

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

Prepared By:

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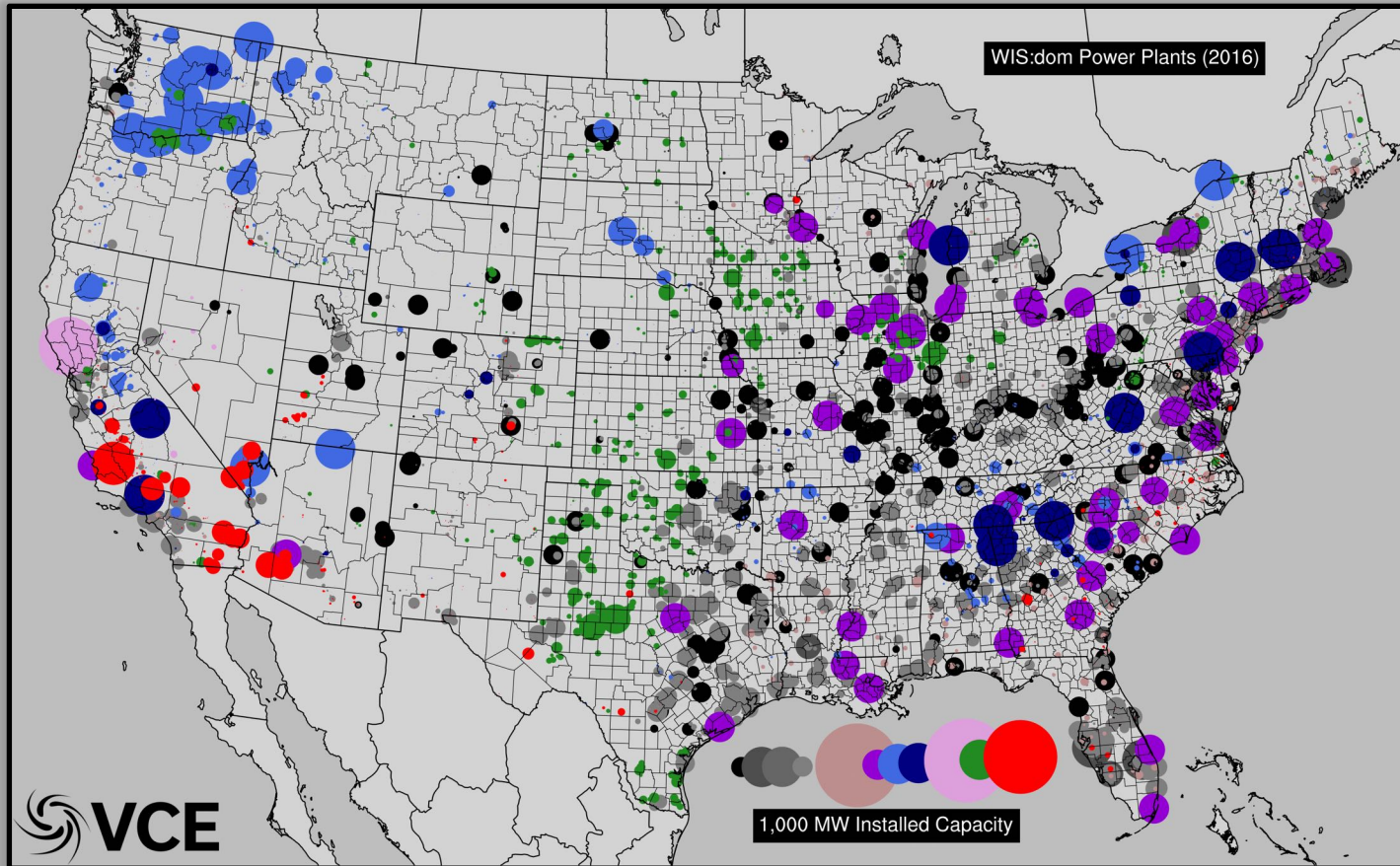
Prepared For:

UVIG Forecasting Workshop

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



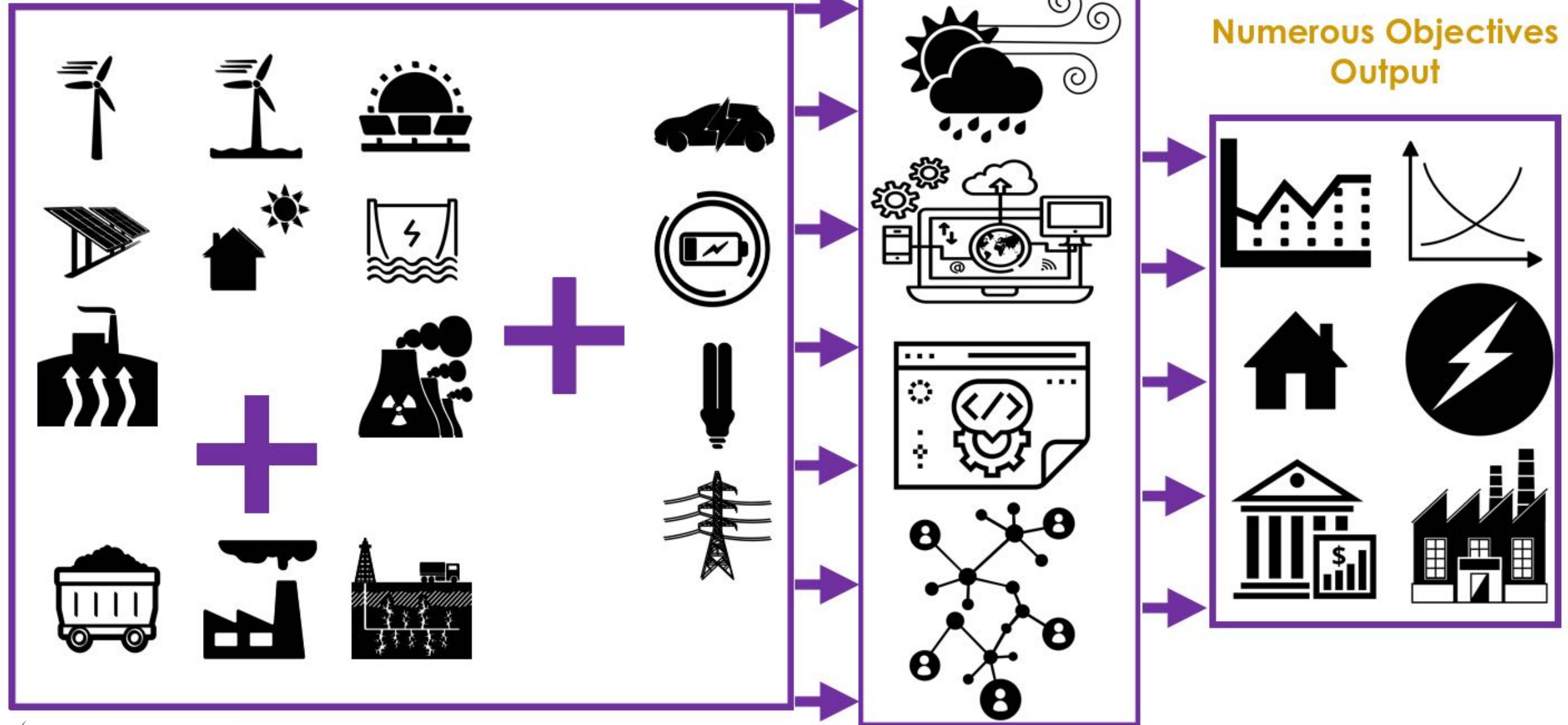
Purpose of Vibrant Clean Energy, LLC:

- 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.

