

100% Renewable Energy: *Distraction or Inevitable?*

Prepared By:

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Prepared For:

2019 Western Water & Energy Forum

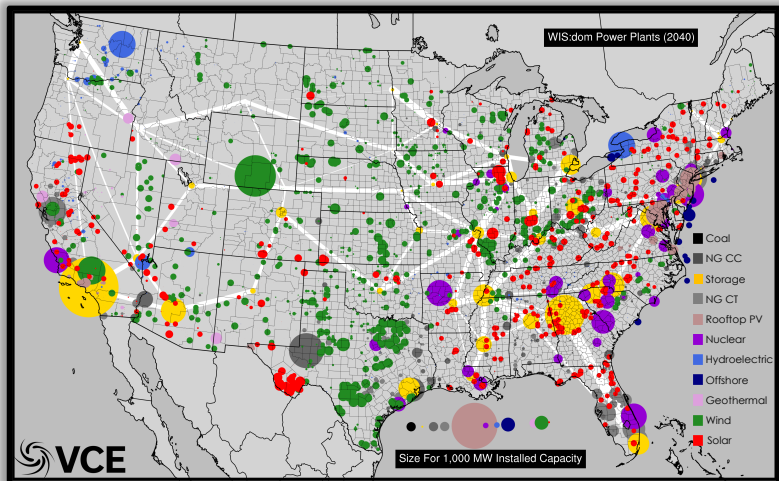
Steamboat Springs, Colorado

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Vibrant Clean Energy

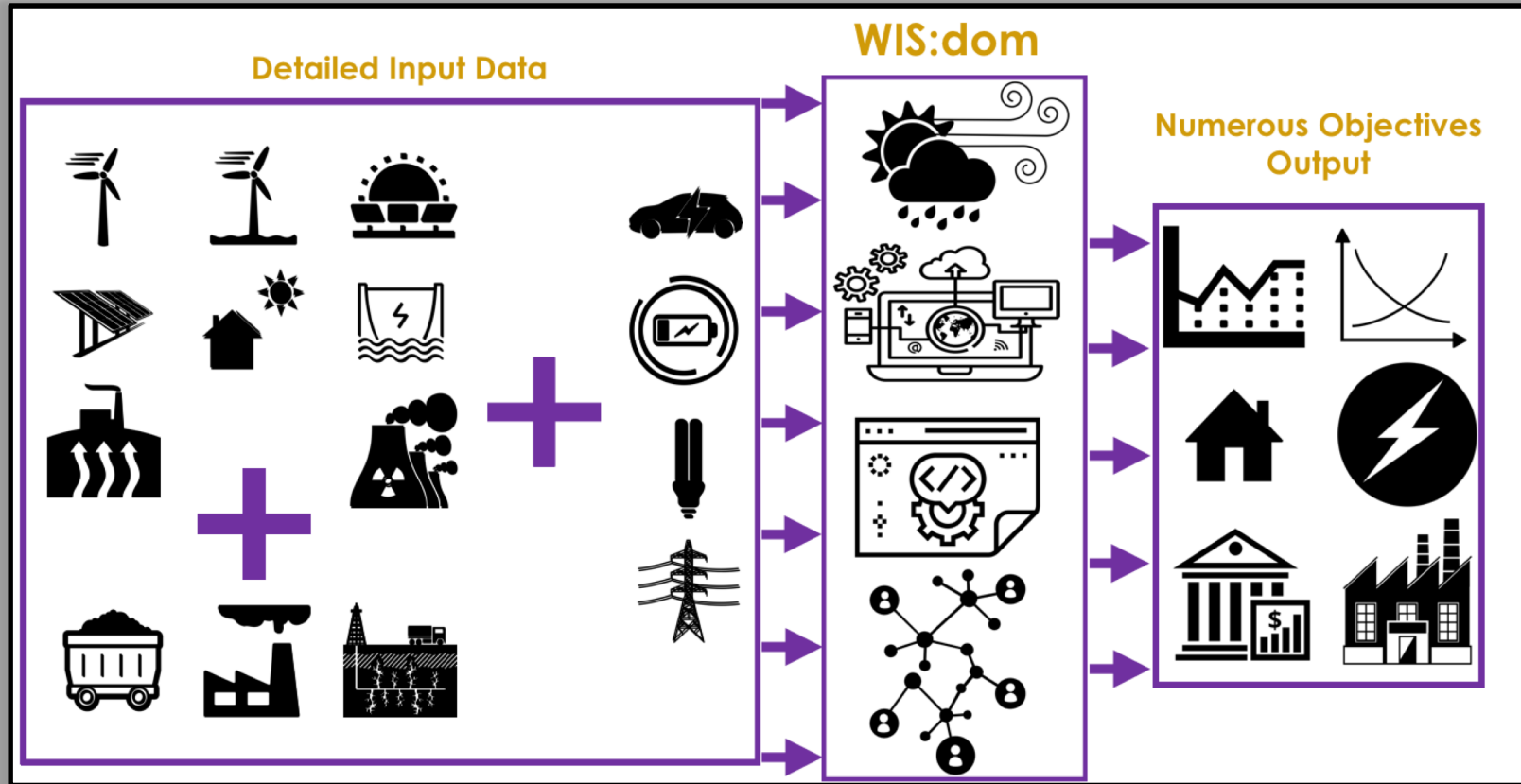


Purpose of Vibrant Clean Energy, LLC:

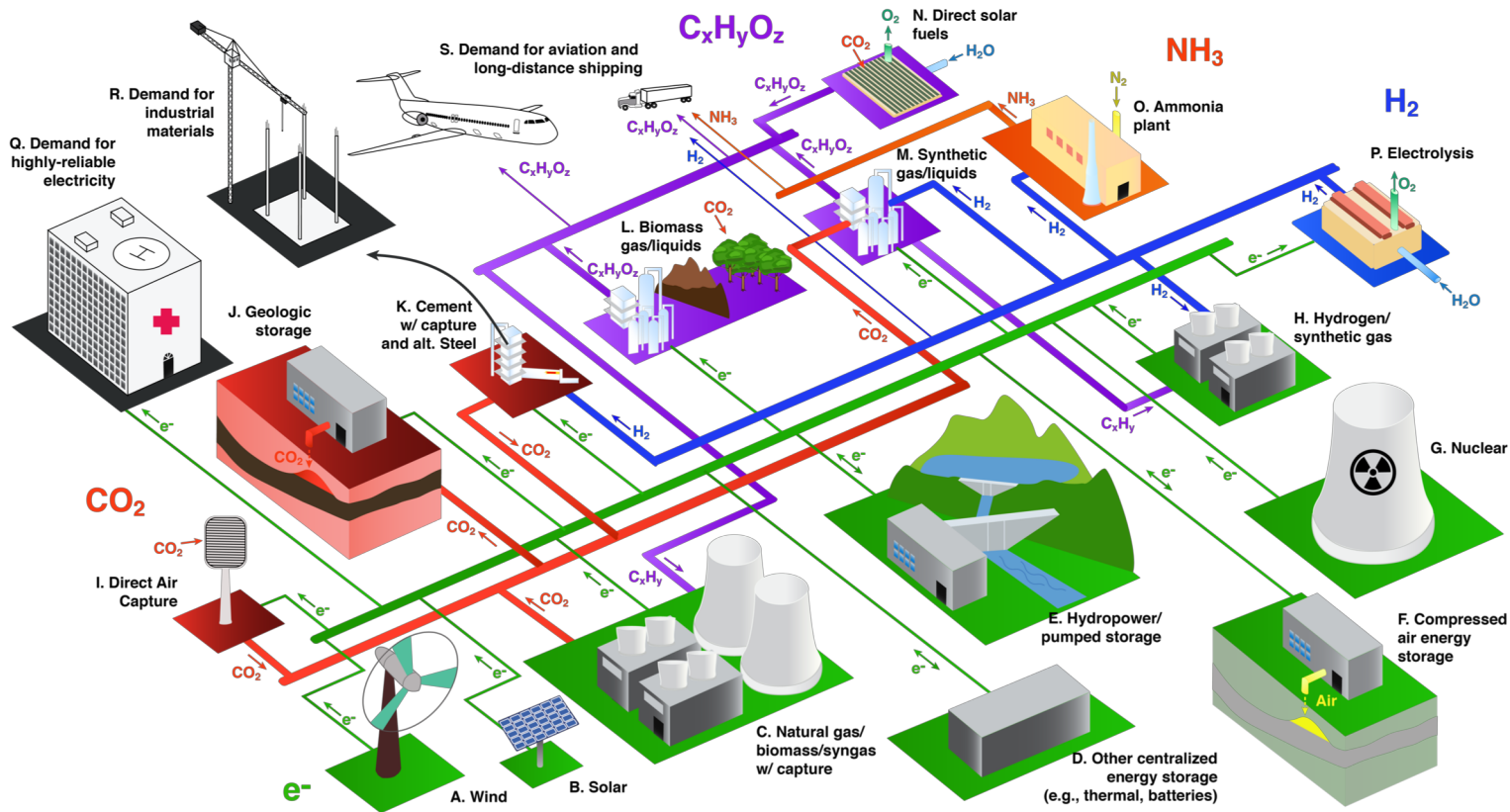
- **Reduce the cost of electricity** & help evolve economies to near zero emissions;
- **Co-optimize** transmission, generation, storage, & distributed resources;
- Increase the understanding of **how Variable Generation impacts & alters the electricity grid** and model it more accurately;
- **Agnostically determine the least-cost portfolio** of generation that will remove emissions from the economy;
- Model the **electrification** of industry, heating & transportation;
- License WIS:dom optimization model and/or perform studies using the model;
- Assist clients **unlock and understand the potential** of high VRE scenarios, as well as zero emission pathways.



