

# Meteorology and Power System Planning For A Large Share of Variable Generation

Prepared By:

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*Vibrant Clean Energy, LLC*

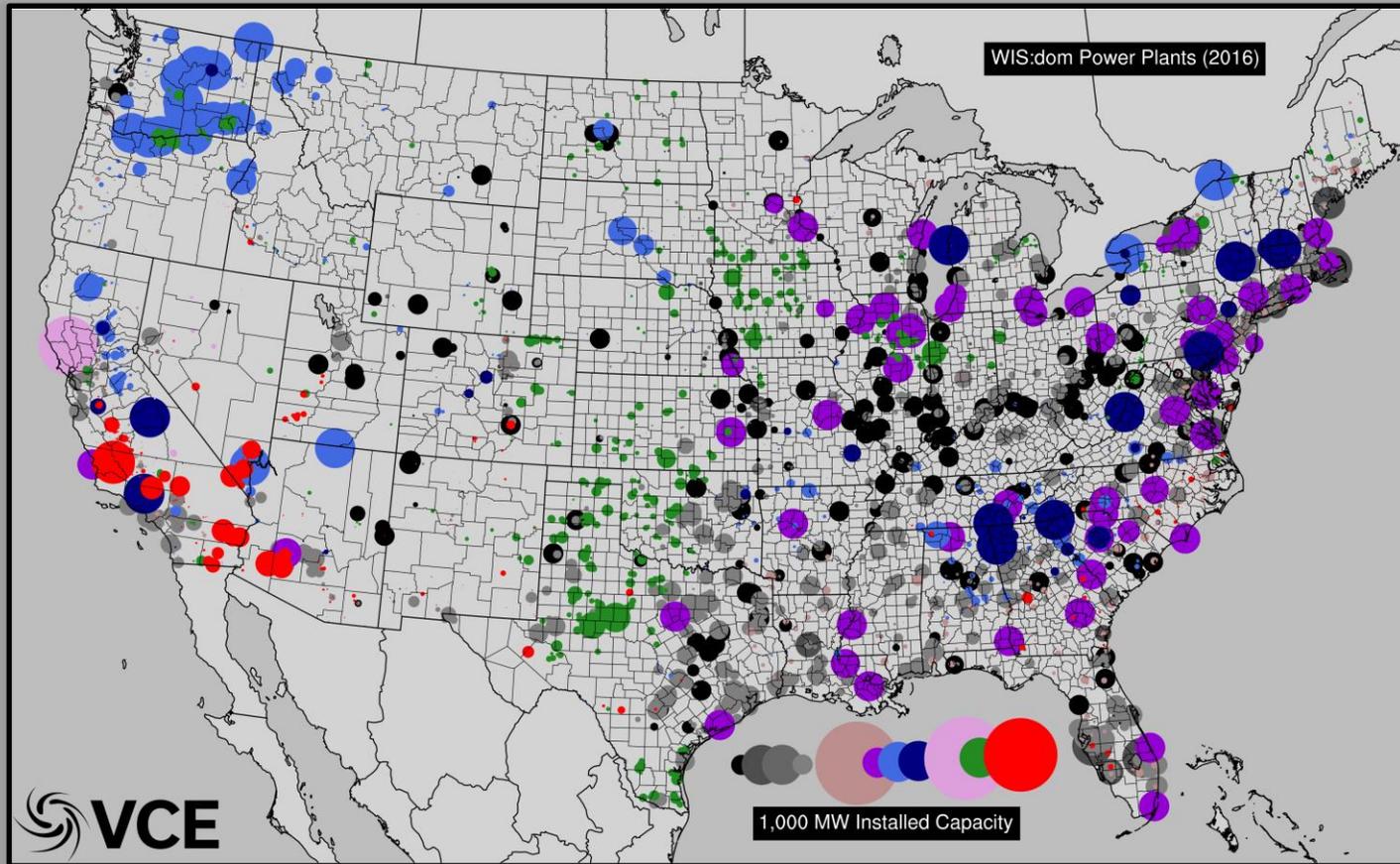
Prepared For:

**UVIG Forecasting Workshop**

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# Wind and solar are building a greater share of the electricity markets



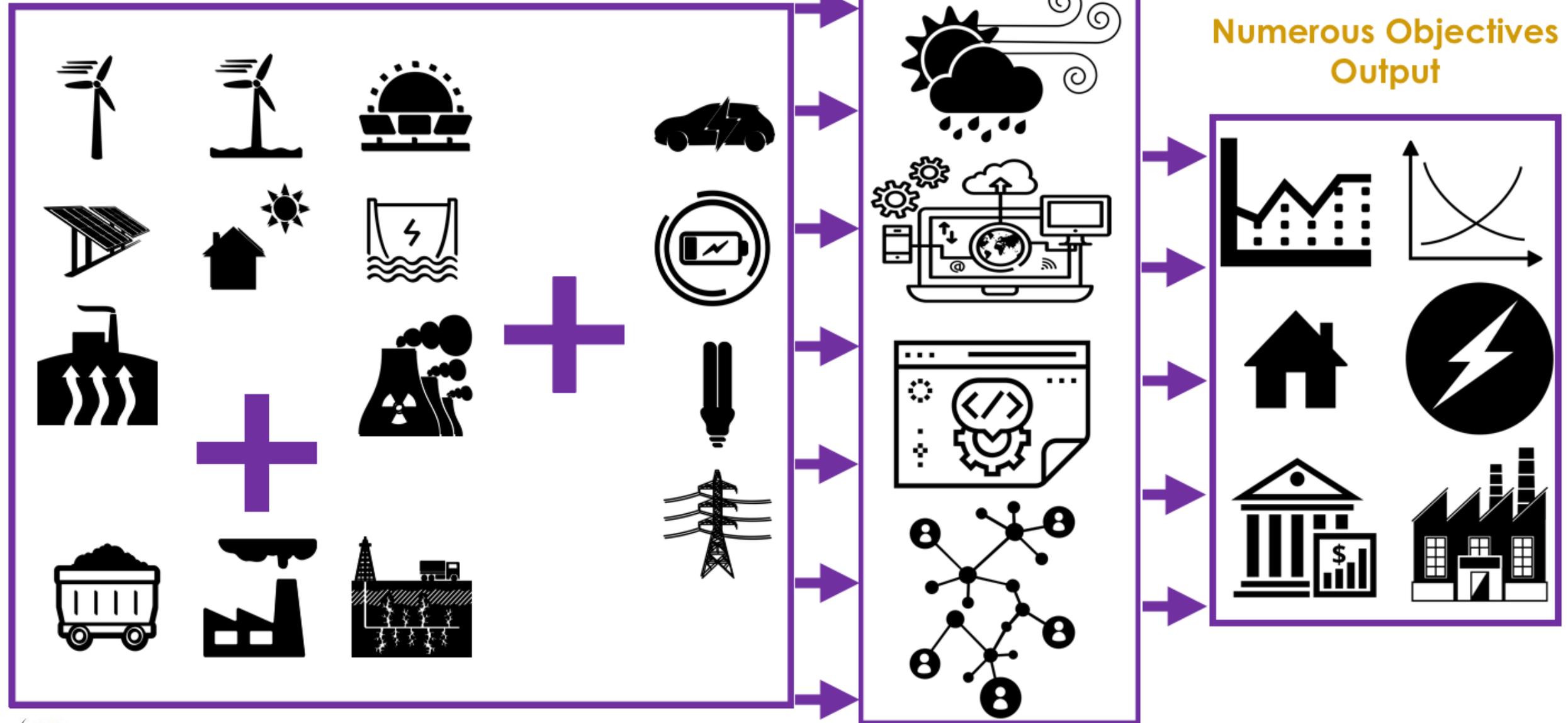
## Purpose of Vibrant Clean Energy, LLC:

- Reduce the cost of variable generation (VG);
- Increase the likelihood of very high penetrations of VG;
- Reduce the emissions from sovereign states around the globe;
- Help direct the transition of heating and transportation to electrification;
- Increase the resiliency of the electricity market for uncertain futures;
- Ensure profits for energy companies with a modernized grid.

