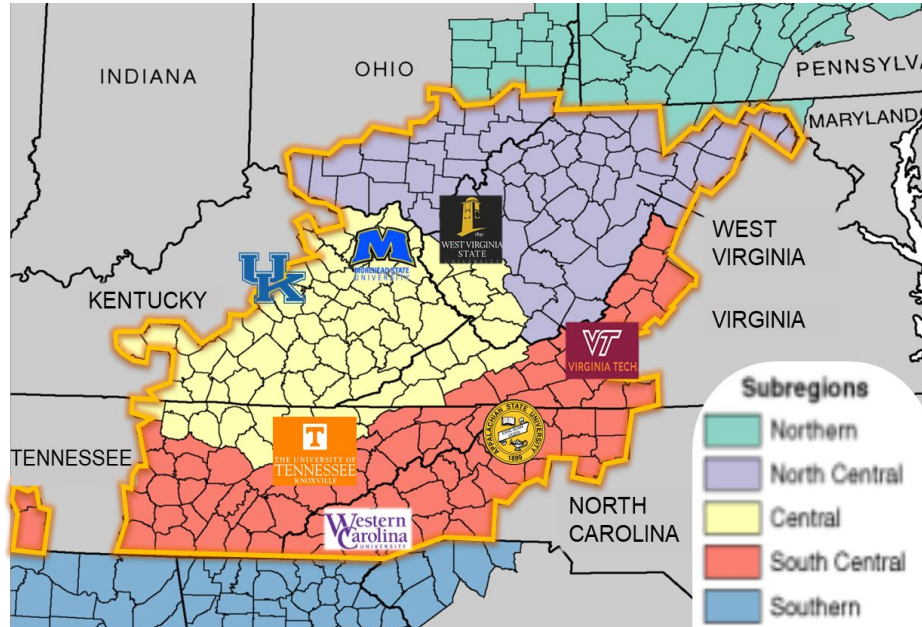


# ISSE Research Highlights

- INFEWS: Coupled FEWS Modeling for Sustainability of the Global Crop Supply Chain, M. Jin and A. Muhammad, NSF
- Utilizing coal-derived solid carbon materials towards next-generation smart and multifunction pavements, DOE/NETL, H. Zhou and B. Huang
- 3D dynamic evolution of pore water-air interaction within saturated sheared sand, K. Alshibli, NSF
- International Research Coordination Network for Creating Transdisciplinary Nodes of Food-Energy-Water to Support Sustainable Urban Systems, J. Zhuang, M. Jin, F. Loeffler, W. Tate, T. Gill, NSF
- Reimagining Urban Watershed Management: A Systems Approach to Stormwater Control and Ecological Rehabilitation, J. Hathaway, NSF
- SRS RN: People-Centric Integrated Assessment Model for Regional Sustainability (PIAMRS): Focusing on the Central Appalachian Region, M. Jin, NSF
- AOP for wastewater treatment from the oil/gas industry, Q. He, Aramco Services Company
- East Tennessee Initiative for Smart Energy Management, M. Jin, DOE/AMO