The WIS:dom Model (All US @ 3-km, 5-min to 2050)



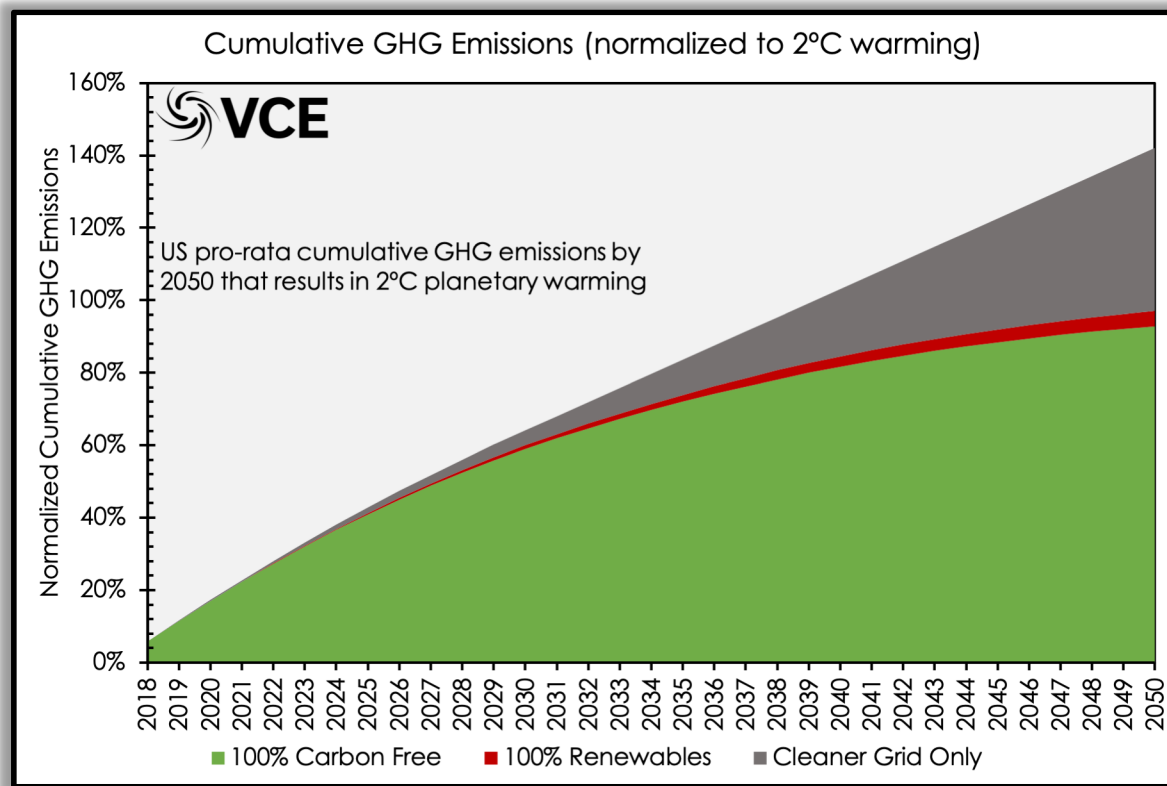
The Scale / Potential of the Energy System