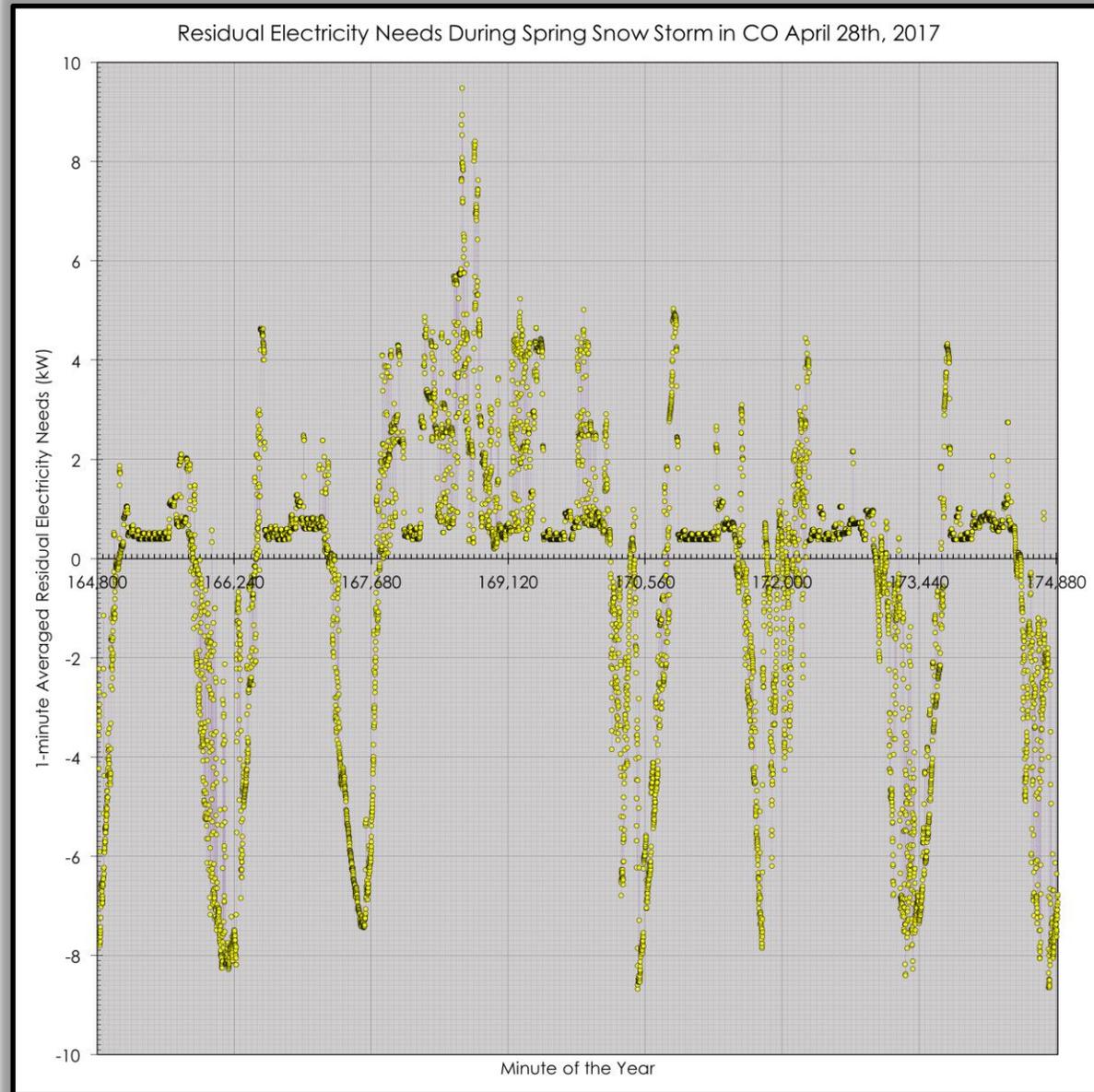
## Detailed Input Data

## WIS:dom

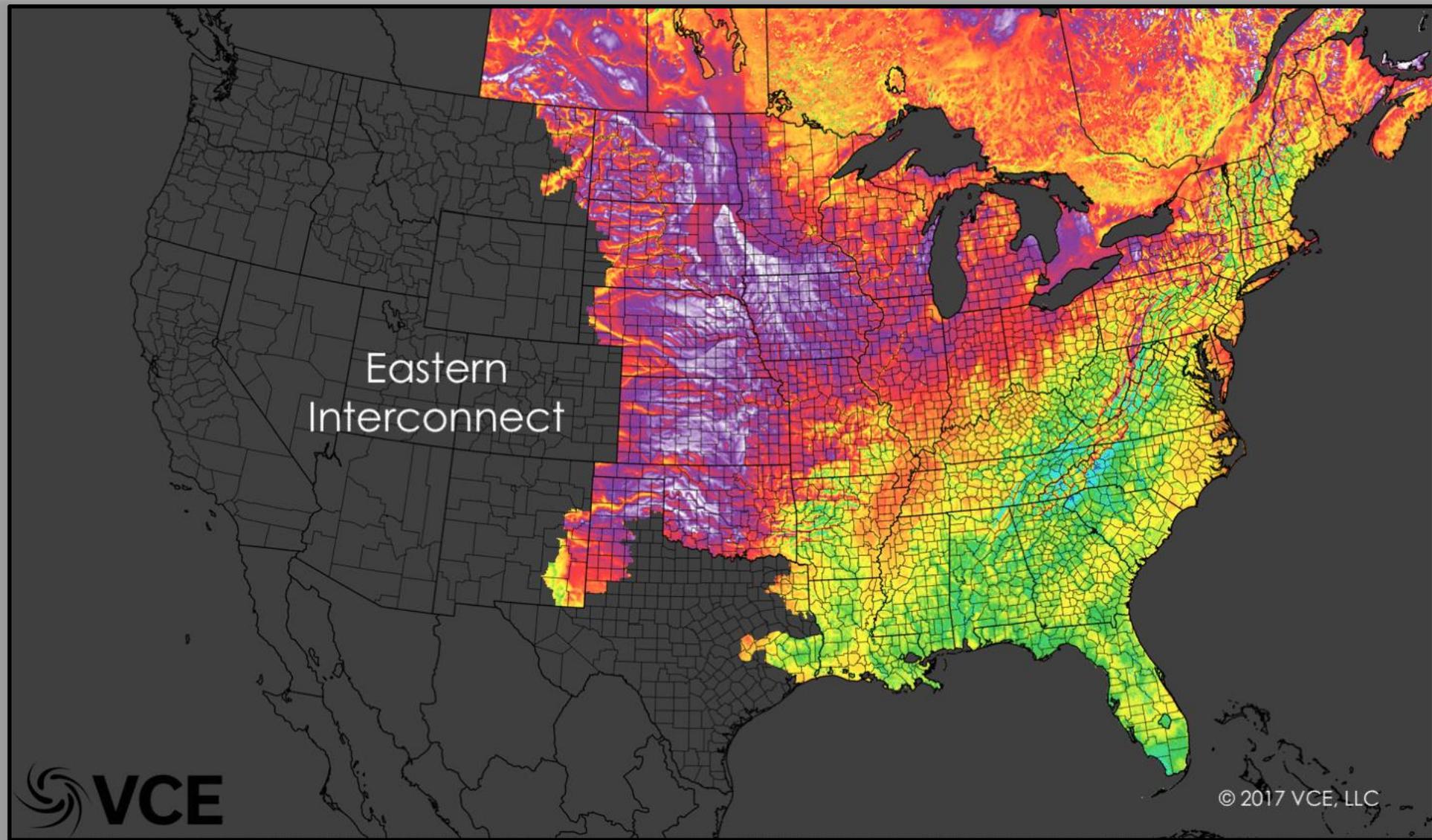
## Numerous Objectives Output



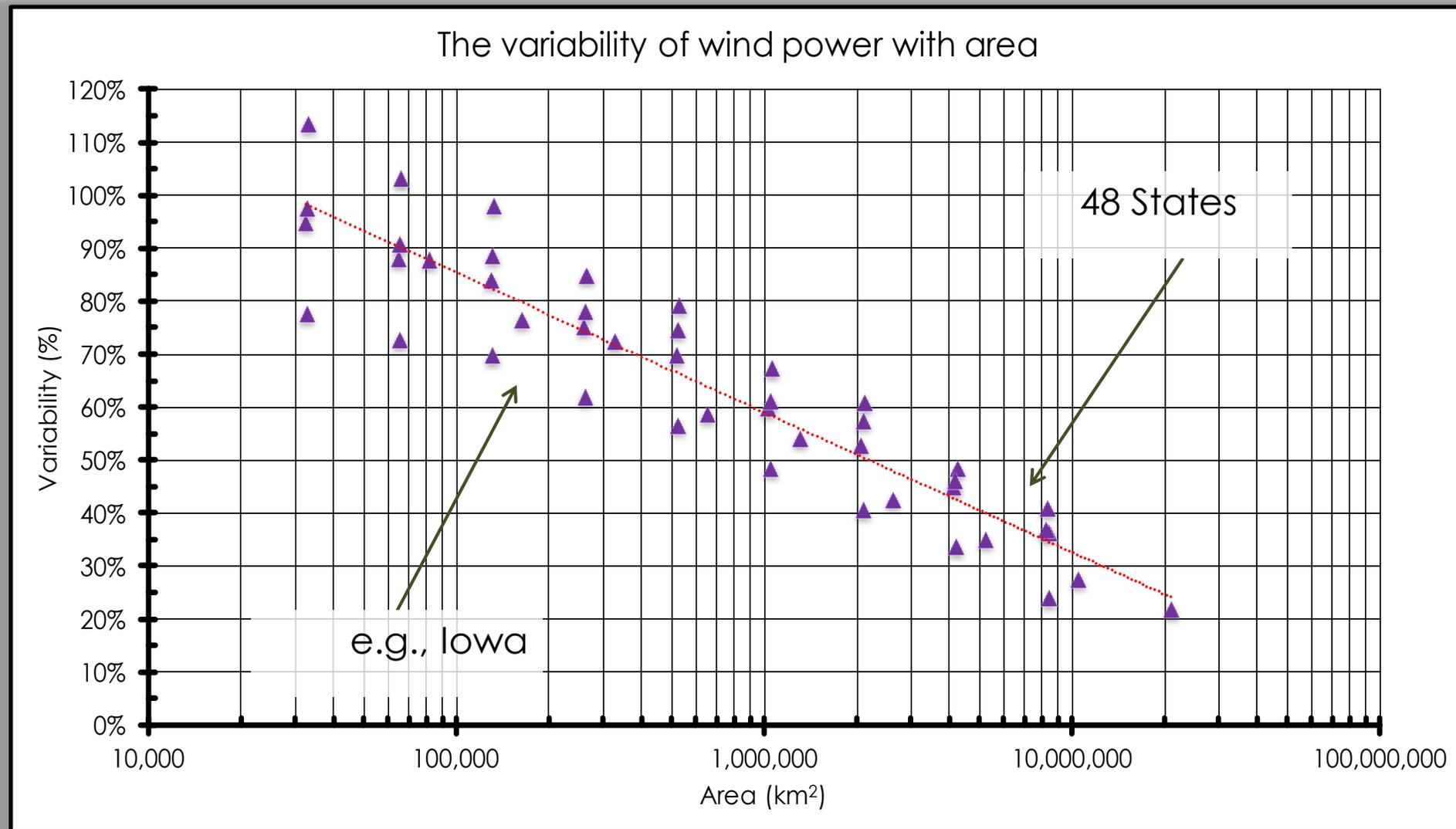
# What 100% Solar Looks Like With Grid At single Home