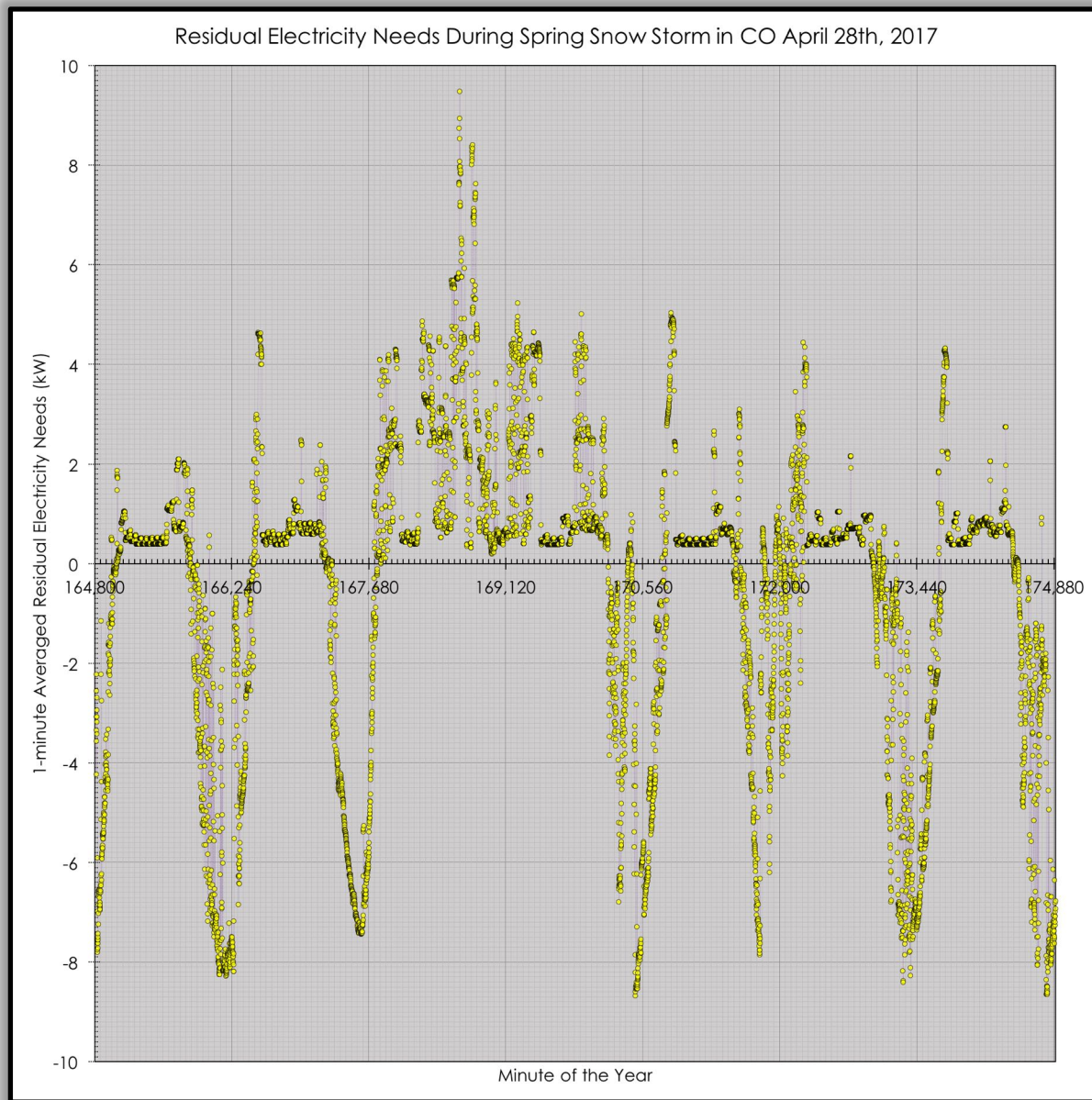
Detailed Input Data

WIS:dom

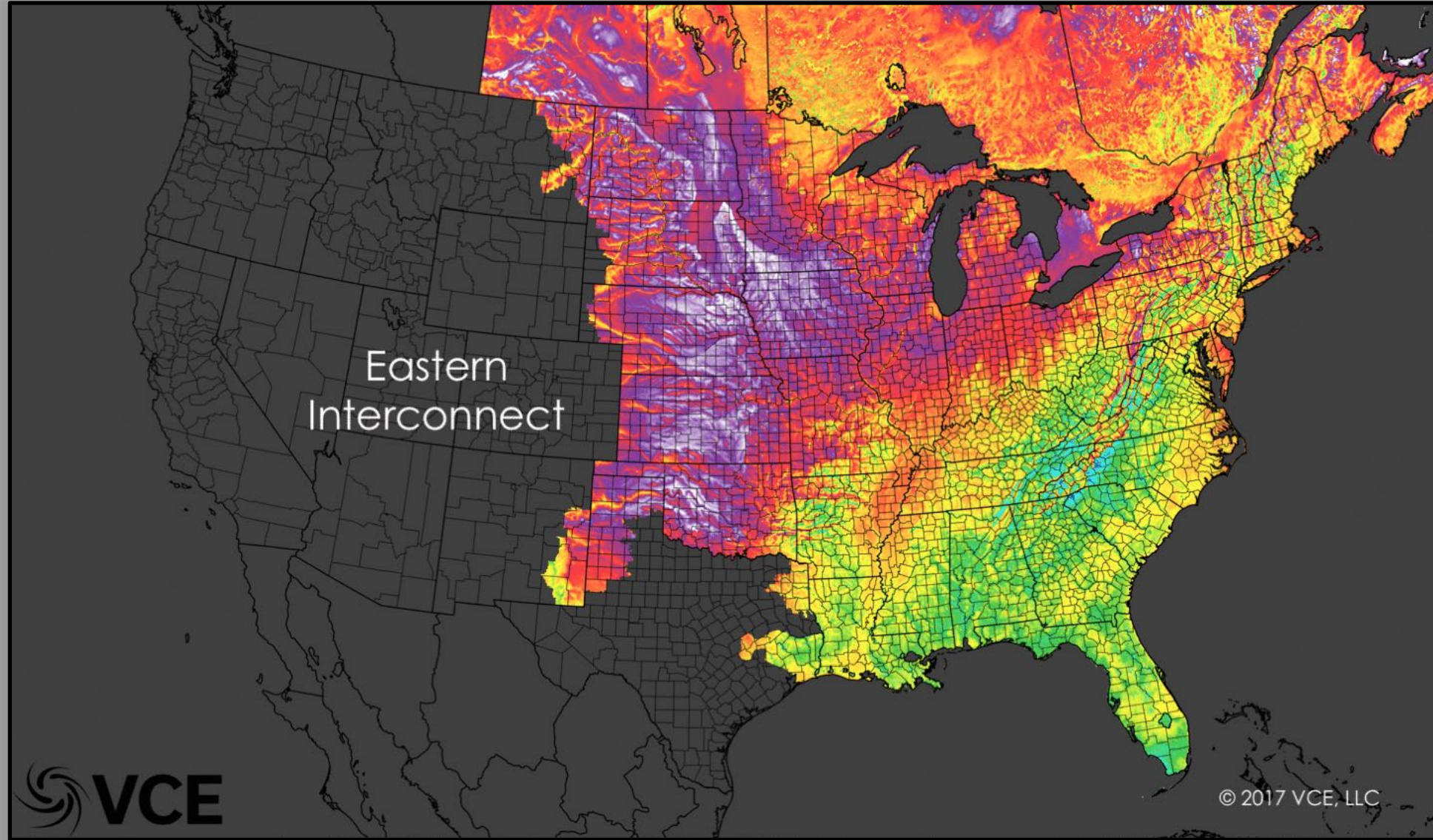
Numerous Objectives Output



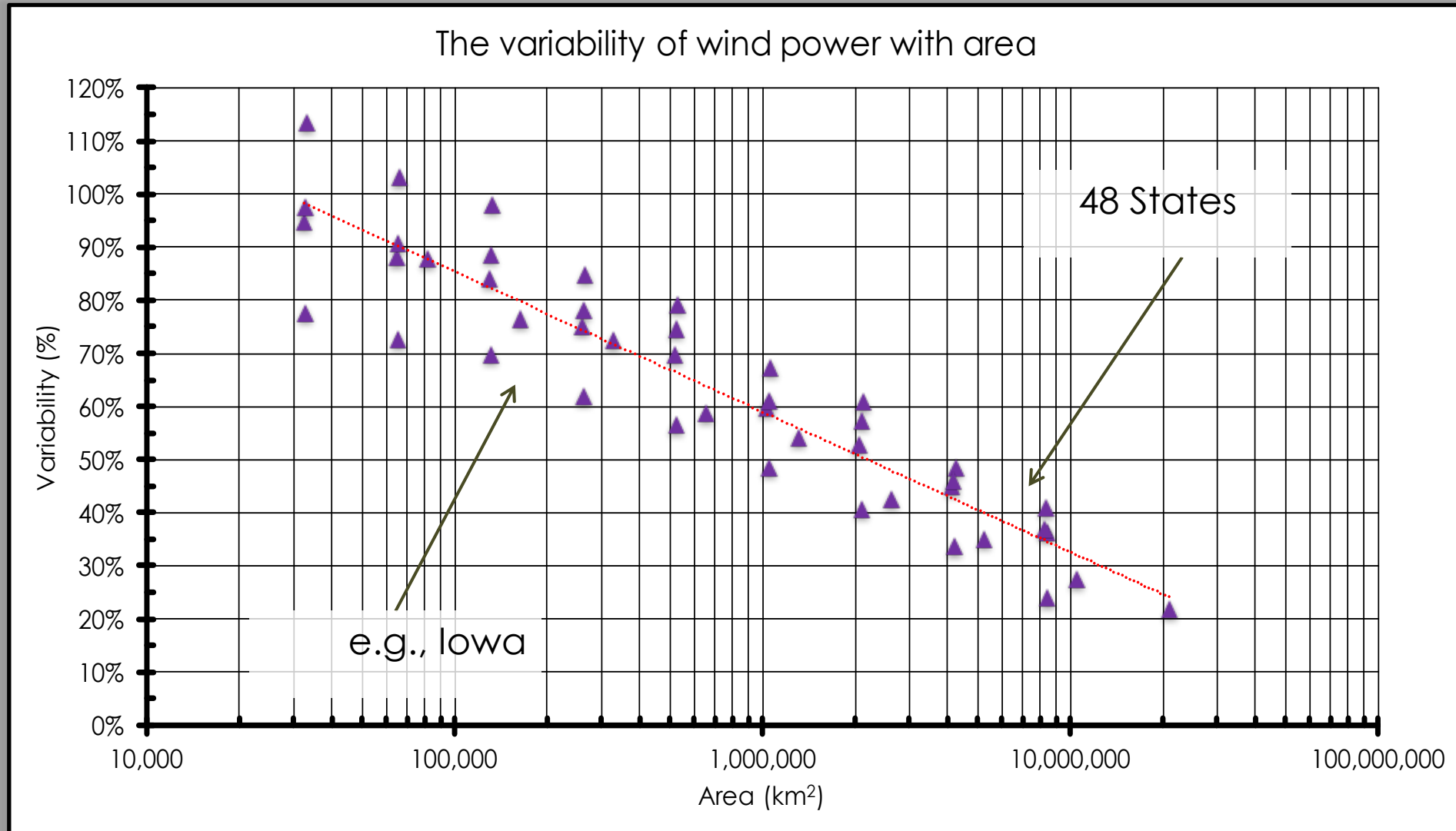
What 100% Solar Looks Like With Grid At single Home