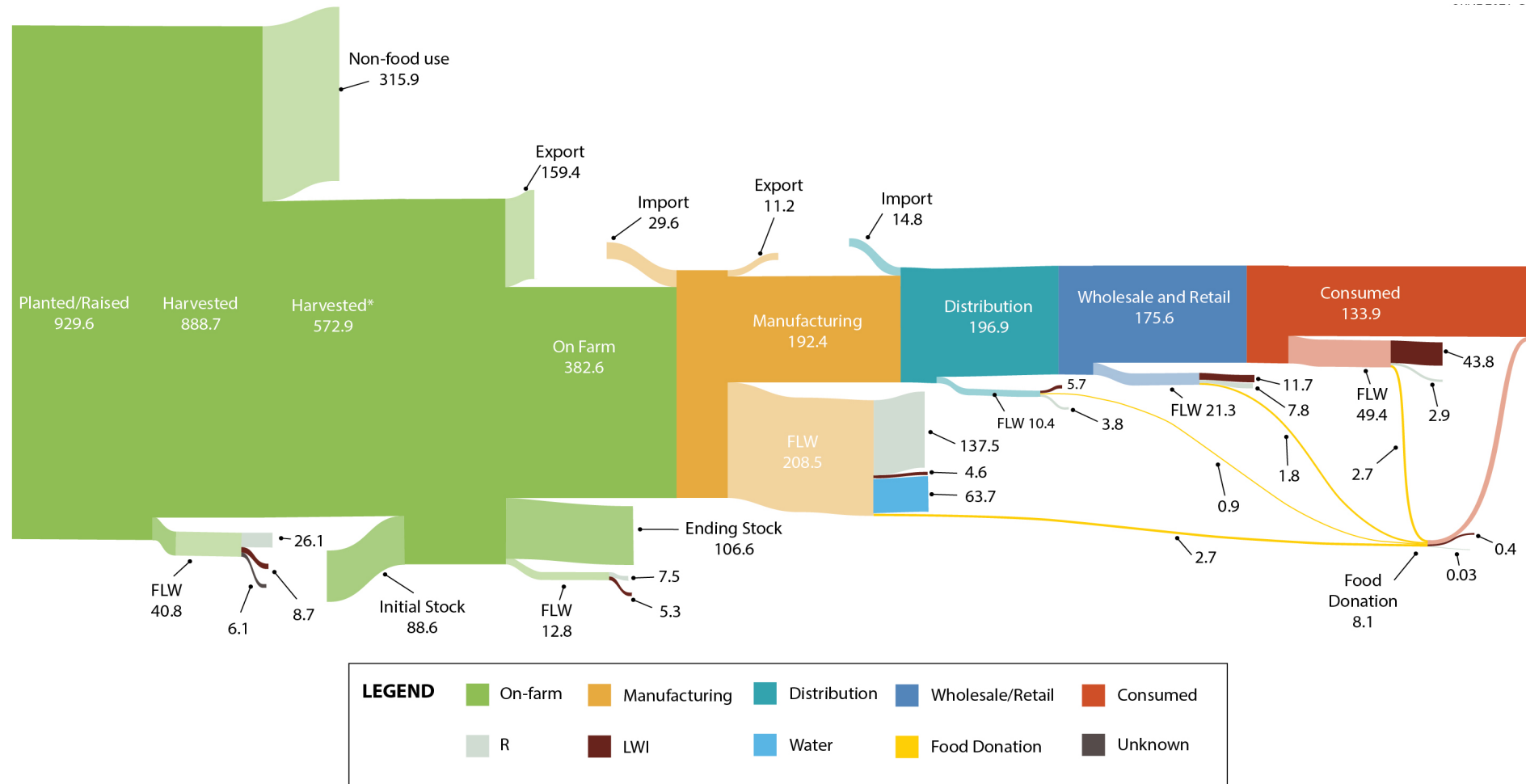


# SRS-RN: People-Centric Integrated Assessment Model for Regional Sustainability (PIAMRS):



- To co-produce a People-Centric Integrated Assessment Model for Regional Sustainability for the Central Appalachian region
- To transform the region from a traditional resource-based economy into a modern sustainable system
- To prepare our interdisciplinary team to develop and submit a quality \$15M Track-1 proposal.