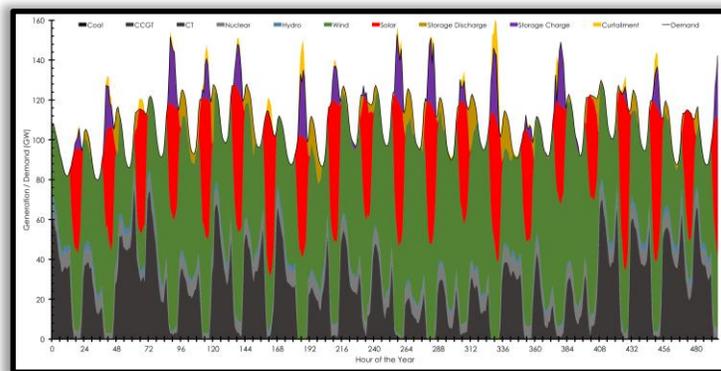
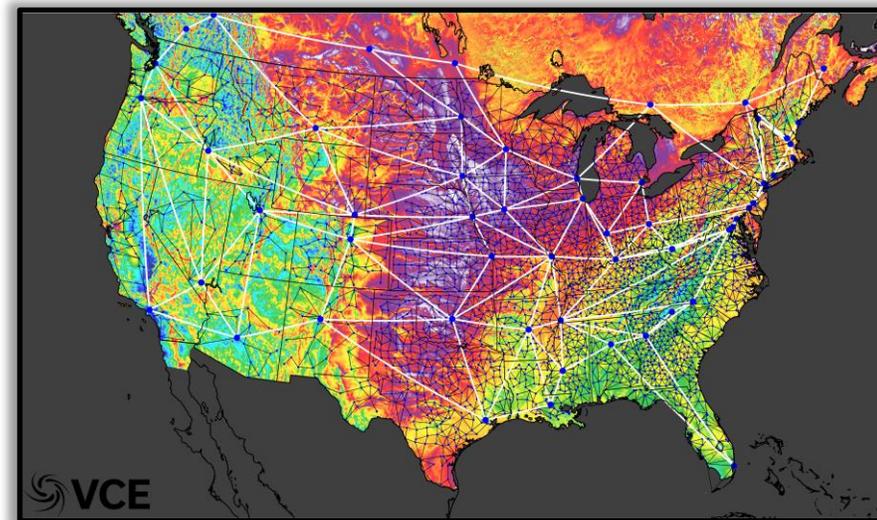
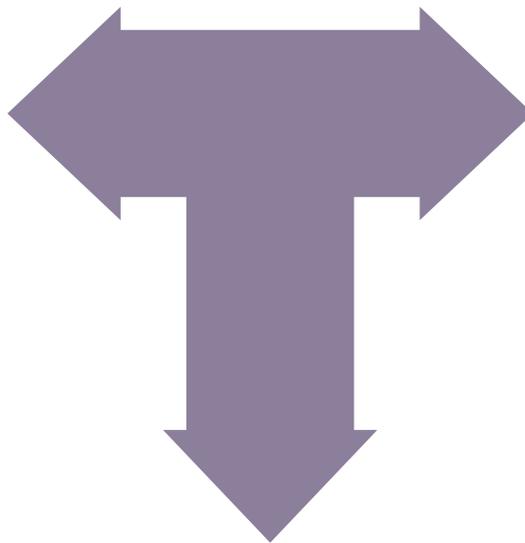
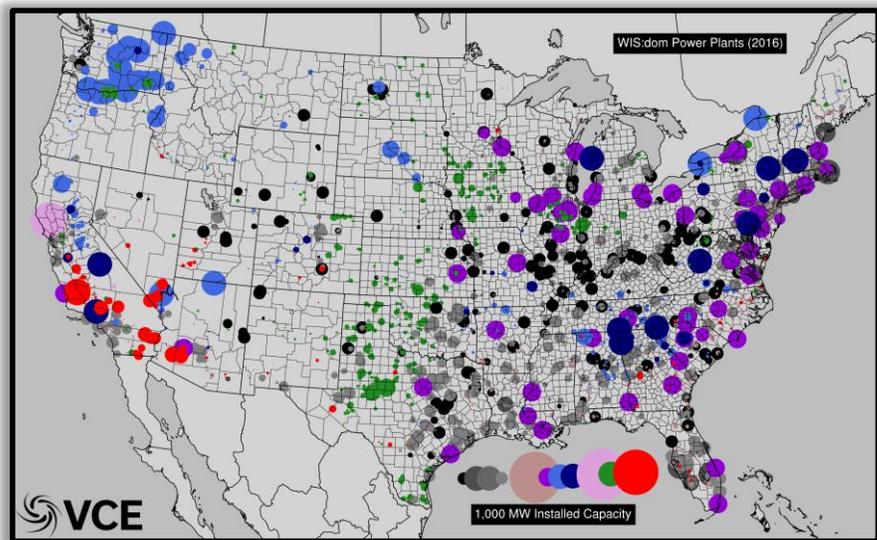
# The US Is Divided Up – So Can Never See Full Picture



# The US Is Divided Up – If We Could Go Big There Is Huge Potential



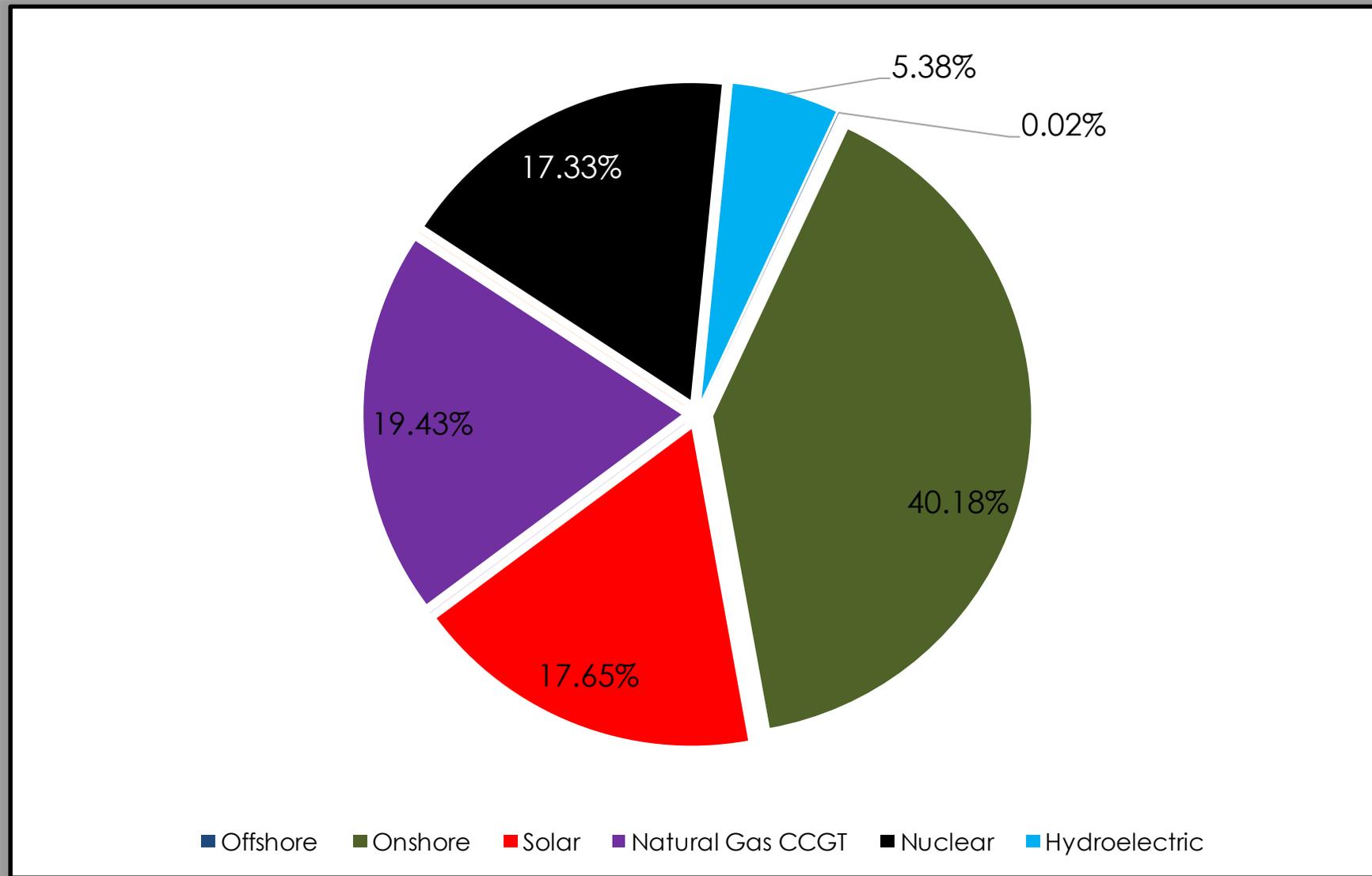
# Need to consider: generation, transmission, retirements, reserves, dispatch, loads and storage