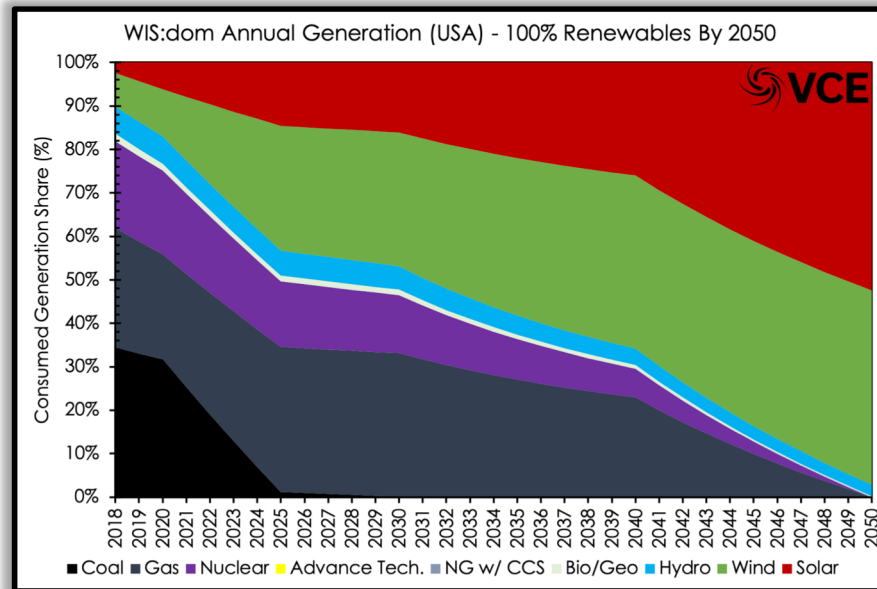
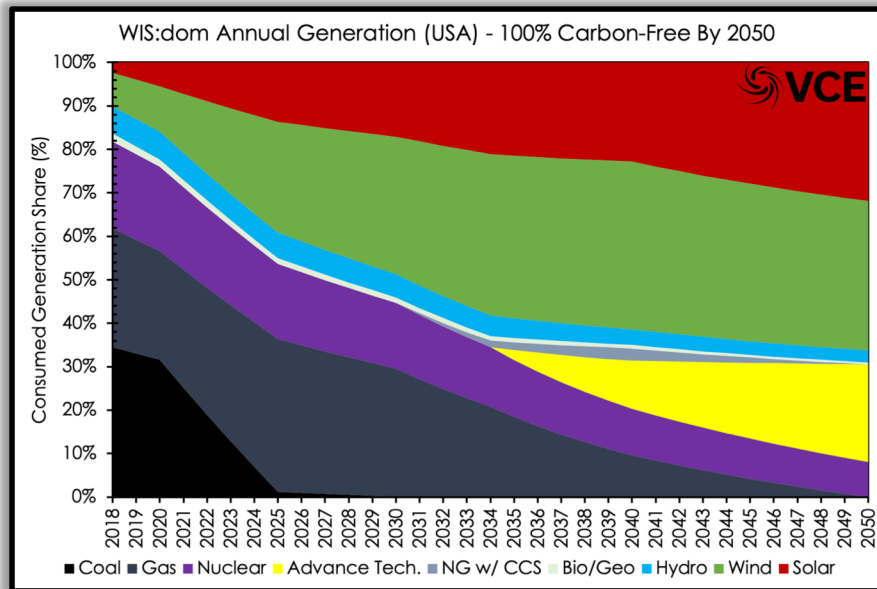
Davis et al., Science 2018.