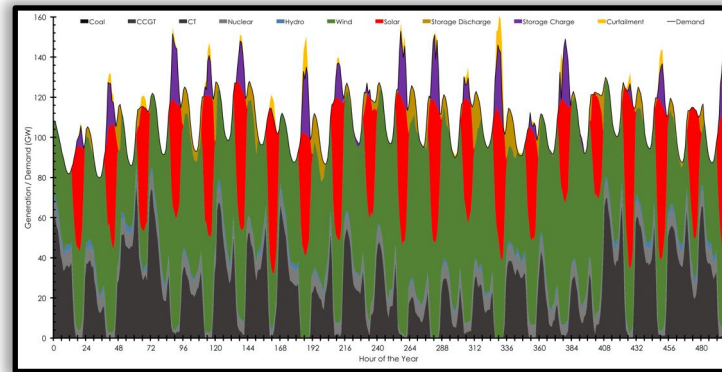
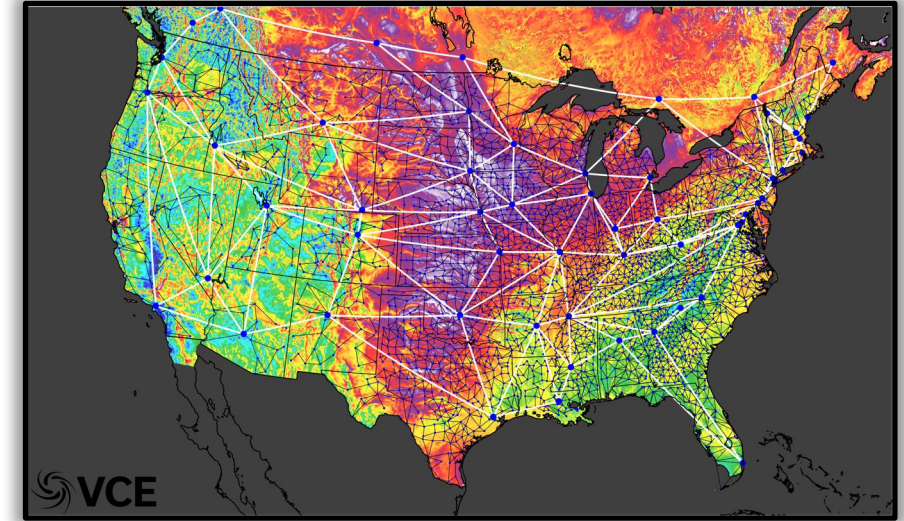
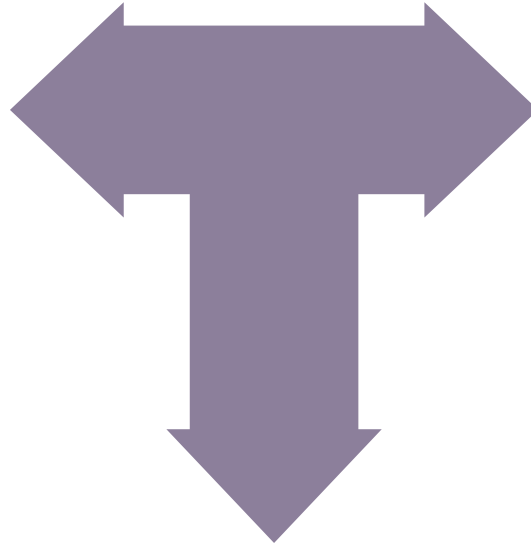
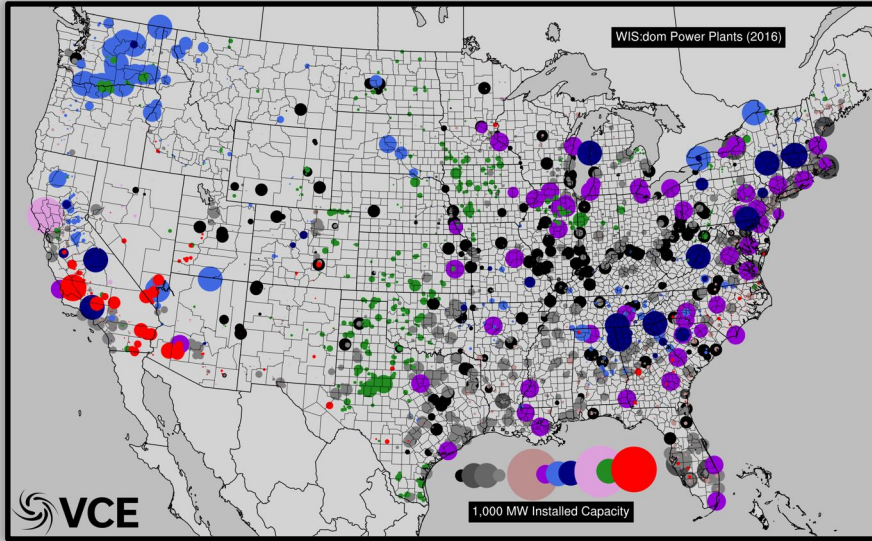
The US Is Divided Up – So Can Never See Full Picture



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



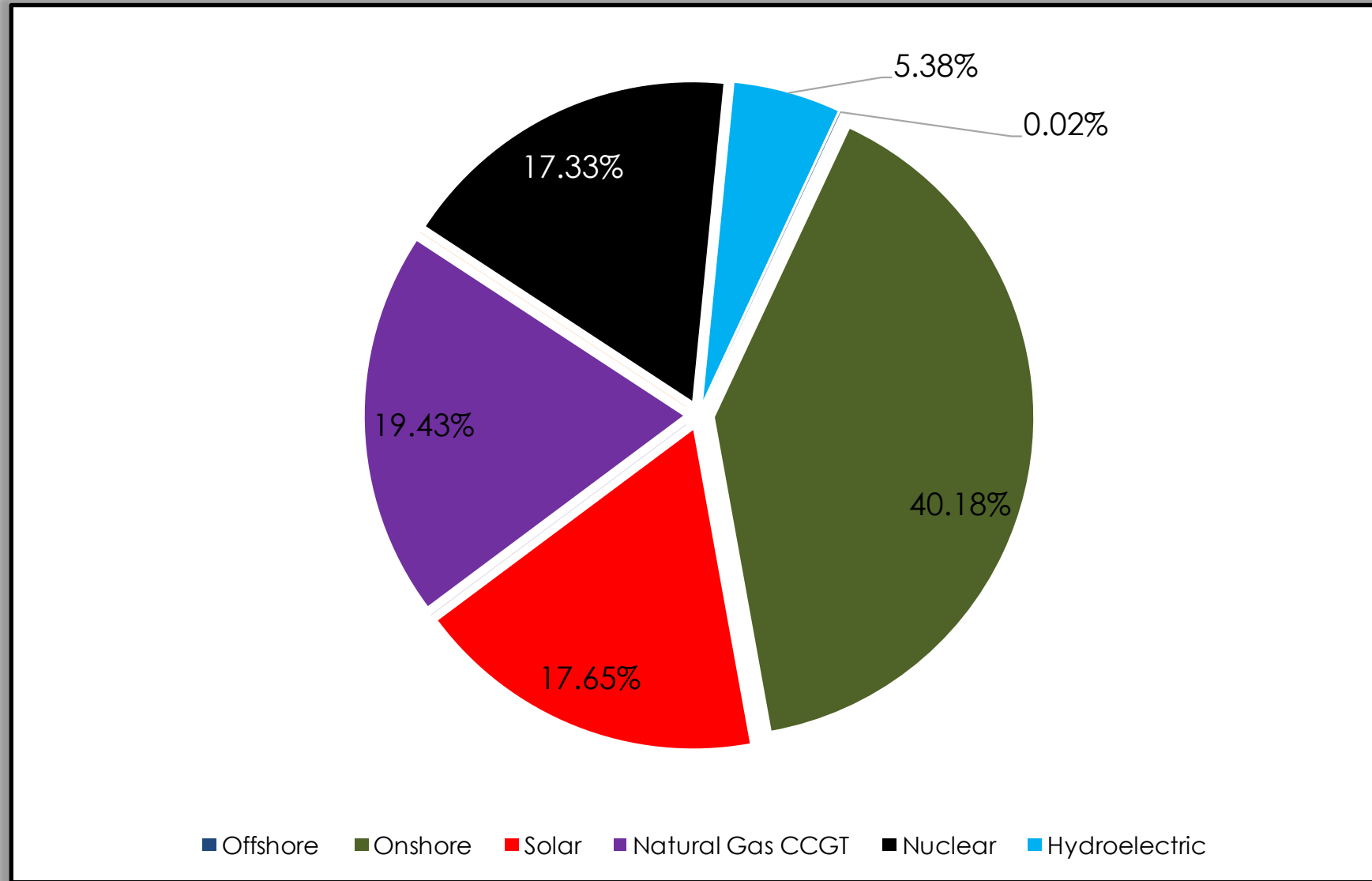
Need to consider: generation, transmission, retirements, reserves, dispatch, loads and storage