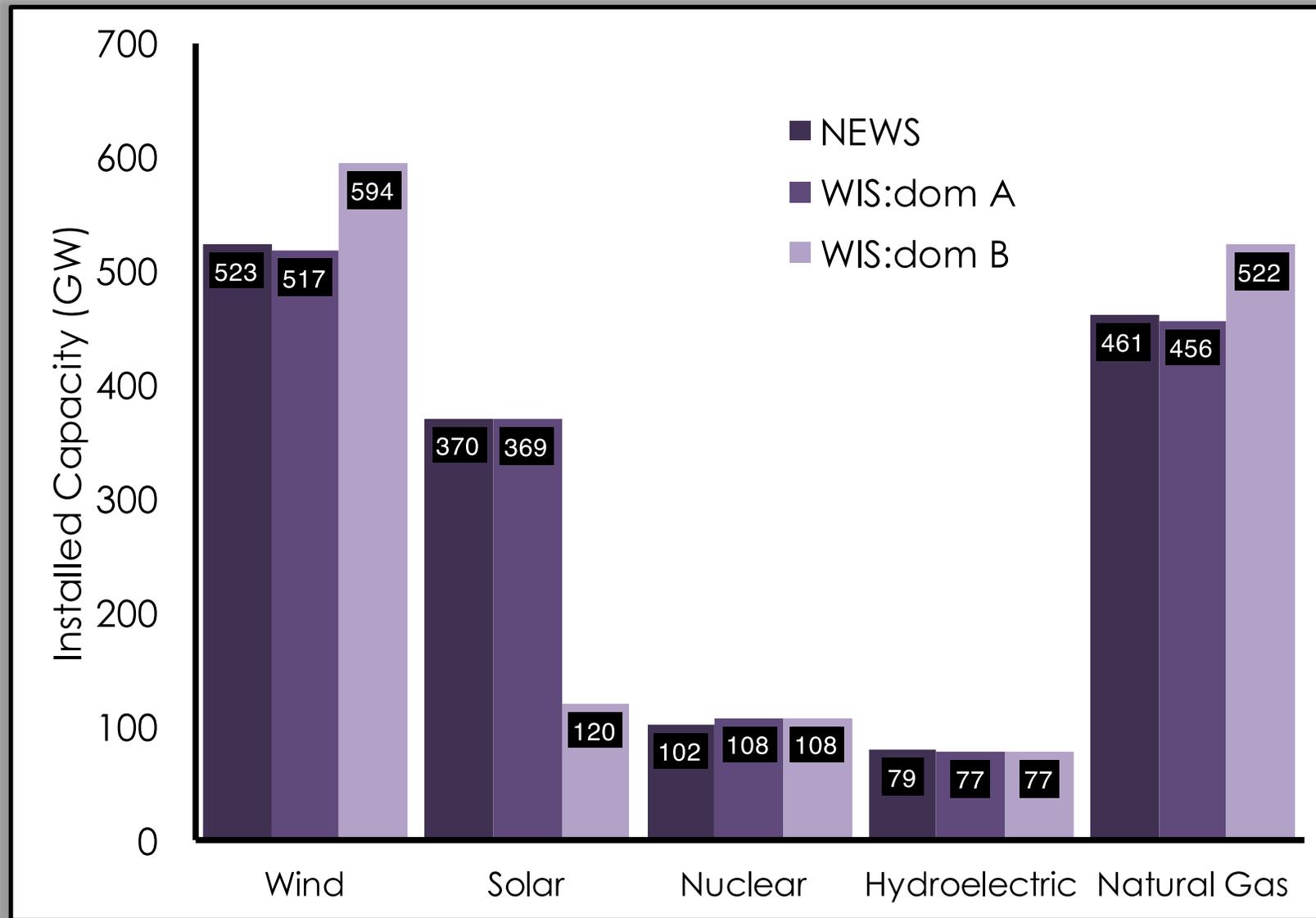
# The WIS:dom Optimization Model And Atmospheric Science To Inform Future Energy Pathways

## National Studies

# Low-carbon electricity grid incorporates diverse generation

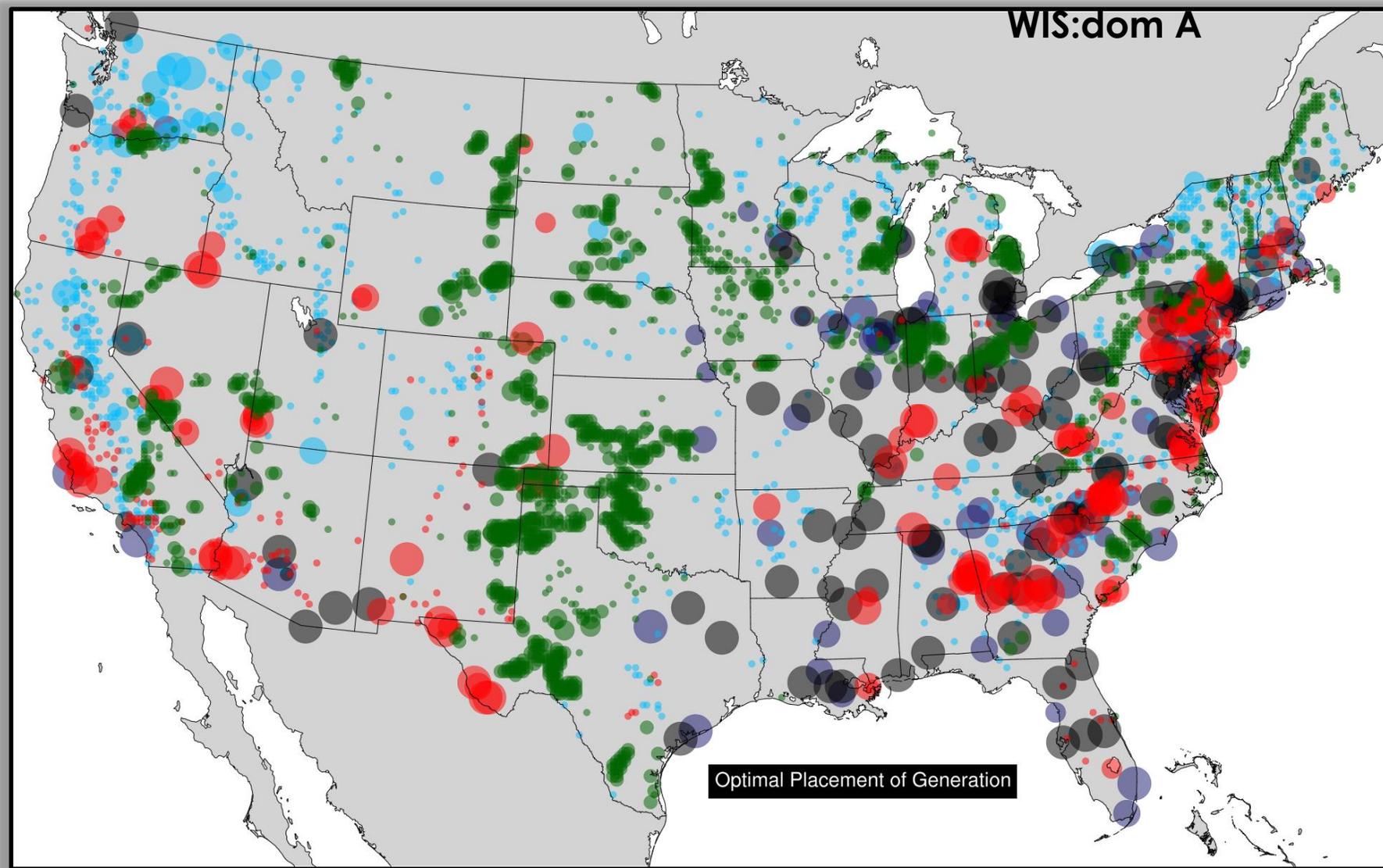


# Current Policies Can Dramatically Shift Future Generation Mixes



As “cost” parity is approached the installed capacities tend to:  
**wind = solar PV = natural gas**

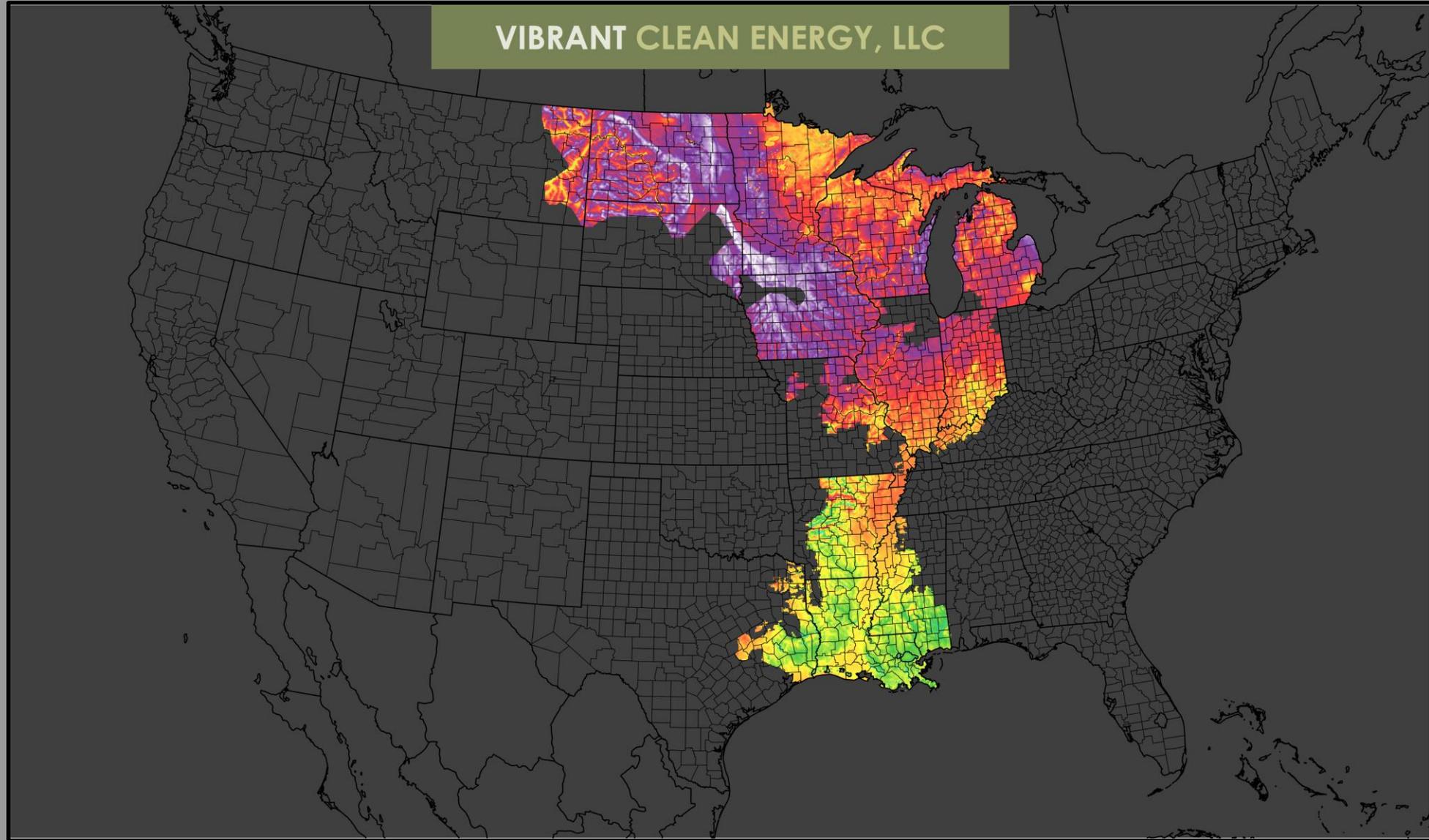
# Low-carbon electricity grid can include all states