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We Must Reduce Emissions To Halt Climate Change

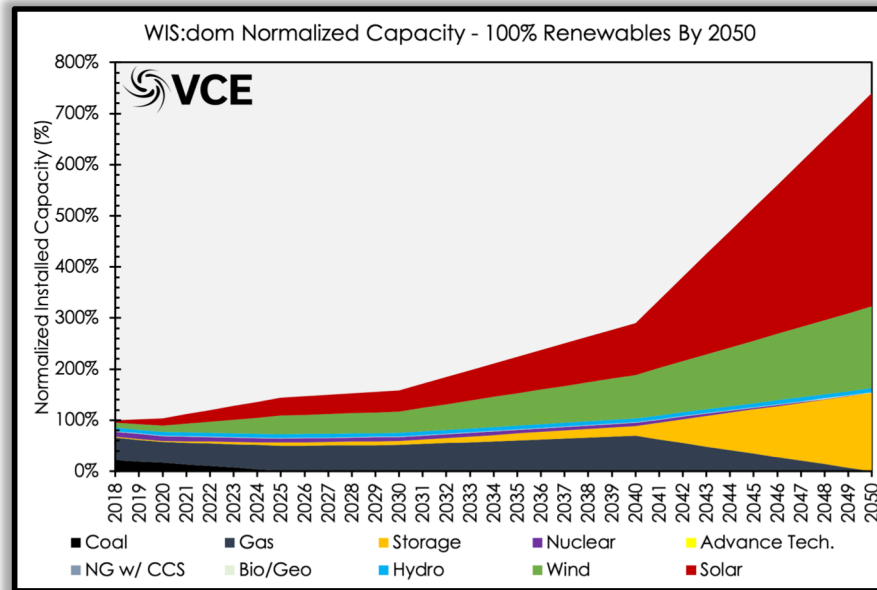
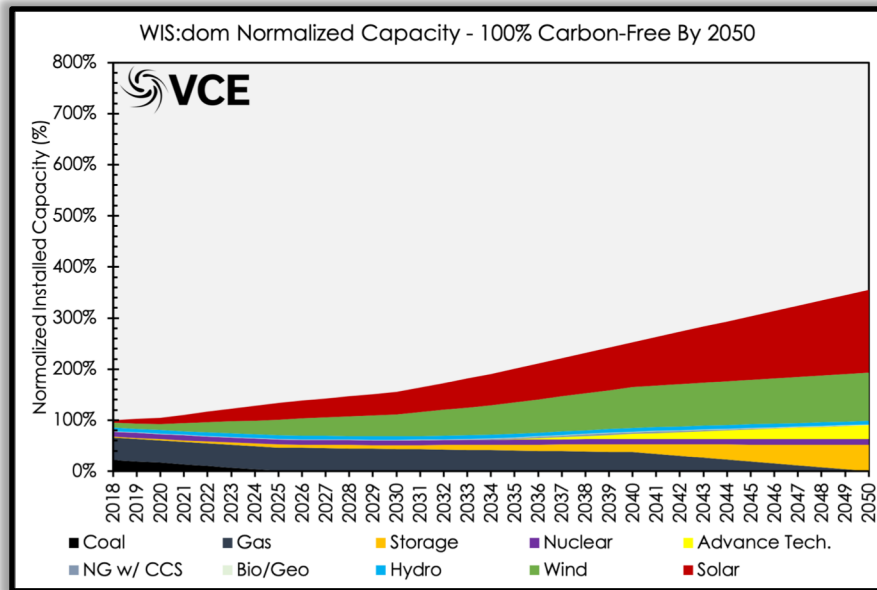