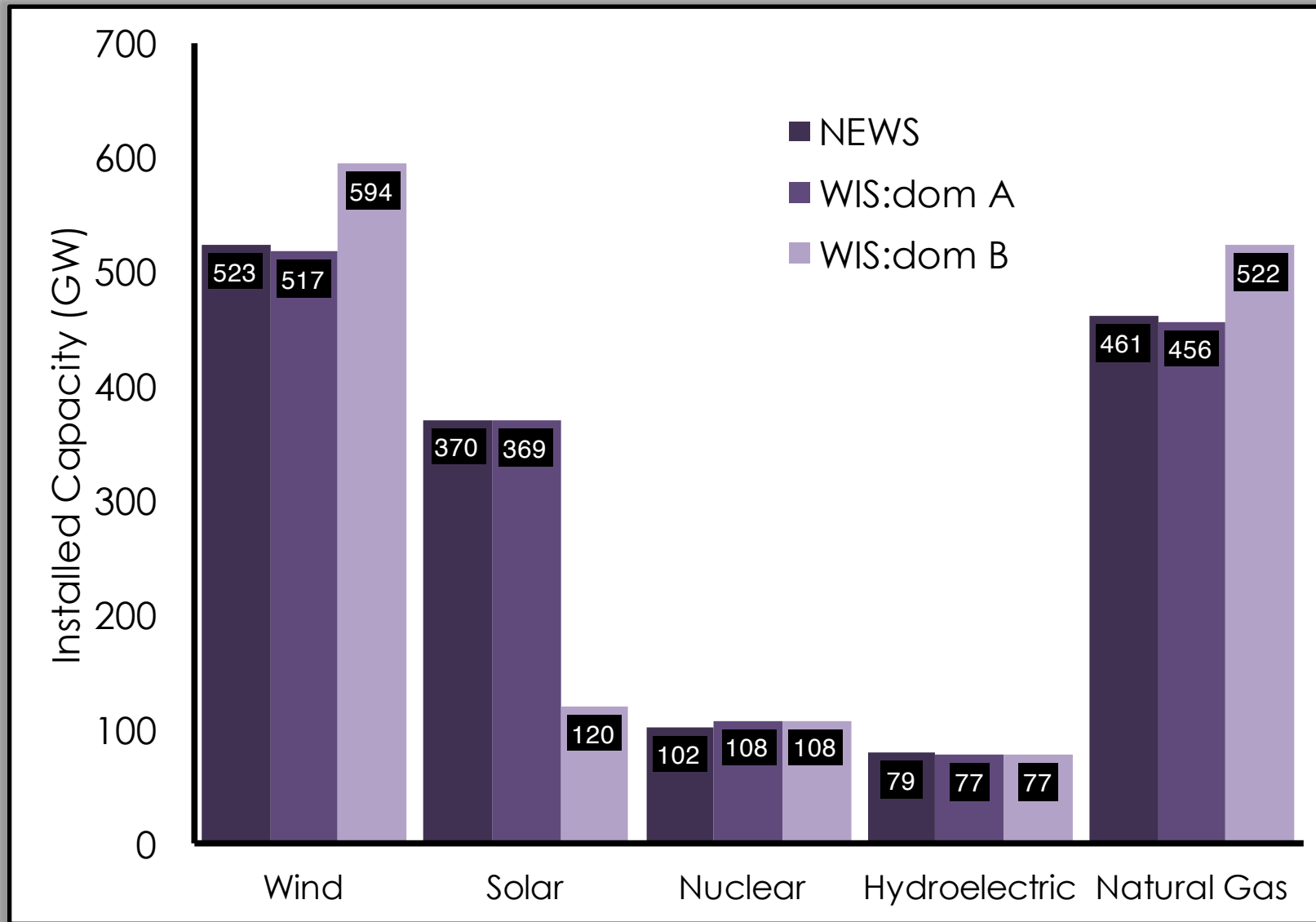
The WIS:dom Optimization Model And Atmospheric Science To Inform Future Energy Pathways

National Studies

Low-carbon electricity grid incorporates diverse generation

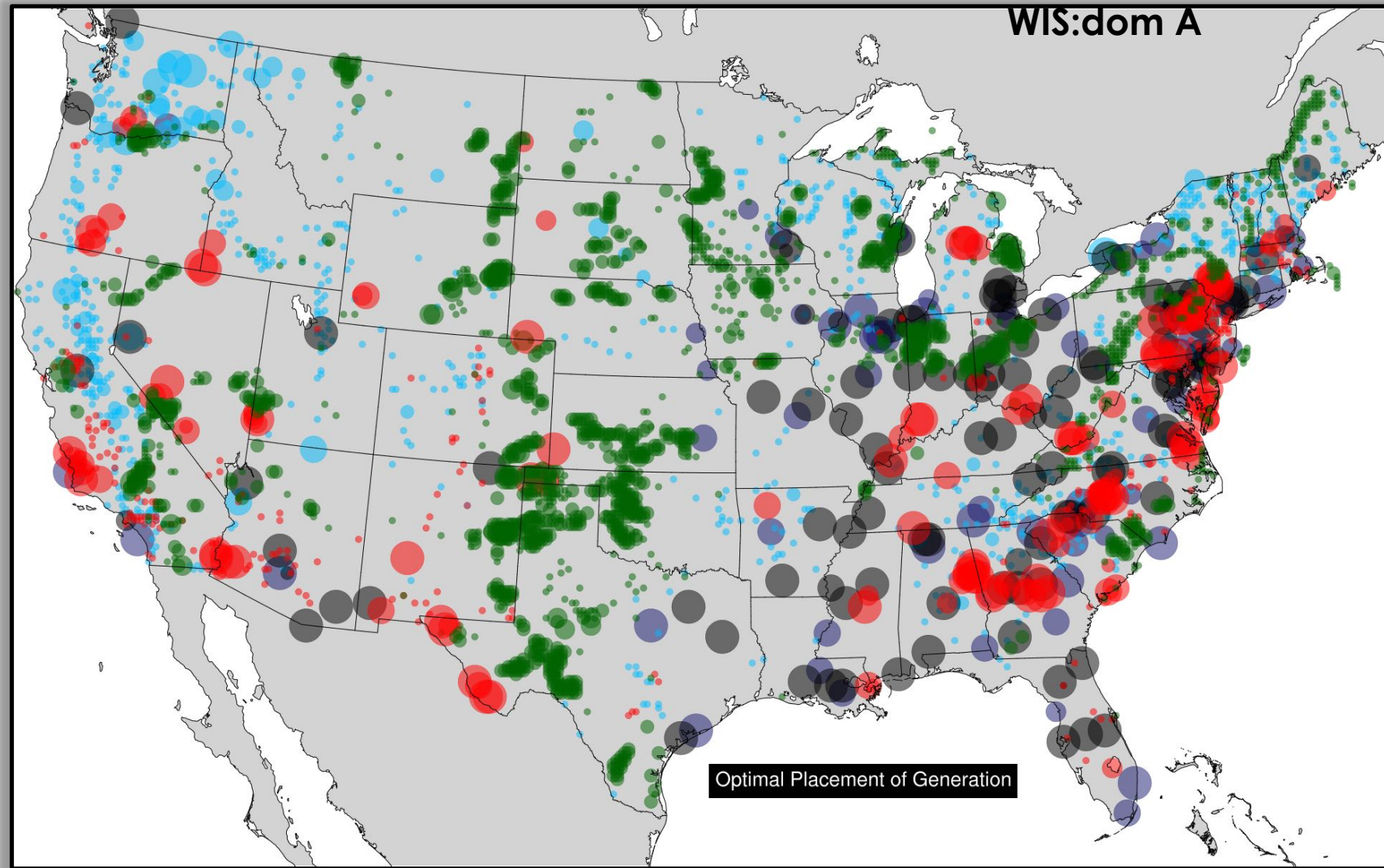


Current Policies Can Dramatically Shift Future Generation Mixes



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

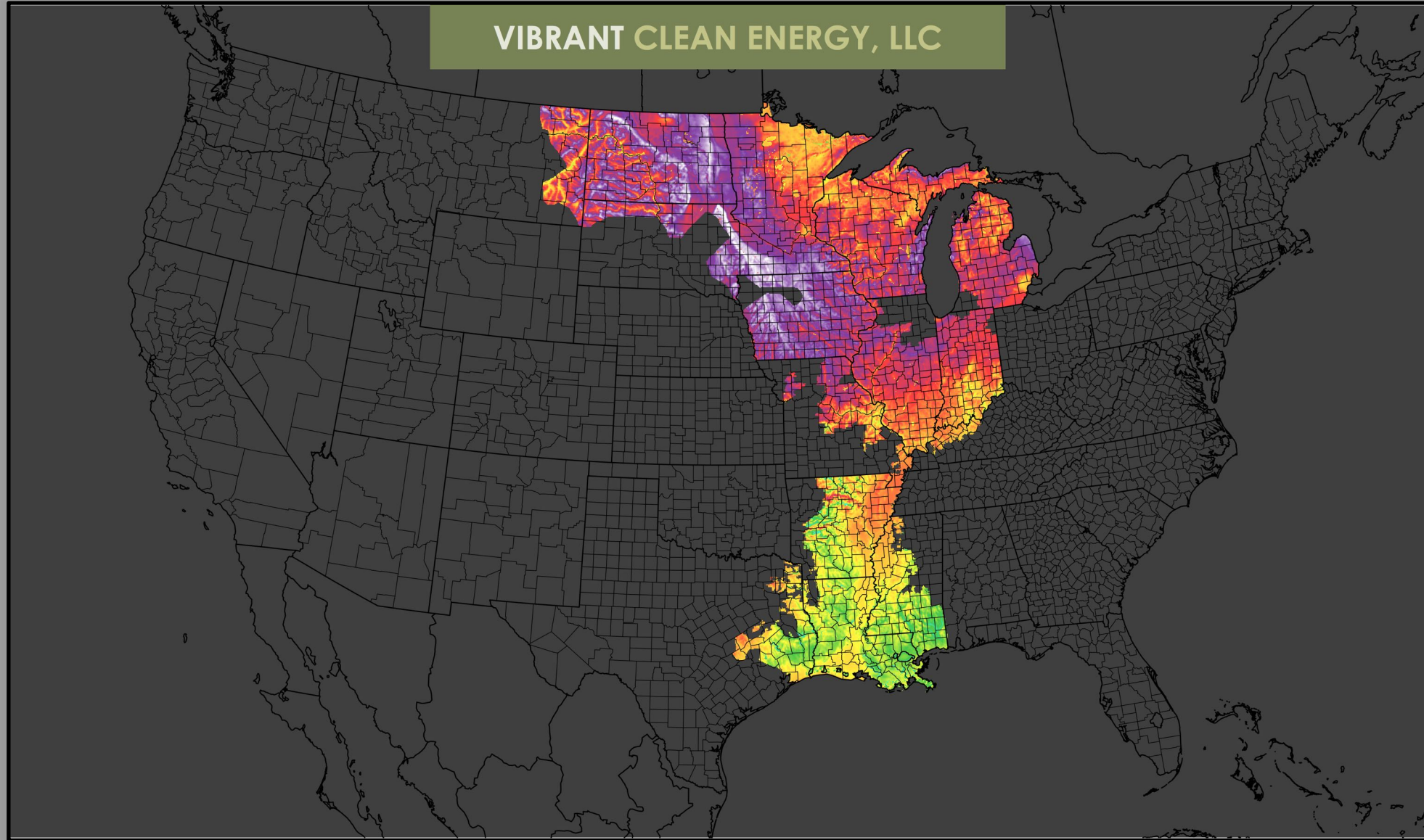
Low-carbon electricity grid can include all states