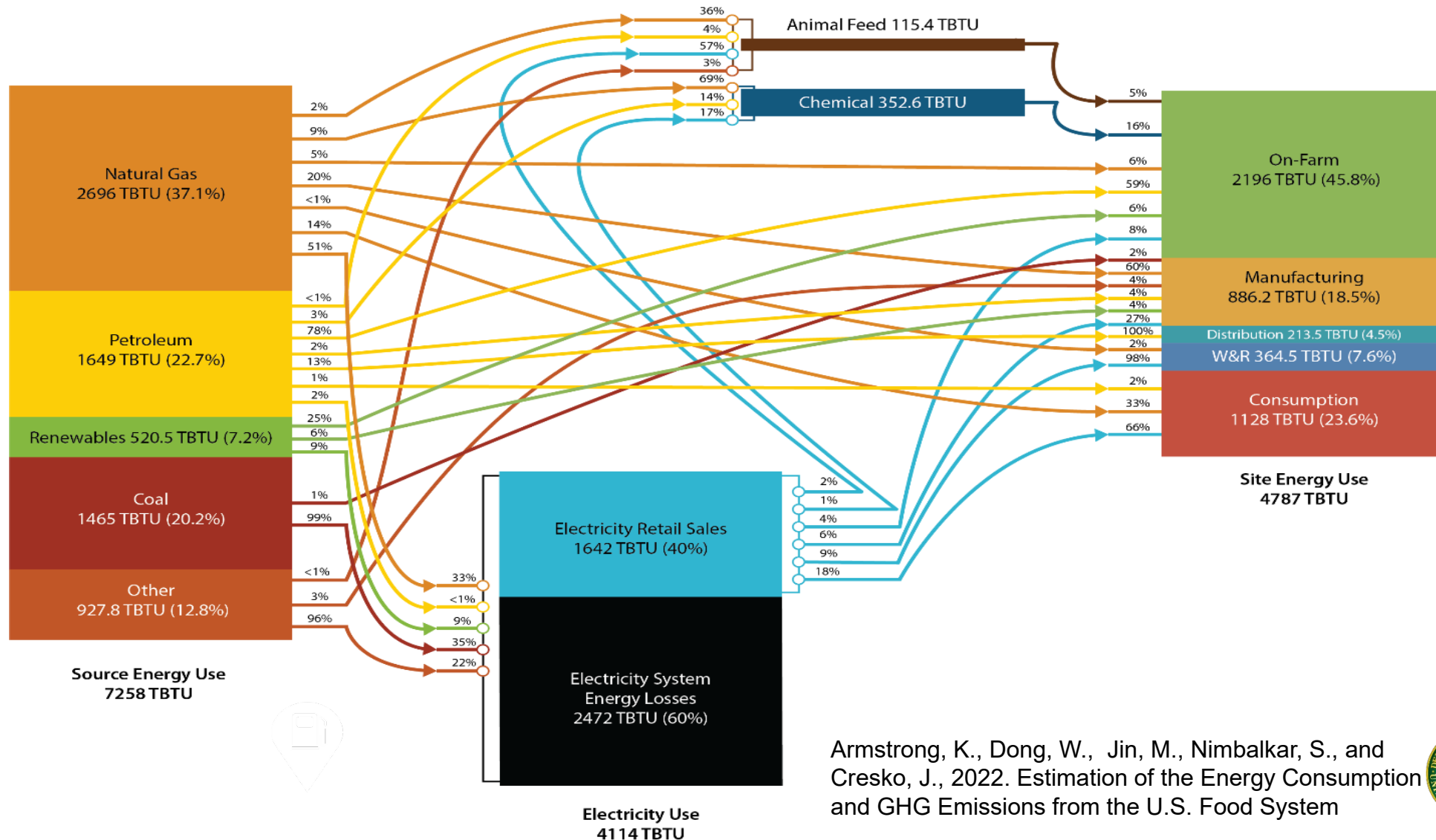
# Food, Loss, and Waste in the U.S. Food Supply Chain



Dong, W., Armstrong, K., Jin, M., Nimbalkar, S., Guo, W., Zhuang, J. and Cresko, J., 2022. A framework to quantify mass flow and assess food loss and waste in the US food supply chain. *Communications Earth & Environment*, 3(1), pp.1-11.



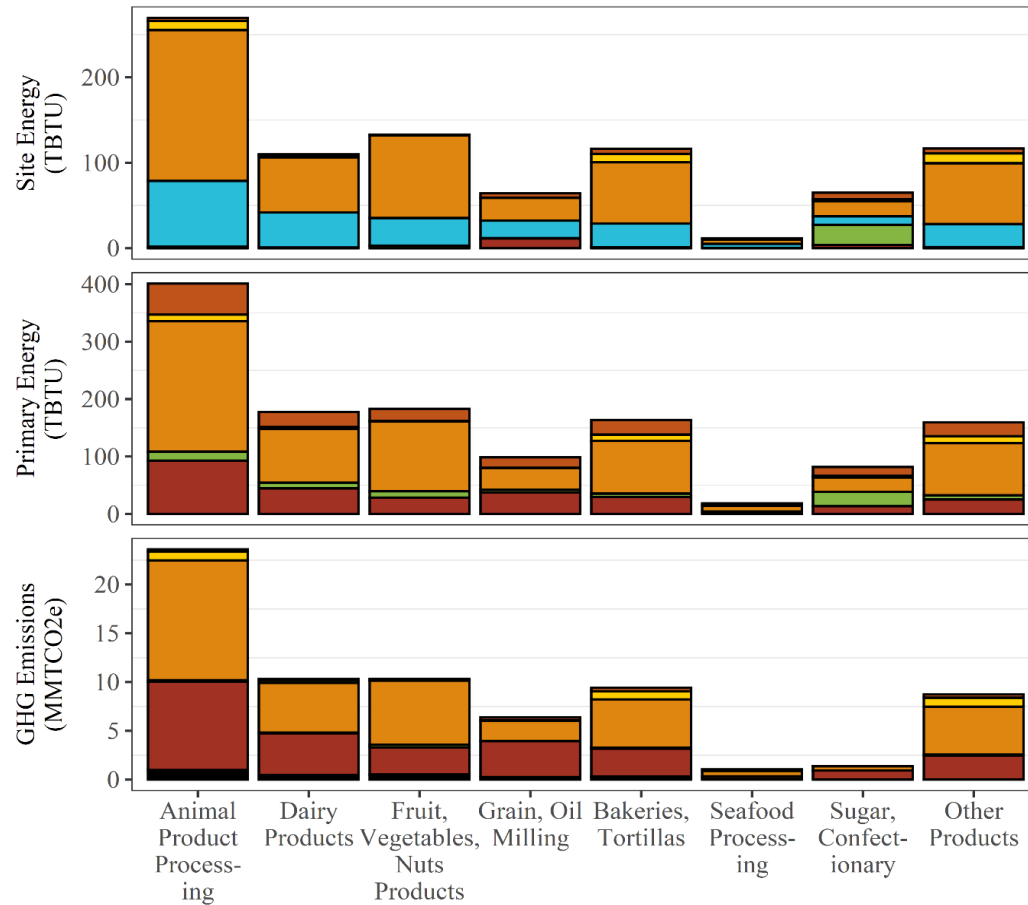
# US Food Energy Consumption and Carbon Emissions