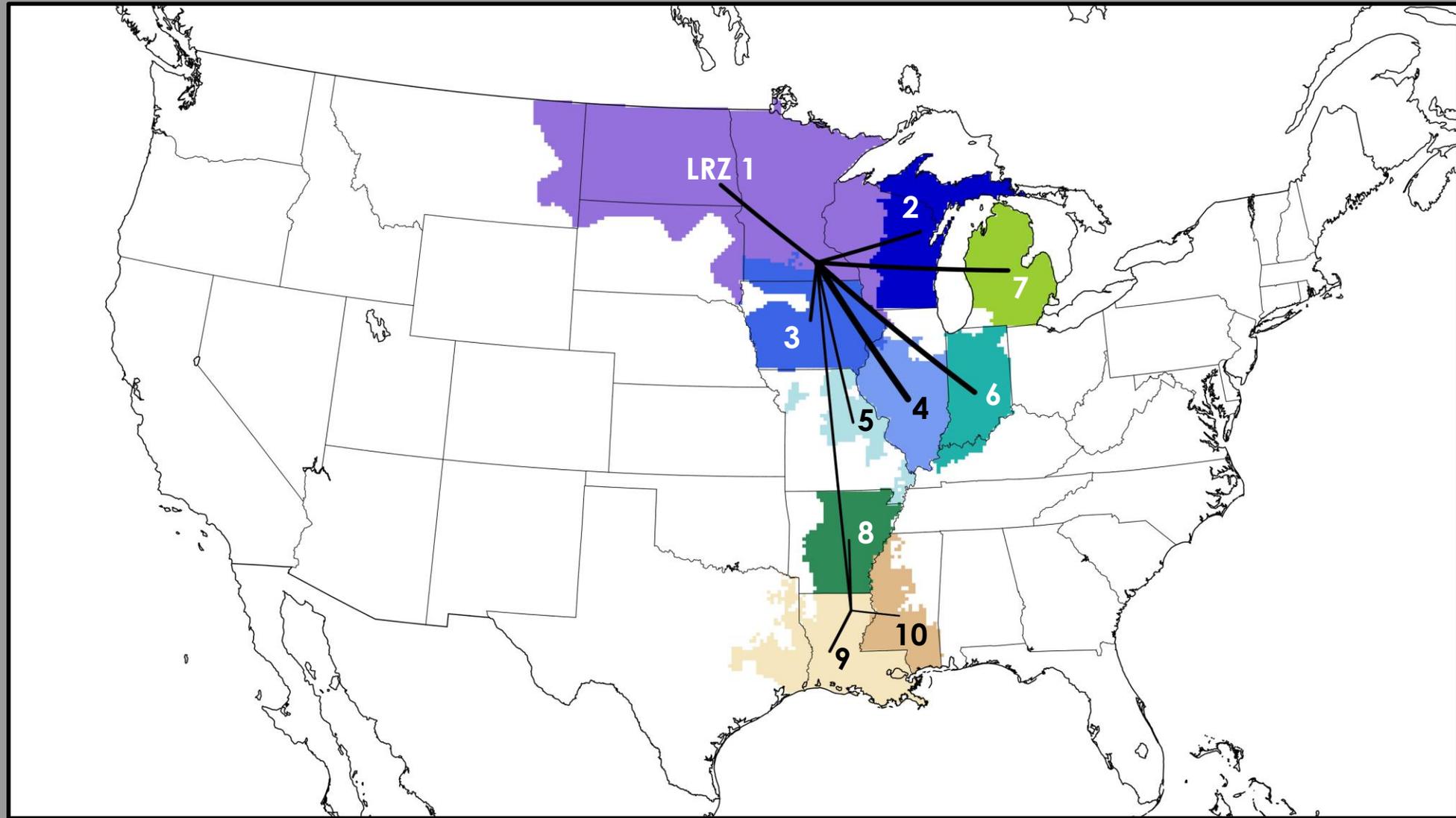
# The WIS:dom Optimization Model And Atmospheric Science To Inform Future Energy Pathways

## Regional Studies - MISO

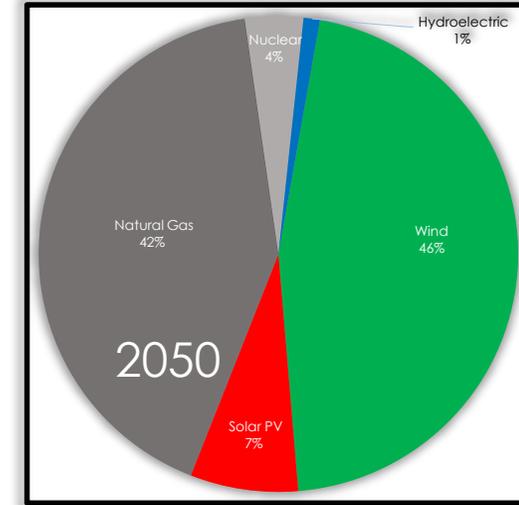
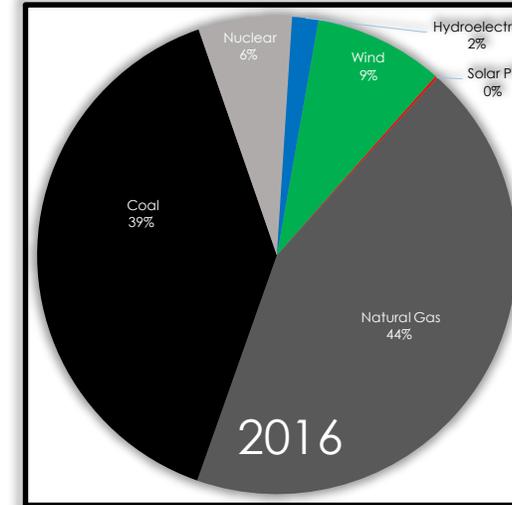
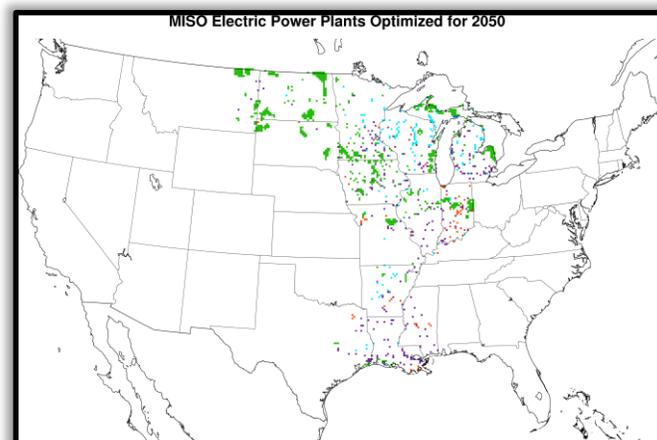
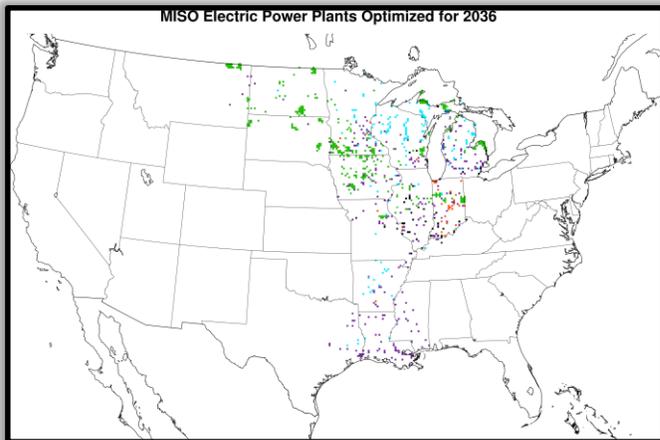
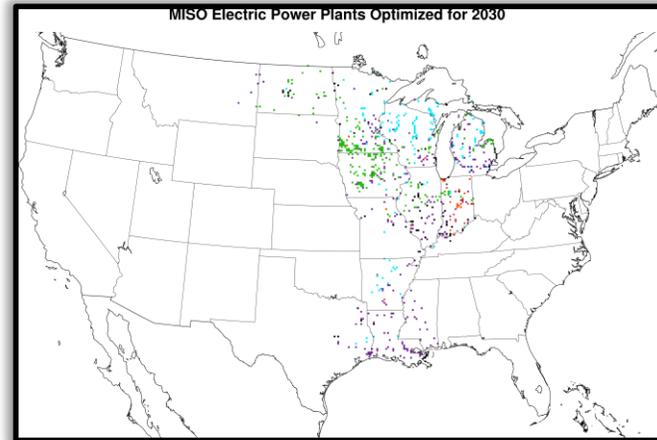
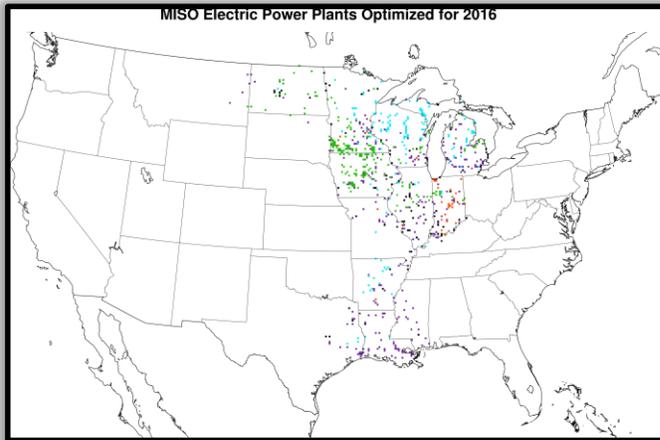
# WIS:dom Has Already Been Used In MISO