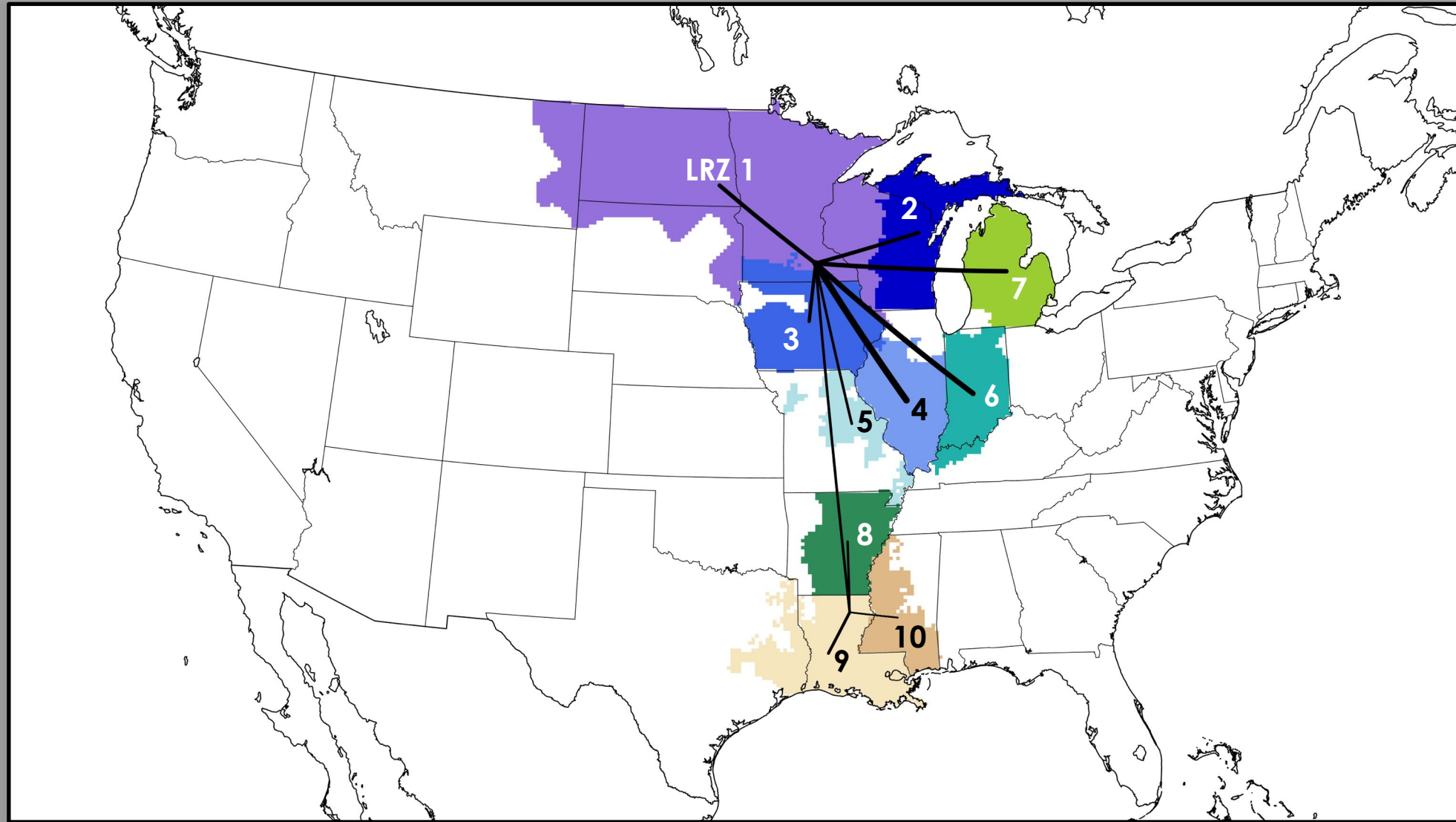
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Regional Studies - MISO

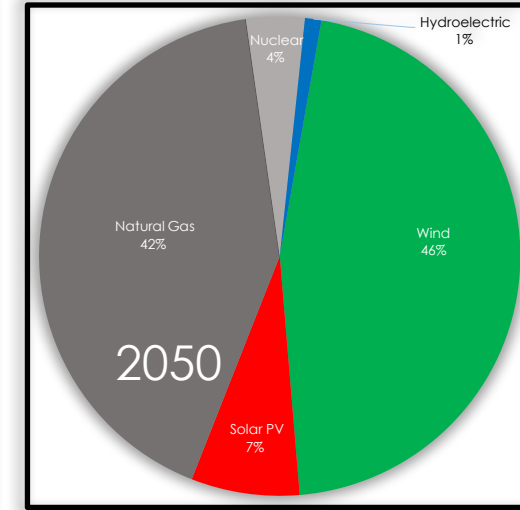
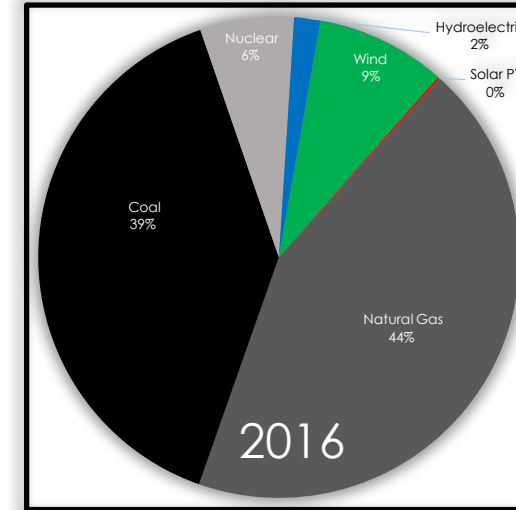
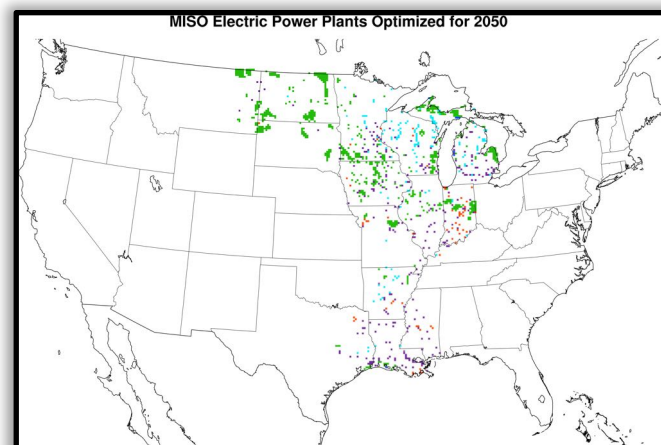
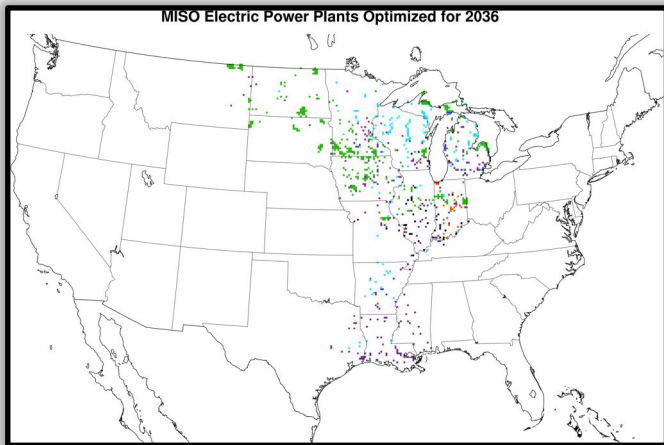
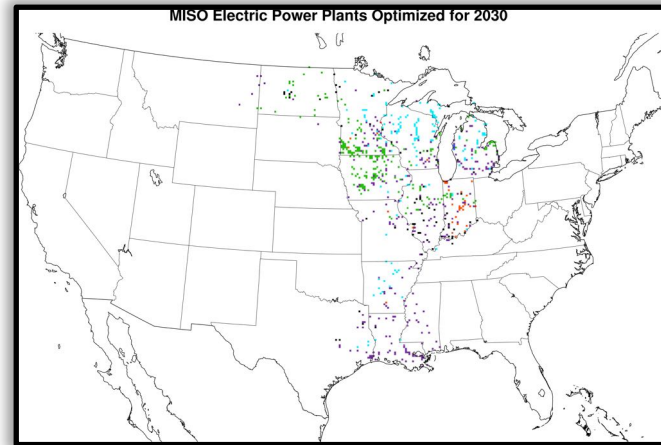
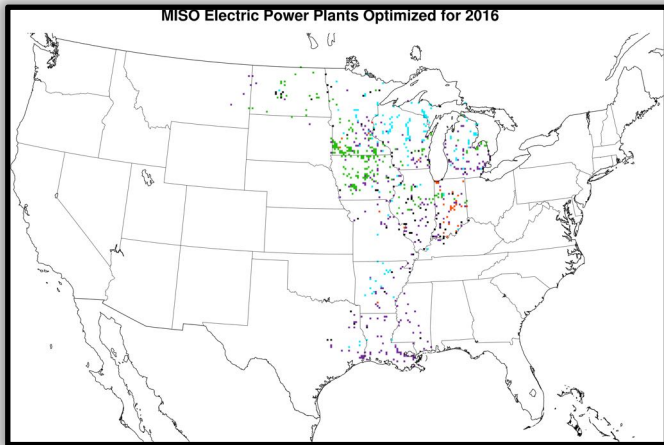
WIS:dom Has Already Been Used In MISO