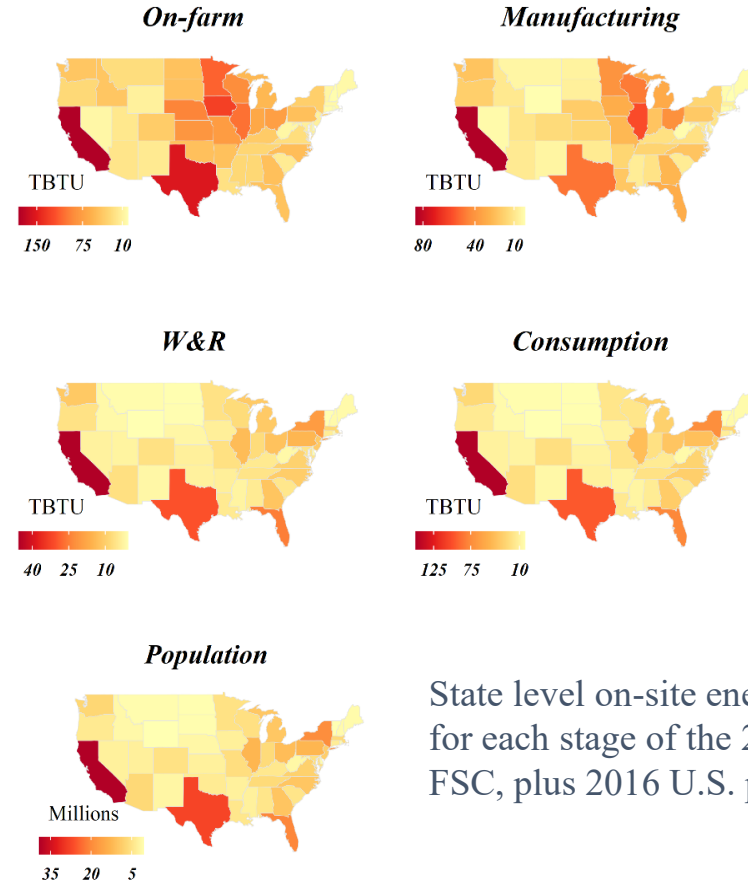
Armstrong, K., Dong, W., Jin, M., Nimbalkar, S., and Cresko, J., 2022. Estimation of the Energy Consumption and GHG Emissions from the U.S. Food System



# US Food Energy Consumption and Carbon Emissions



### Energy/Emission Sources



State level on-site energy use for each stage of the 2016 U.S. FSC, plus 2016 U.S. population

Armstrong, K., Dong, W., Jin, M., Nimbalkar, S., and Cresko, J., 2022. Estimation of the Energy Consumption and GHG Emissions from the U.S. Food System