100% Carbon-Free & 100% RE Have Different Outcomes



Need to determine the trade-off between approaches and rationally determine which is better at achieving our goals

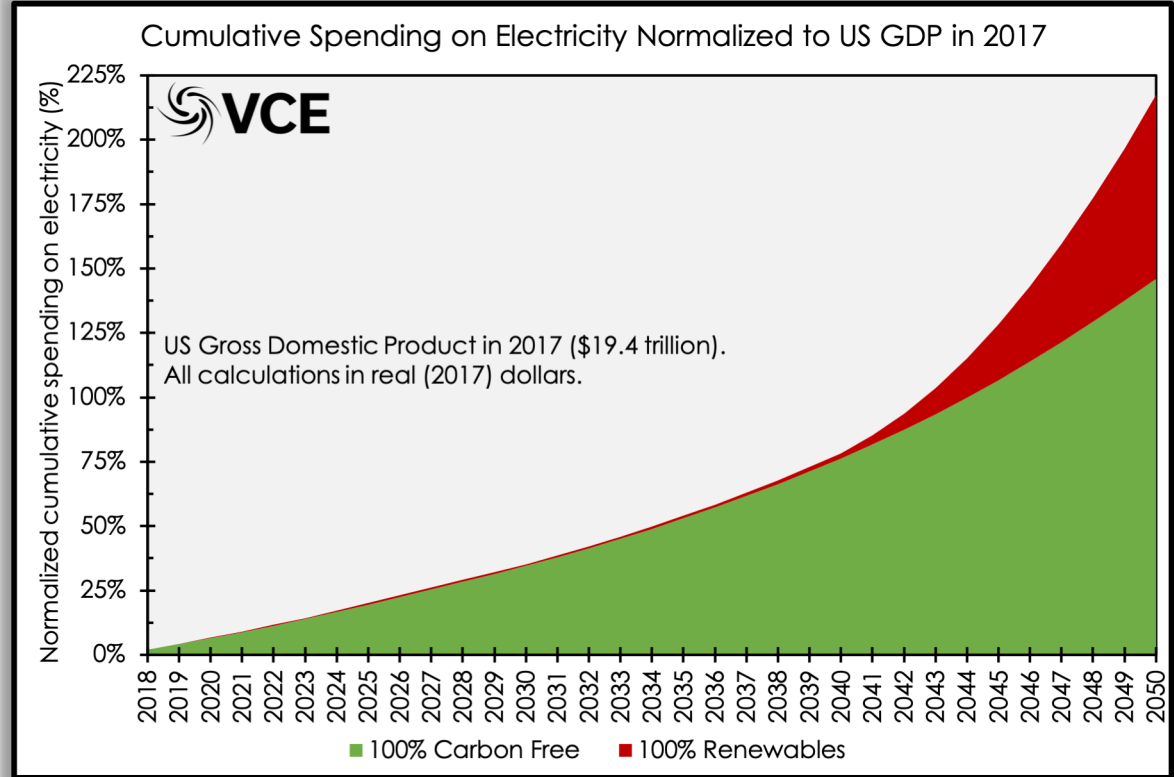
100% Carbon-Free & 100% RE Have Different Outcomes



We include new HVDC transmission, demand-side resources for flexibility (50%+ by 2050), energy storage, hydrogen production, ammonia production, electrification of heating, electrification of transportation, electrification of industry, aggressive energy efficiency, and more for both scenarios.

At What Cost is 100% Clean or 100% RE “Feasible”?

- *Is over-building environmentally prudent?*
- *Are advanced technologies going to arrive in time?*
- *Can we build enough transmission?*
- *Can we operate the system given climate changed resources and forecast errors?*
- *Do we need to do anything differently now?*



Thank You

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