WIS:dom Has Already Been Used In MISO



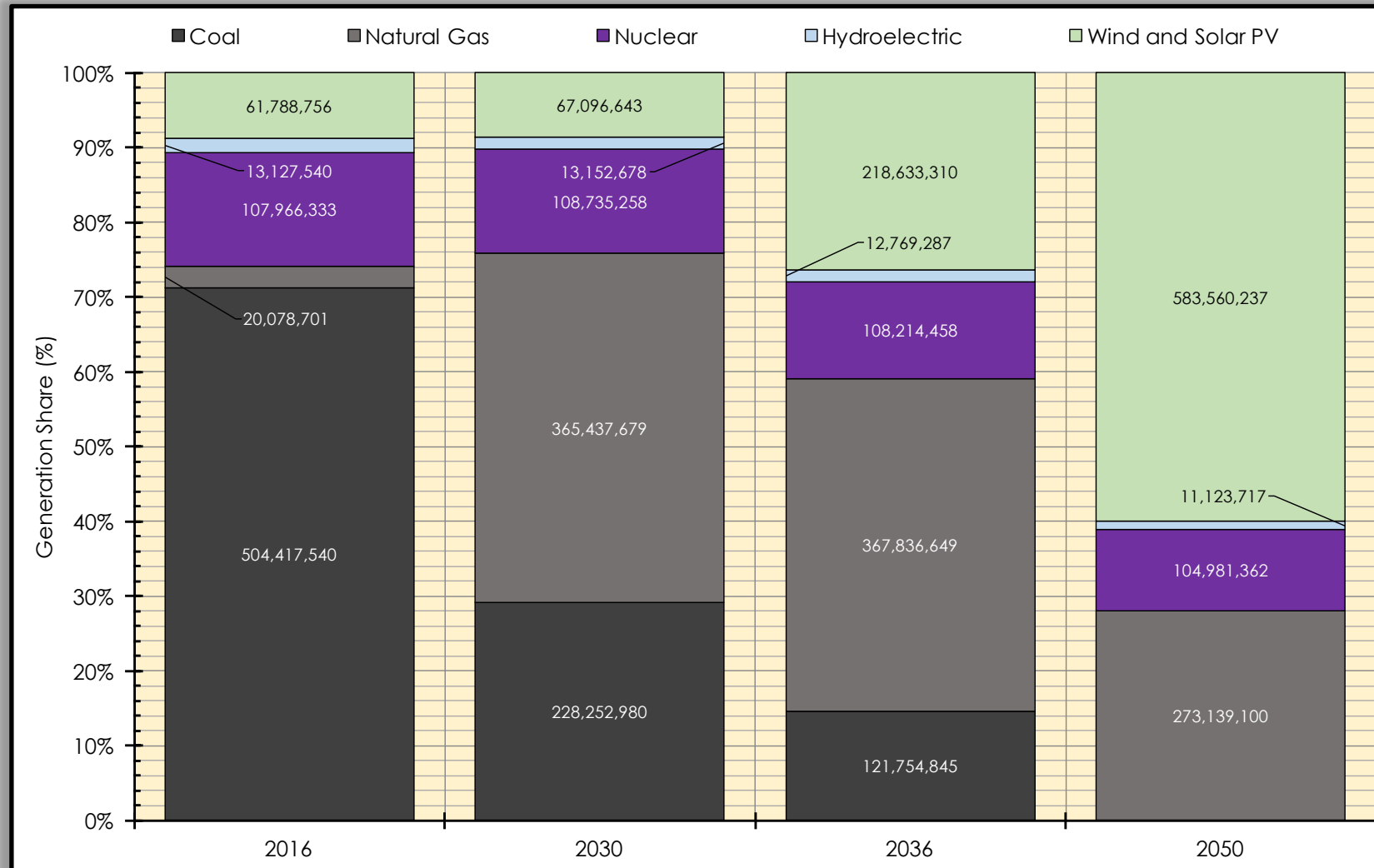
Transforming ISO/RTOs With Smarter Planning



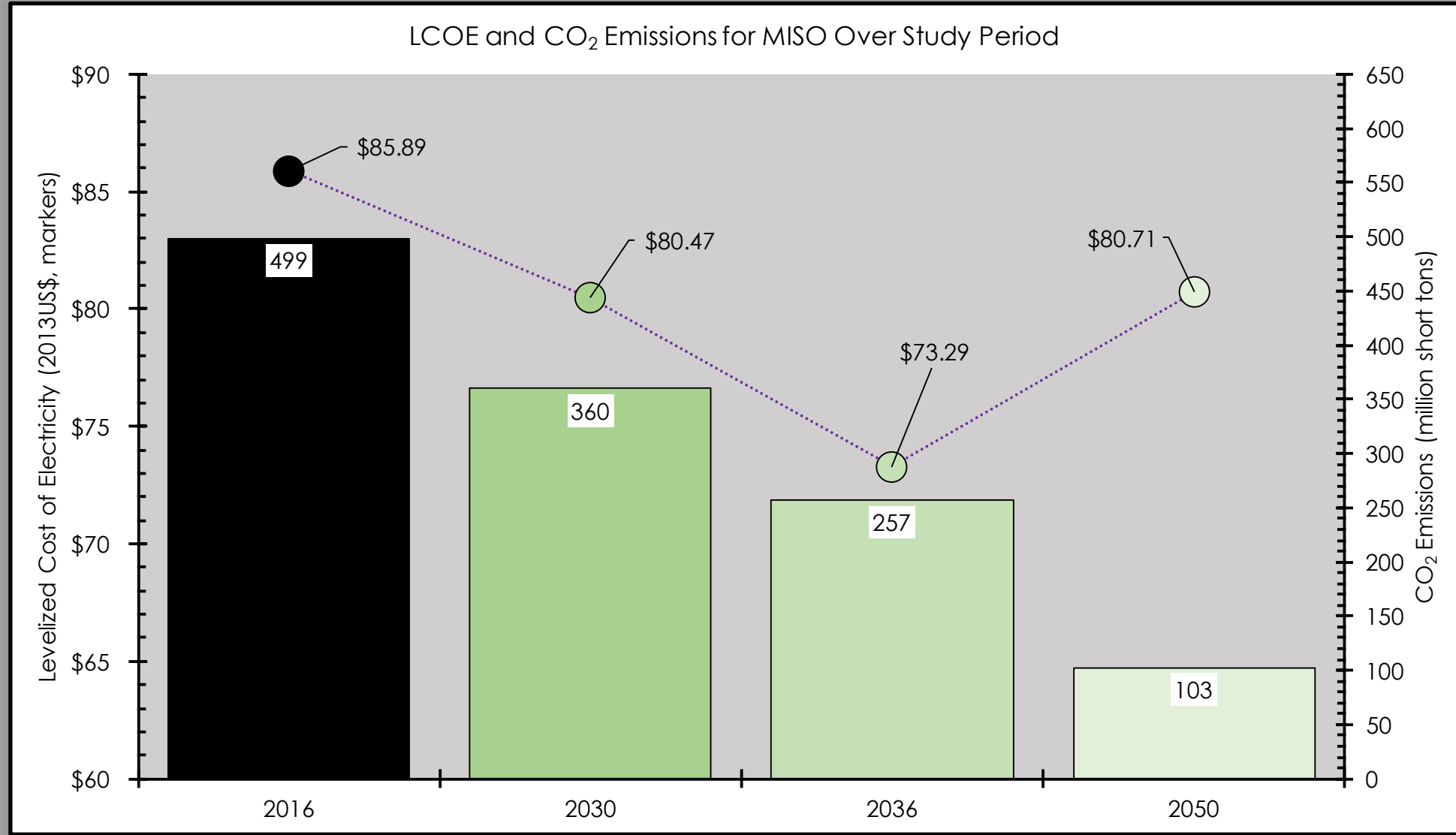
- WIS:dom was used by MISO as part of their MTEP-17 process;
- Determined grids that were constrained by carbon and baseline;
- Model outputted values, locations and developments for four time horizons;
- Results are determining the Resource Zones for MISO for the coming years.

http://www.vibrantcleanenergy.com/wp-content/uploads/2016/05/VCE_MISO_Study_Report_04252016.pdf
<https://www.misoenergy.org/Events/Pages/MTEP17Futures20160428.aspx>