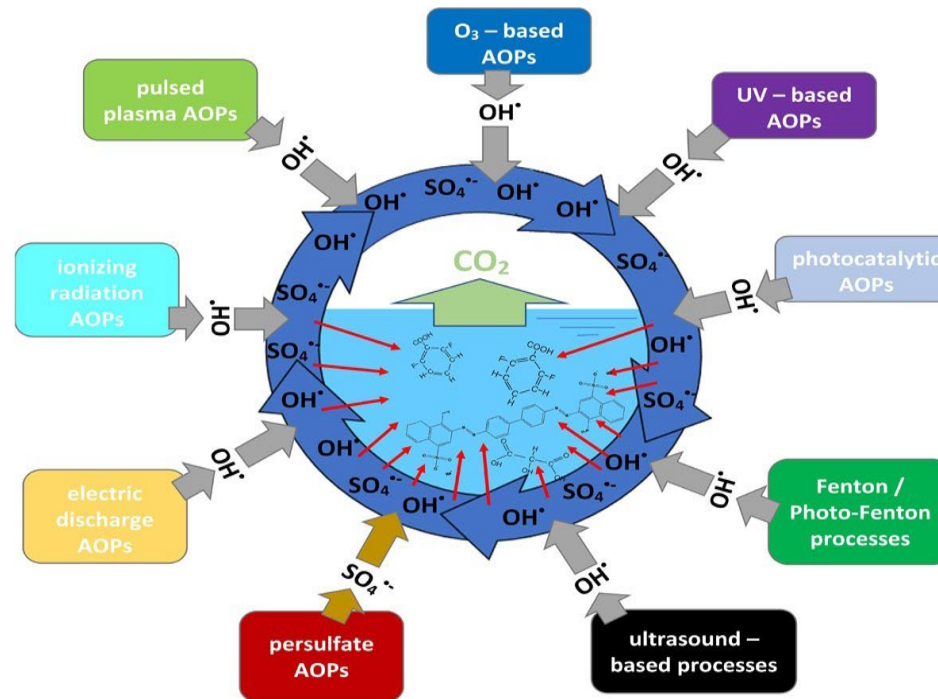


# Sustainable Treatment Solutions to Wastewater from the Oil/Gas Industry

## Sustainability Challenges

- ❑ ~21 billion barrels of produced water generated from oil and gas production in the U.S. alone
- ❑ Contains multiple organic and inorganic contaminants with high salinity
- ❑ Lack of effective and sustainable treatment options
- ❑ Saudi Aramco is the largest oil-producing company in a country with scarce water resources

## Advanced Oxidation Processes (AOP)



## Technical Advantages of AOP

- ❑ Innovative with IP potential
- ❑ Minimal use of chemicals via utilization of produced water constituents
- ❑ Complete pollutant destruction without secondary contamination
- ❑ AOP configuration without needs for material recovery
- ❑ High adaptability and implementability