# WIS:dom Has Already Been Used In MISO



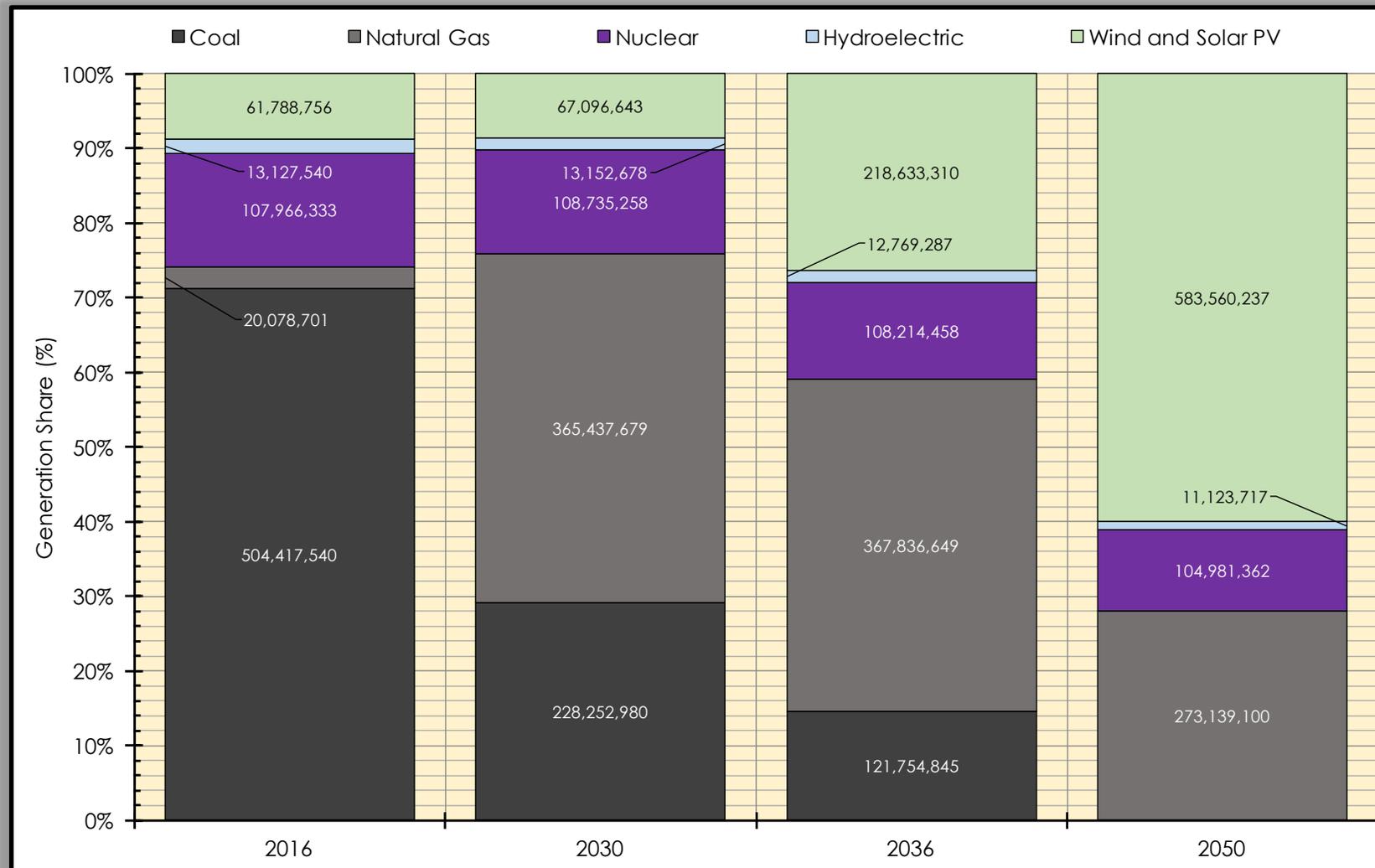
# Transforming ISO/RTOs With Smarter Planning



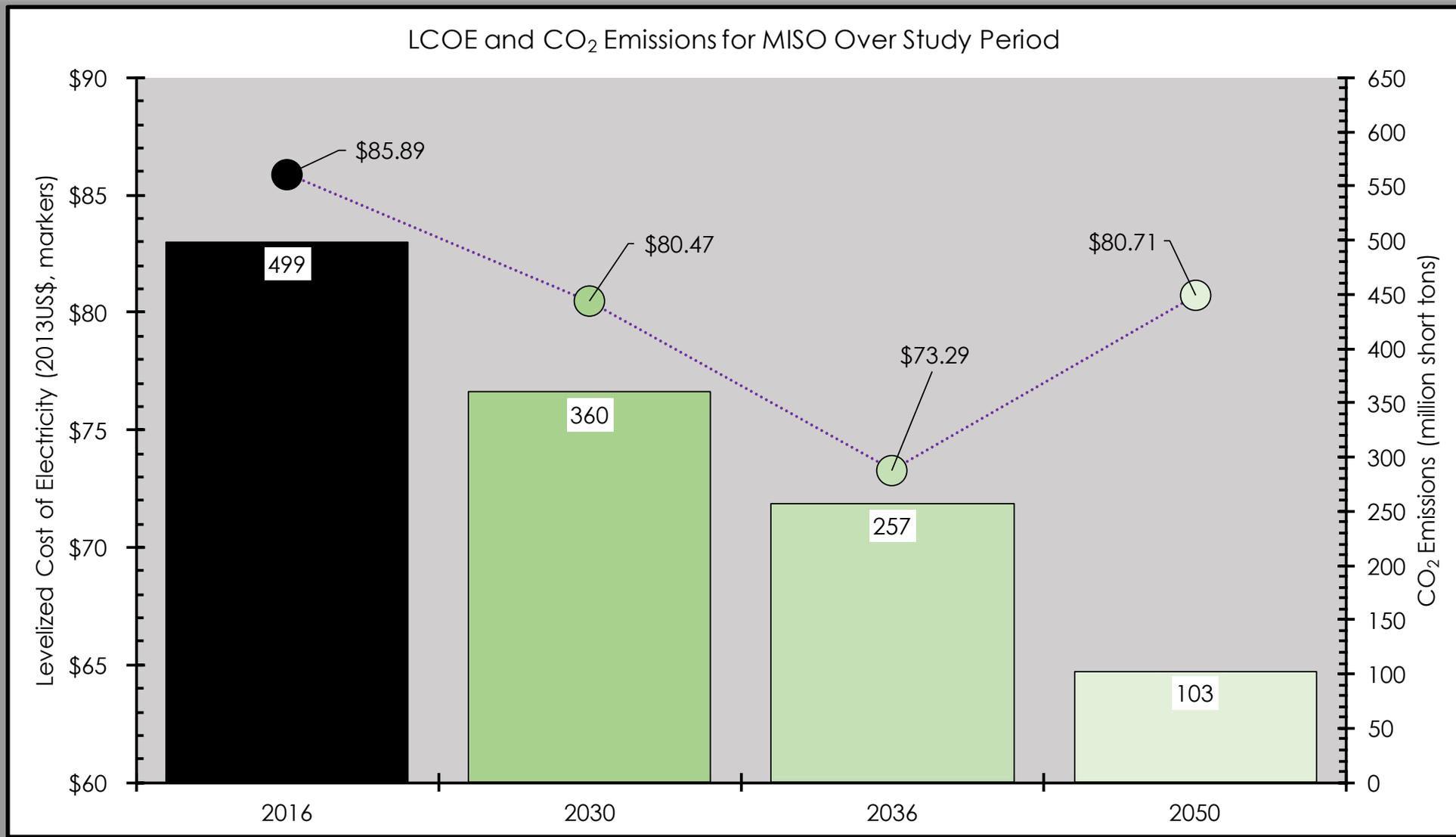
- WIS:dom was used by MISO as part of their MTEP-17 process;
- Determined grids that were constrained by carbon and baseline;
- Model outputted values, locations and developments for four time horizons;
- Results are determining the Resource Zones for MISO for the coming years.

[http://www.vibrantcleanenergy.com/wp-content/uploads/2016/05/VCE\\_MISO\\_Study\\_Report\\_04252016.pdf](http://www.vibrantcleanenergy.com/wp-content/uploads/2016/05/VCE_MISO_Study_Report_04252016.pdf)  
<https://www.misoenergy.org/Events/Pages/MTEP17Futures20160428.aspx>