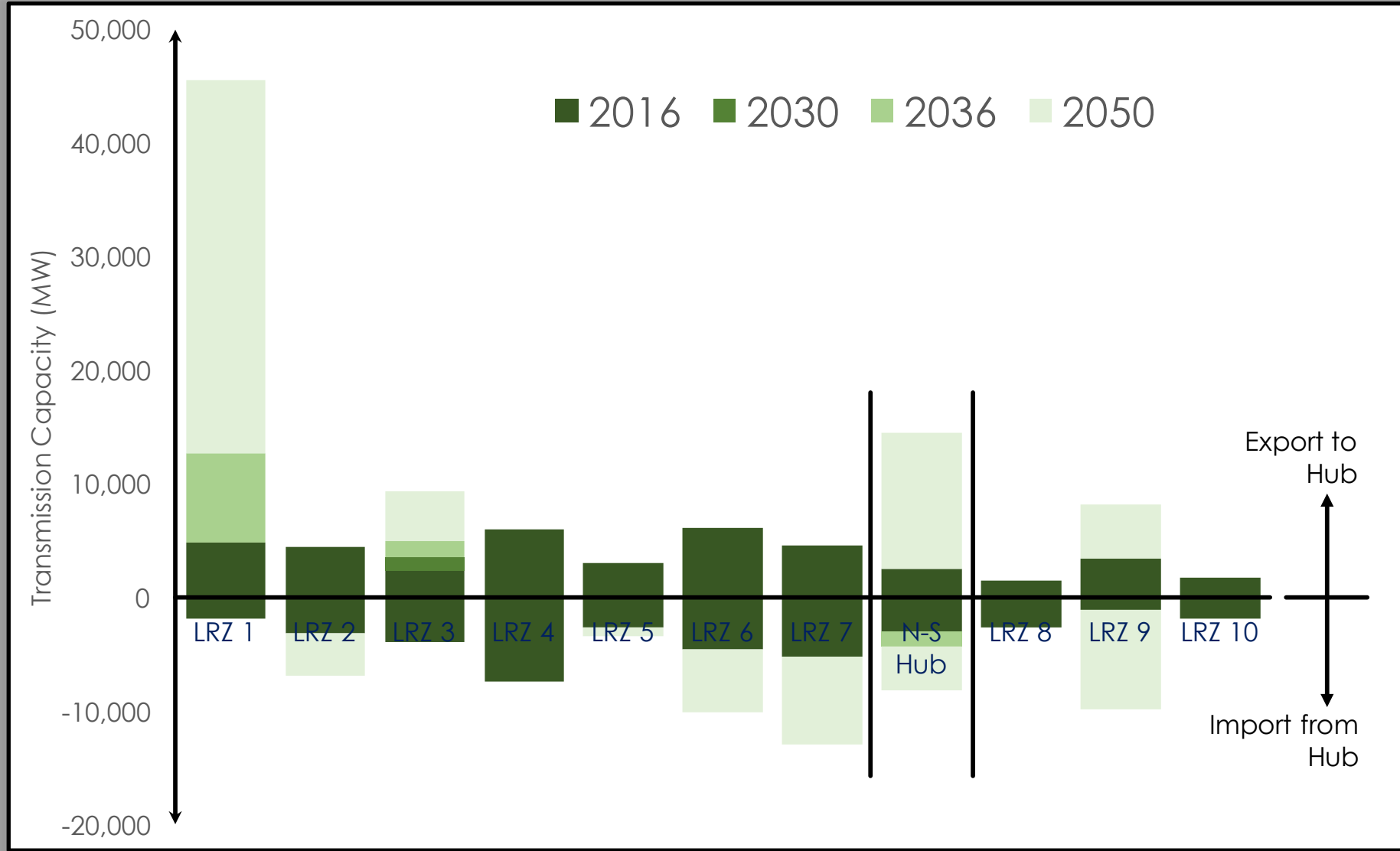
Emissions Can Be Dramatically Reduced



Cost Can Be Lower Than Today With Careful Planning



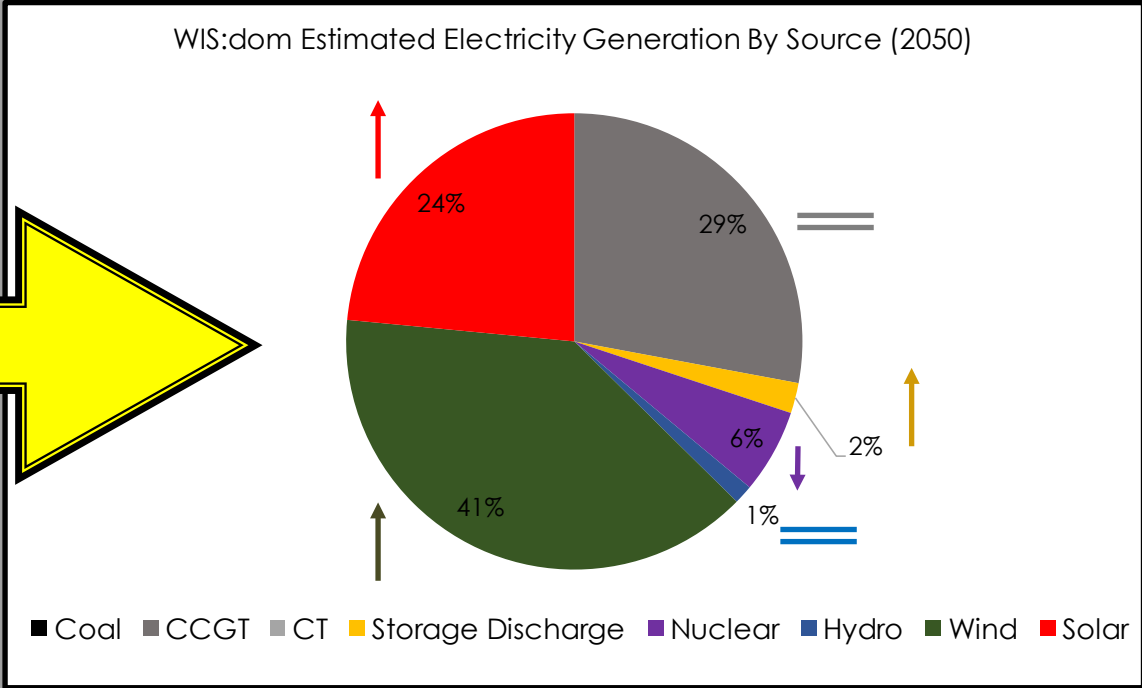
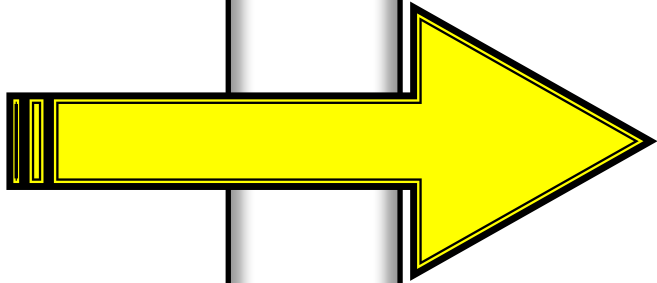
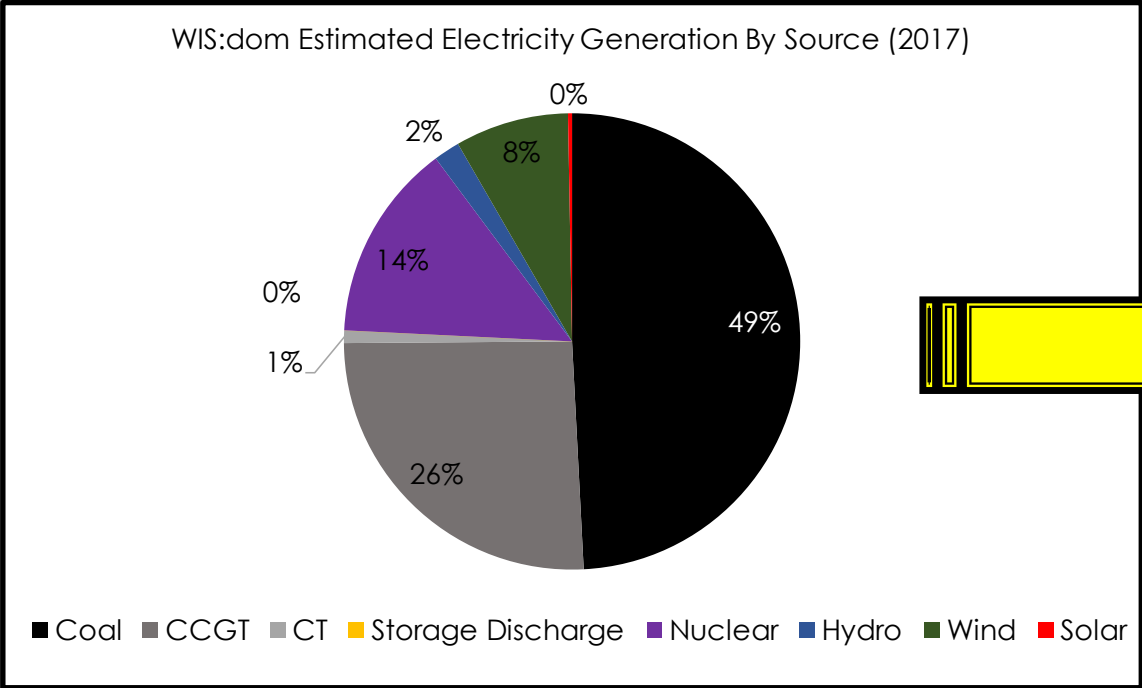
Need Transmission For Large Expansion Of Wind & Solar



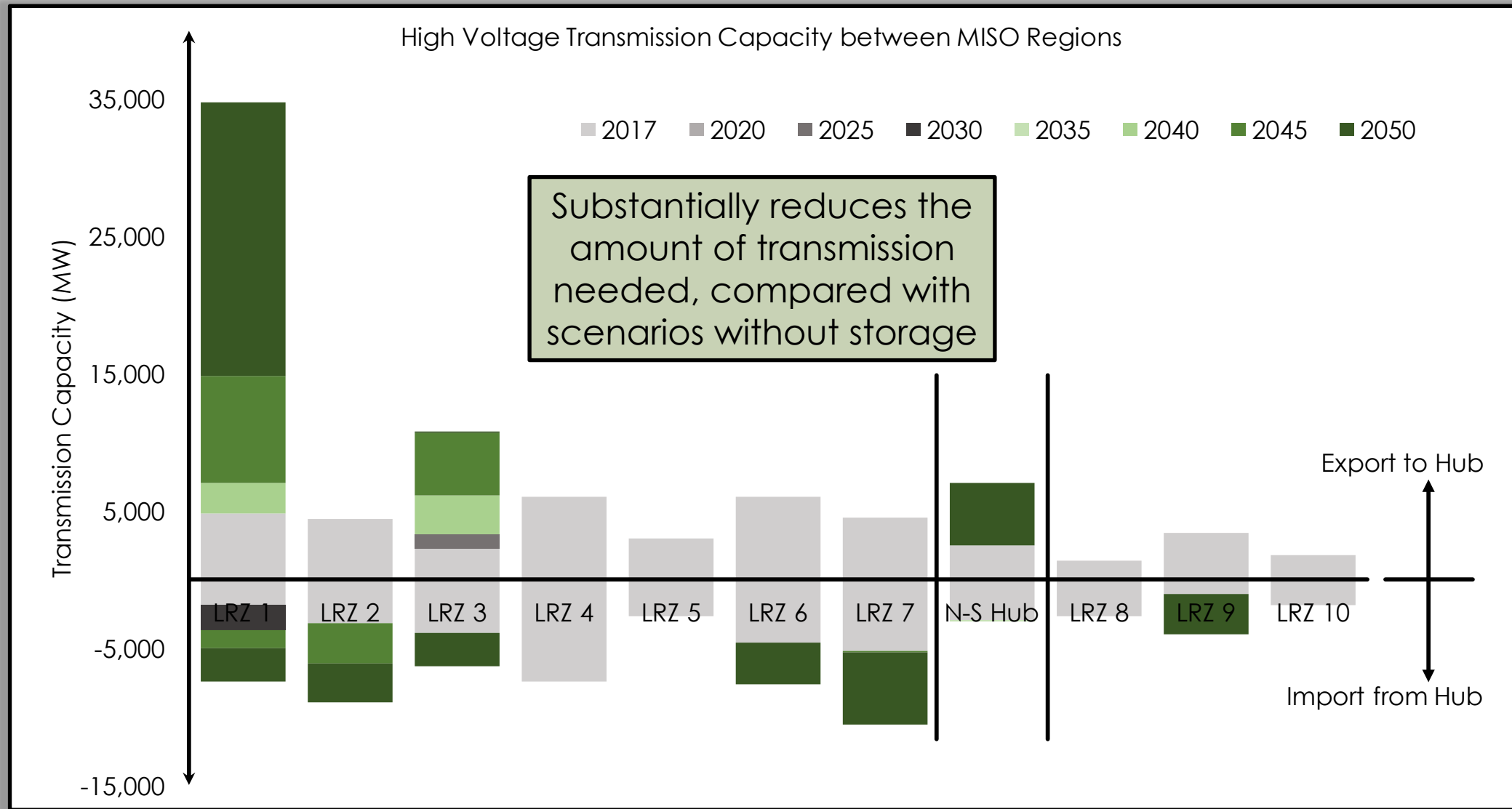
The WIS:dom Optimization Model And Atmospheric Science To Inform Future Energy Pathways