aramco

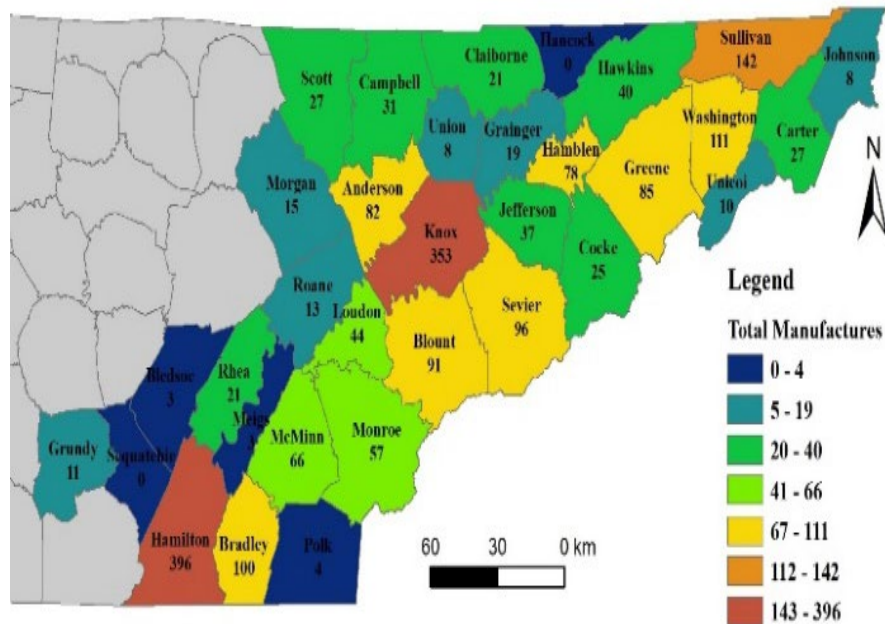


Led by Q. He; C. Smugor; C. Swanson

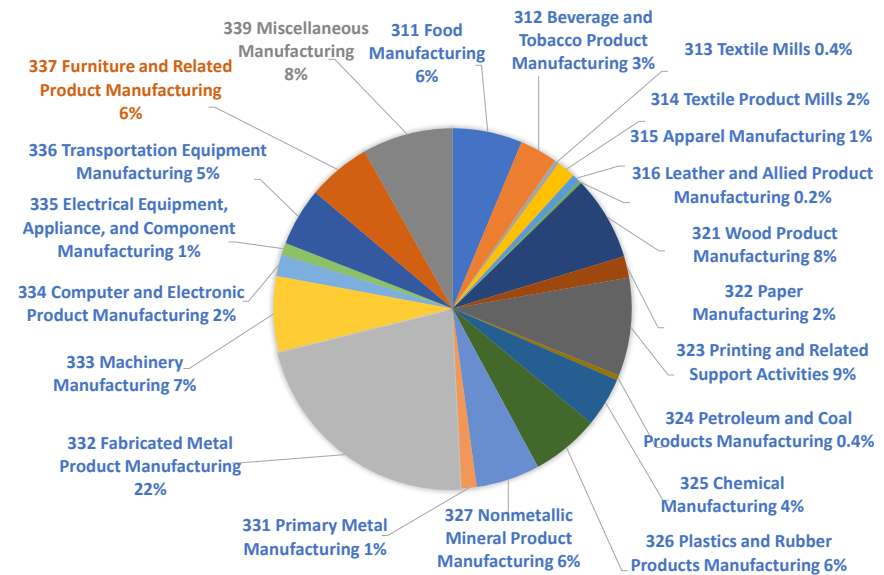


# East Tennessee Initiative for Smart Energy Management (ETISE)

Create a regional model for technical assistance and workforce training to effectively integrate smart manufacturing (SM) in energy management systems into energy-related business practices. The resulting regional model based on East Tennessee could be applied by DOE to other regions to improve the national goals of reducing manufacturing energy consumption and carbon emissions.



Distribution of SMEs



Distribution of SMEs by Industry



Volkswagen



Energy Efficiency & Renewable Energy

ADVANCED MANUFACTURING OFFICE

# Building Environment



A live lab to conduct research on smart buildings for energy saving and human health through data collection, data integration, analytics, adaptive controls, and people engagement.



## WPA Product Portfolio

Occupancy Solution	Wellbeing Solution	Area-counting Solution	People-flow Solution
Desk Sensor Ceiling Sensor	Wave Plus Sensor	Area-counting Sensor	People-flow Sensor
PIR + IR PIR	Temp - RH - CO2 - VOC - Lux - Pressure - Radon	Optical Sensor	Active IR
Gateway	Gateway	Gateway Repeater	

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Life is On | Schneider Electric

A \$58,000 gift with sensors and an integrated system from Schneider Electric. Led by S. Li