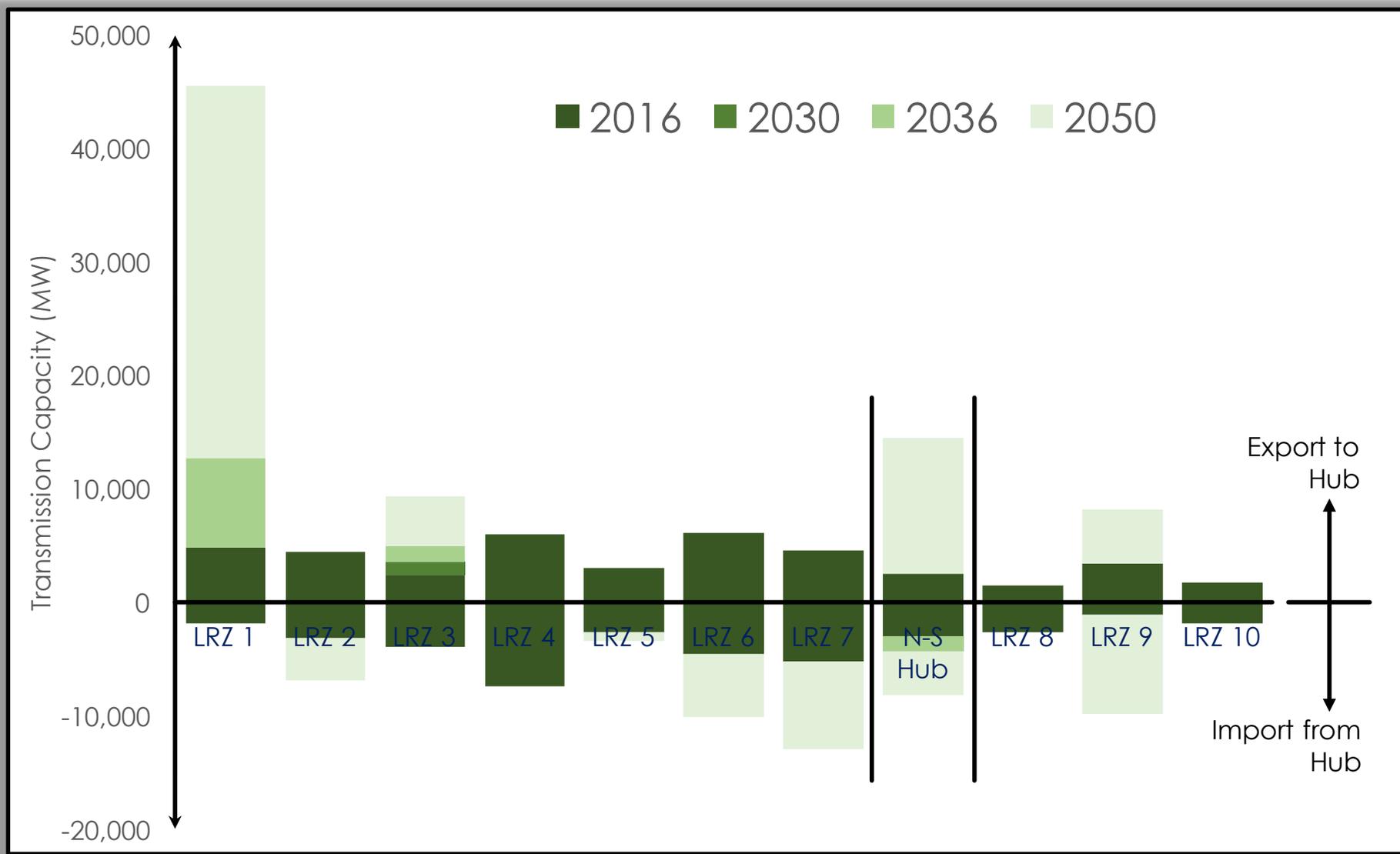
# Emissions Can Be Dramatically Reduced



# Cost Can Be Lower Than Today With Careful Planning



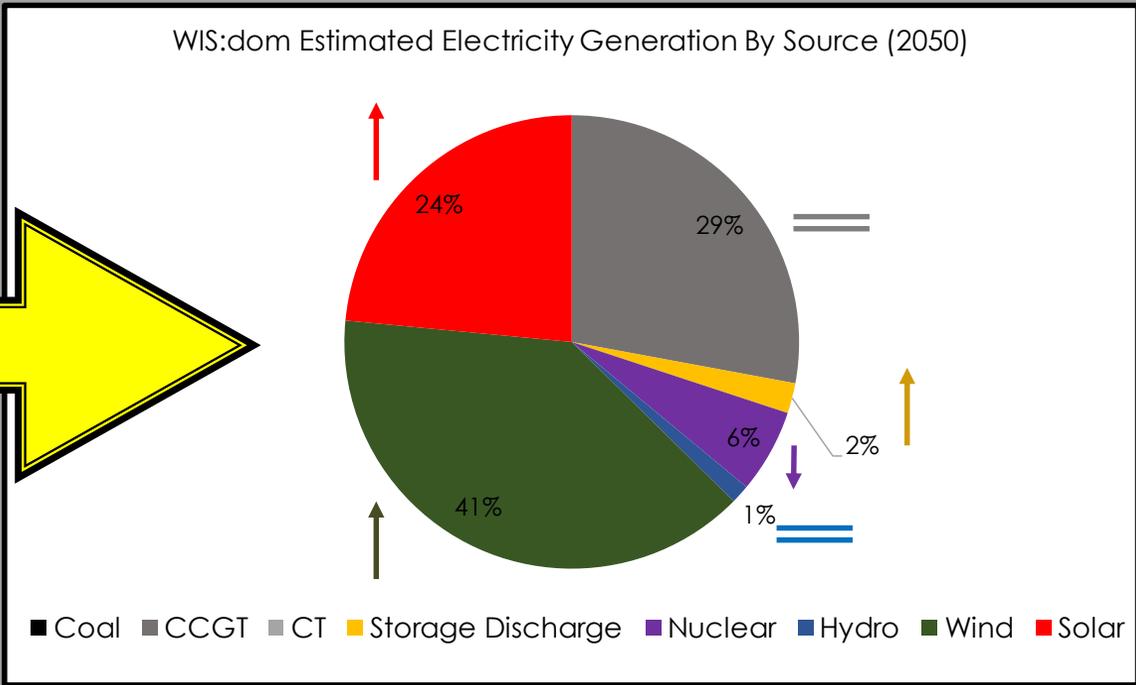
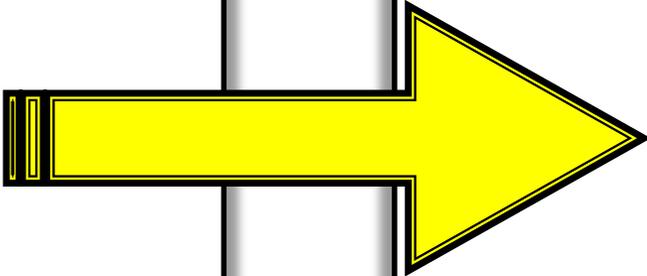
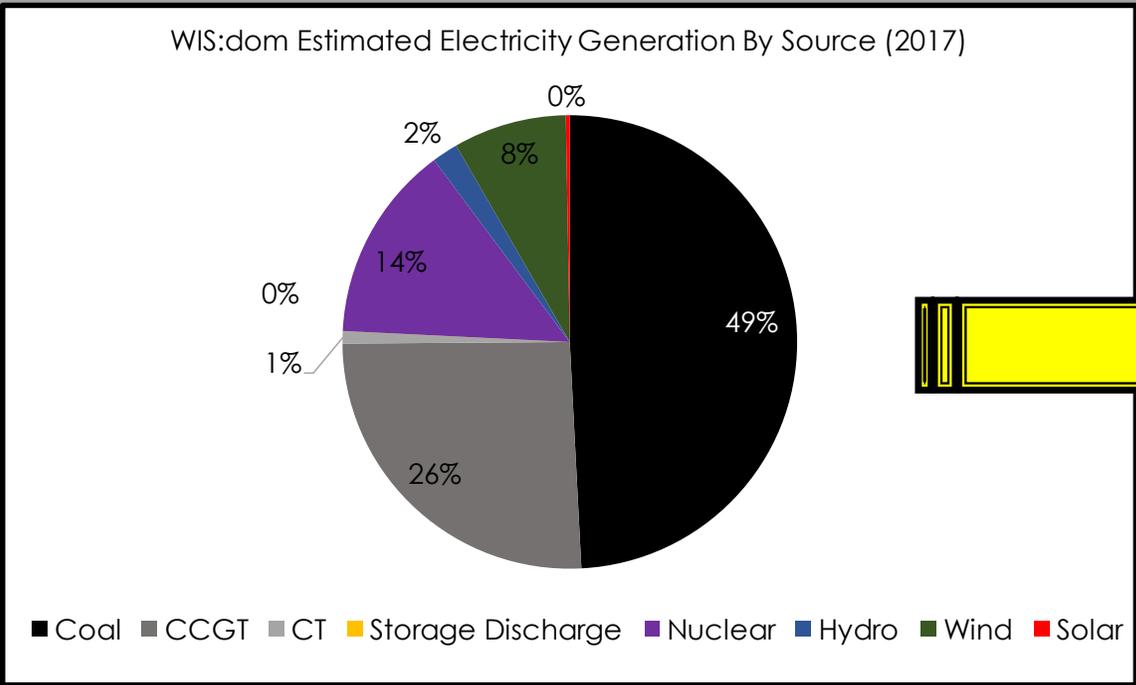
# Need Transmission For Large Expansion Of Wind & Solar



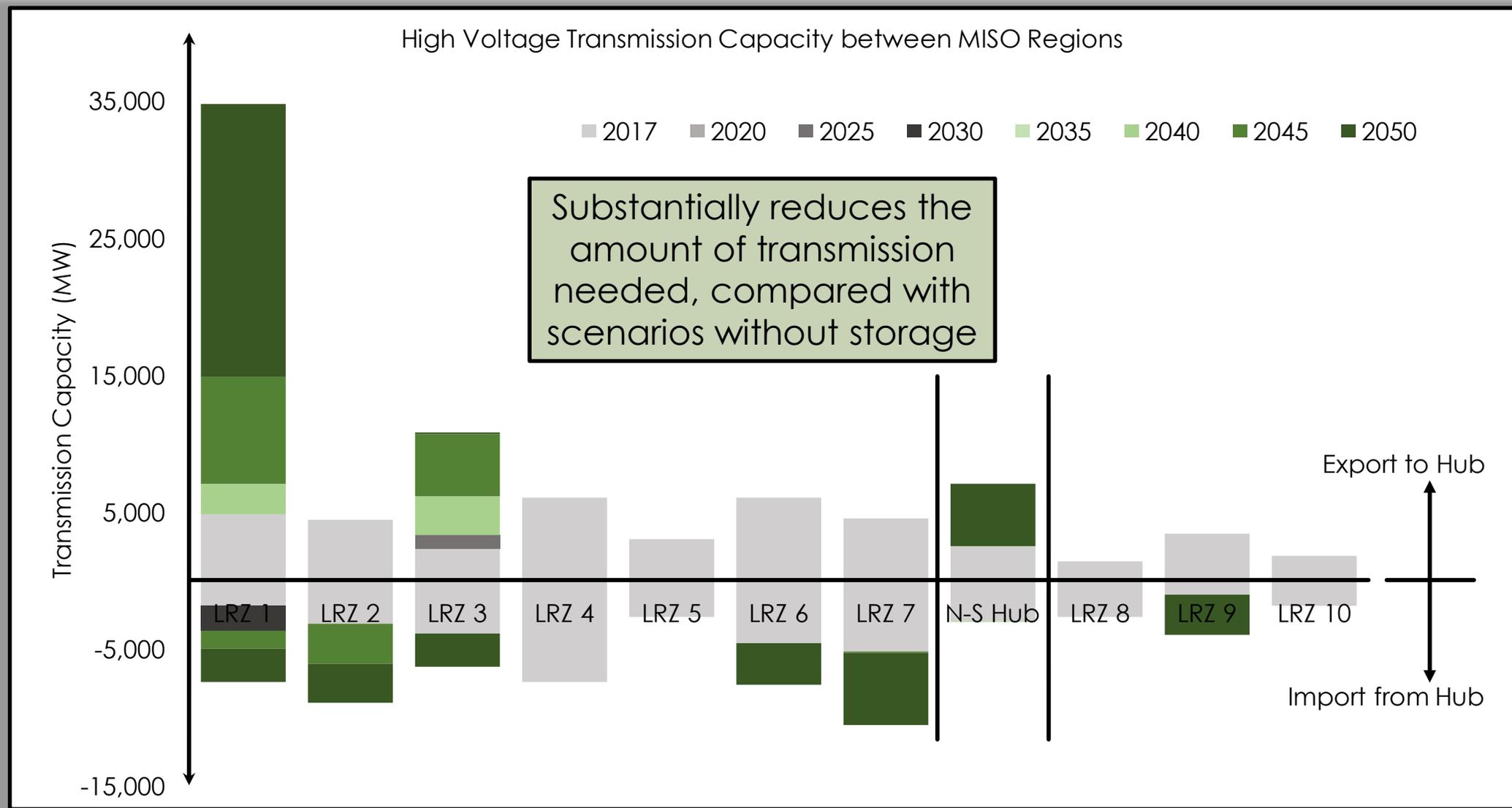
# The WIS:dom Optimization Model And Atmospheric Science To Inform Future Energy Pathways