Regional Studies – MISO with storage

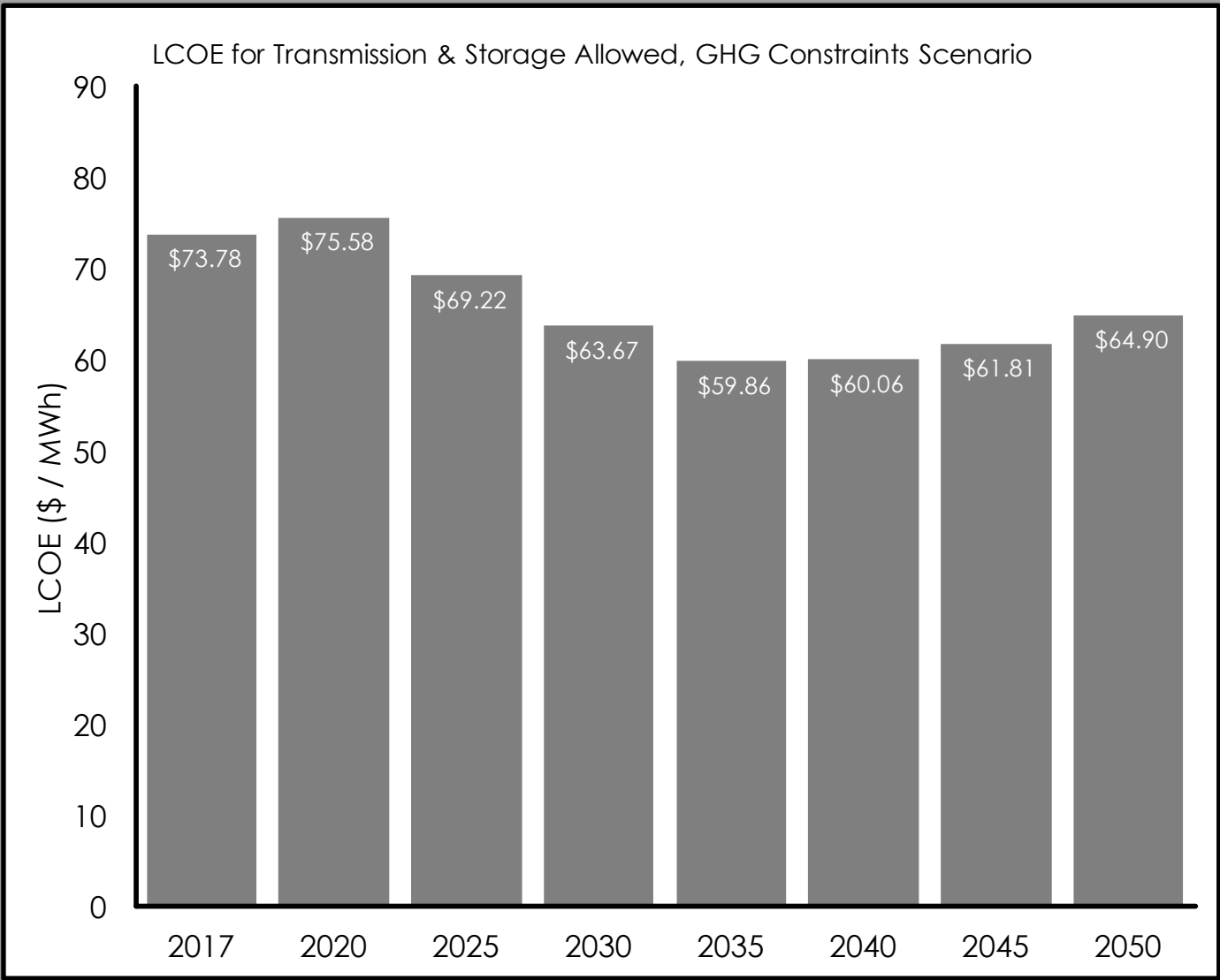
Addition Of Storage Increases VRE, If Planned Properly



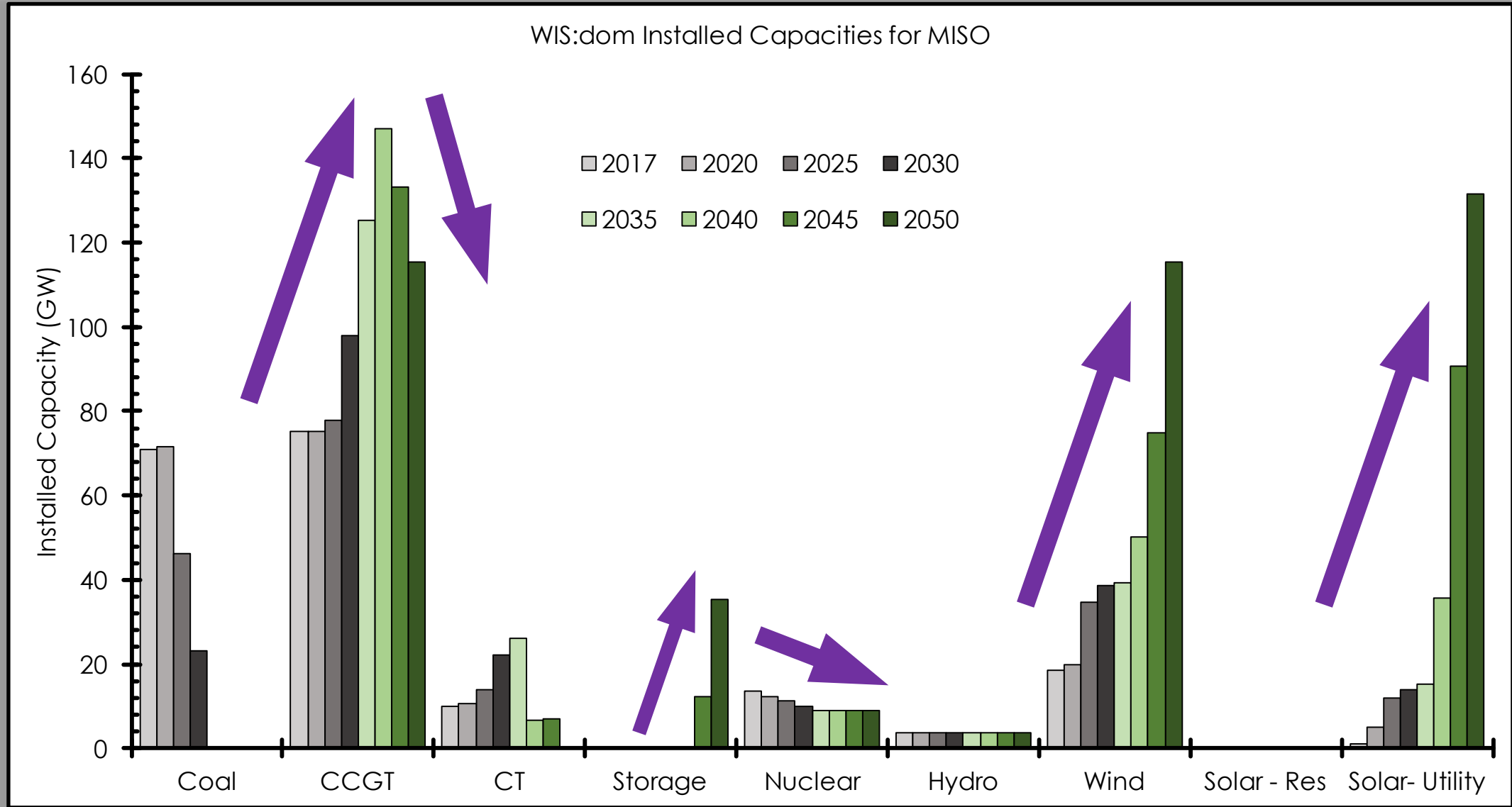
With Smarter Planning, Still Need Transmission, But Much Less



Costs Are Reduced By Storage



The Transition Takes Time And Markets Must Evolve Along Way



QUESTIONS?



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