# Requirement Analysis for Workplace Charging



**Knoxville  
Level 2  
(Peak time)**



**Nashville  
DCFC  
(Peak time)**



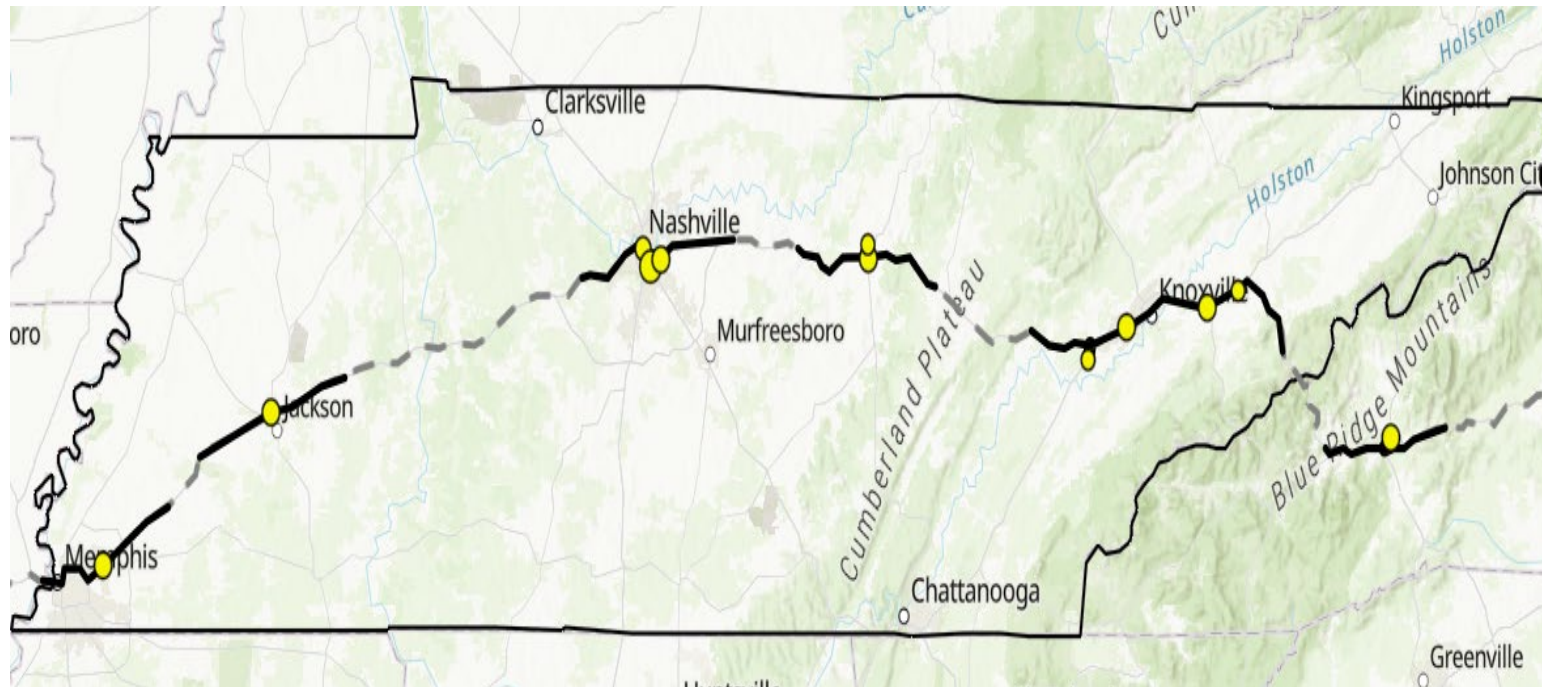
Region	Total Energy Demand (GWh)	Charger Level	Energy Demand Satisfied (GWh)	% of Satisfied Daily Demand	Peak Power (MW)	Median Power (MW)	Average Power (MW)	Power Standard Deviation (MW)
Nashville	8.5	1.8 KW	6.79	79.93%	891.12	106.56	282.86	295.86
		7.2 KW	8.49	99.98%	1975.61	119.10	353.83	534.34
		50 KW	8.49	100.00%	2465.31	94.69	353.89	624.03
Knoxville	3.8	1.8 KW	3.13	82.86%	429.55	58.08	130.45	135.63
		7.2 KW	3.78	99.98%	901.81	60.73	157.41	231.90
		50 KW	3.78	100.00%	1270.62	43.71	157.44	273.67

**Significant pressure on grids : 270.6 GWh monthly electricity required to support all commuting trips through workplace charging in the two regions, about 4.8% of all electricity generated in TN.**



# I40-EV and CNG Station Siting Selection

- Inform the Tennessee Department of Transportation's (TDOT) role in Statewide EV Charging Network Initiative
- Conduct EV and CNG station site selection and analysis
- Develop a sustainable funding strategy



**I40 EV Infrastructure Coverage Gap**



# Priorities in AY 2022~2023

- Add more affiliated faculty members and more collaboration with other disciplines and other institutions
- Help ORIED launch and grow the *Global Energy Ecosystems* (GE<sup>2</sup>) initiative
- Develop track-1 NSF Sustainable Regional Systems proposal
- Further grow outreach and research at ETCFC and lead the adoptions of EV and other alternative fuel vehicles in TN and US
- Further grow TNWRRC research, training, and outreach activities
- Take leadership in environmental and energy justice and outreach
- Grow building Environment initiative
- May start an initiative around net-zero and decarbonization



Coupled  
with  
Climate  
Change  
research

# *Big Thanks & Questions?*

*Summer in Knoxville, TN*