## Regional Studies – MISO with storage

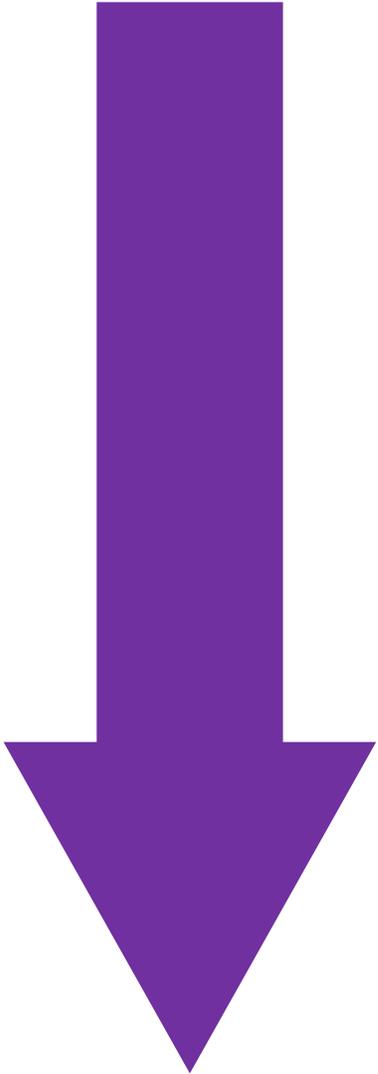
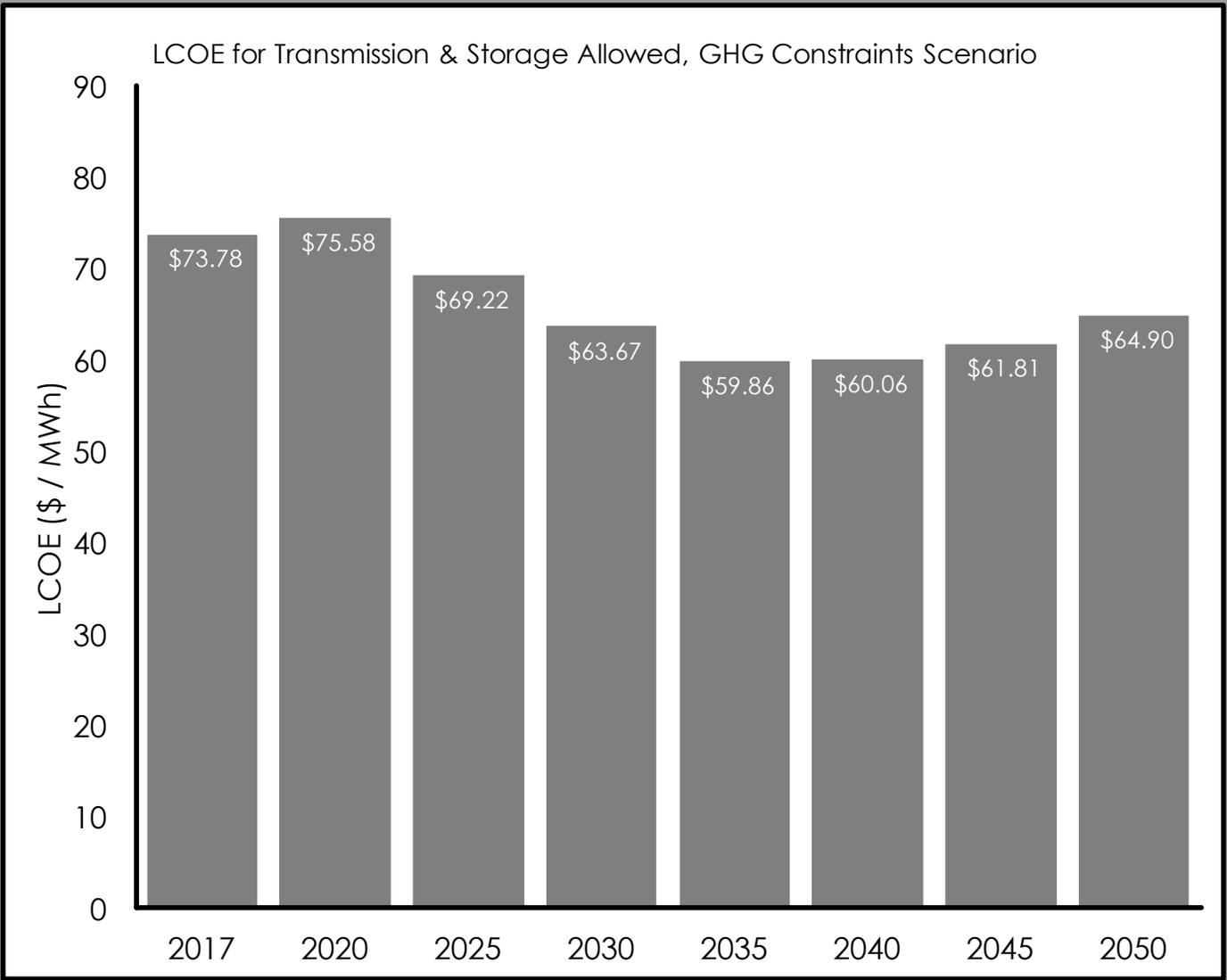
# Addition Of Storage Increases VRE, If Planned Properly



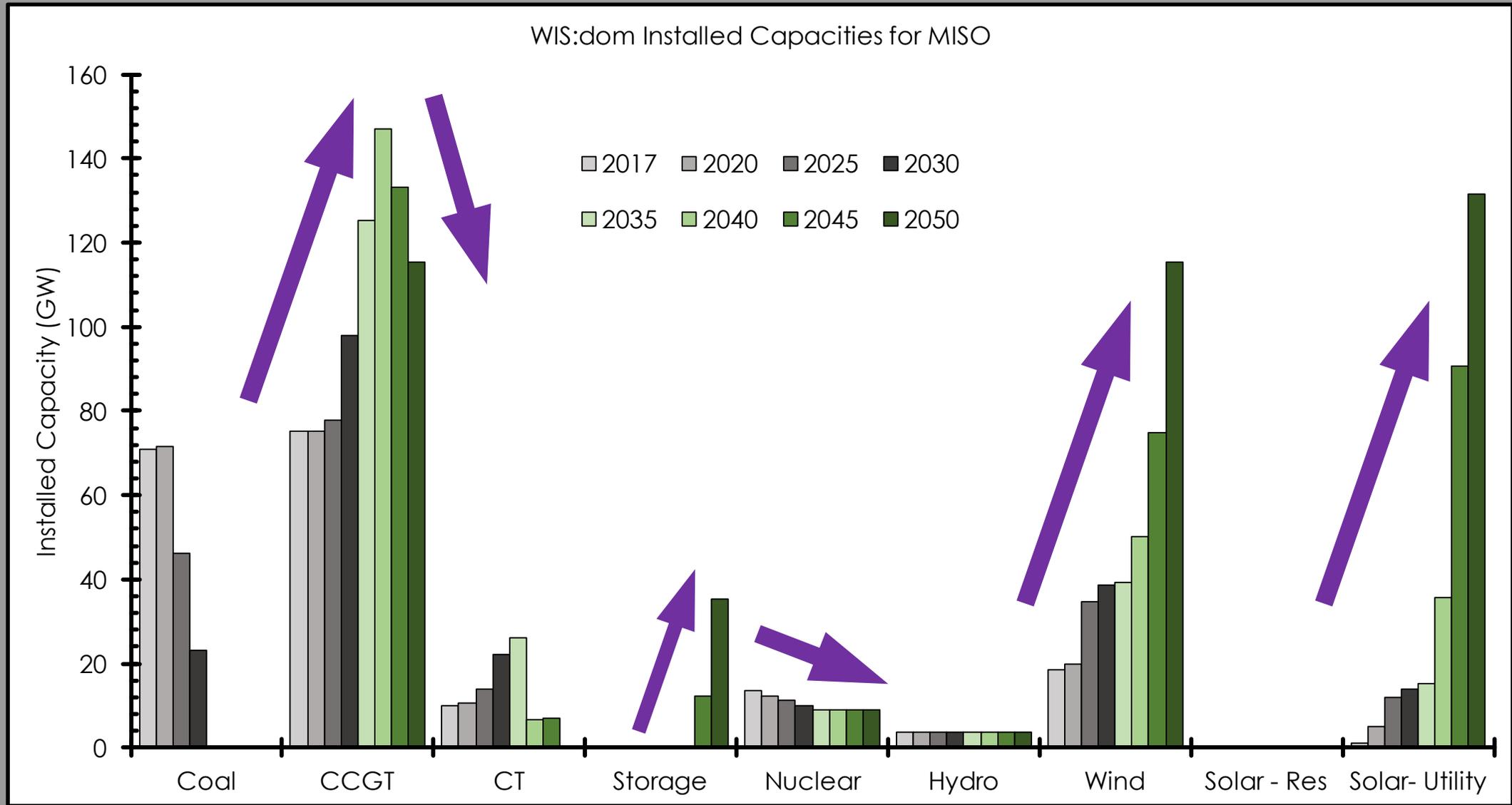
# With Smarter Planning, Still Need Transmission, But Much Less



# Costs Are Reduced By Storage



# The Transition Takes Time And Markets Must Evolve Along Way



# QUESTIONS?



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