

Making Sense of the Western Grid: *Is a Regional Solution Possible?*

Prepared By:

Vibrant Clean Energy, LLC
Dr Christopher T M Clack

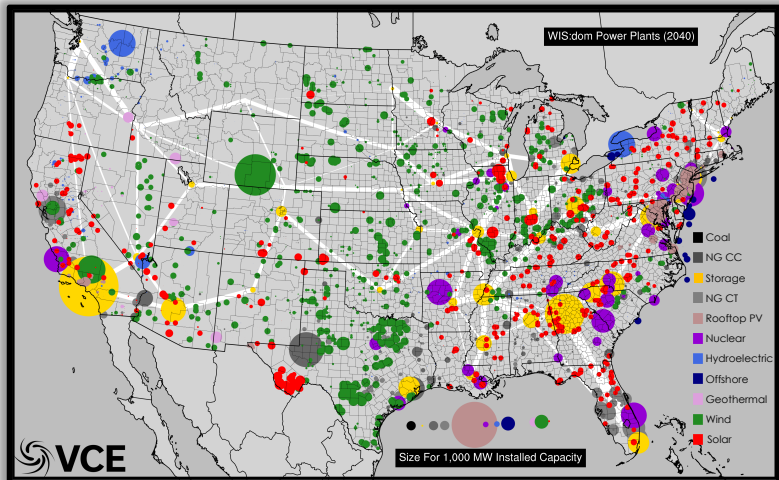
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Vibrant Clean Energy



Purpose of Vibrant Clean Energy, LLC:

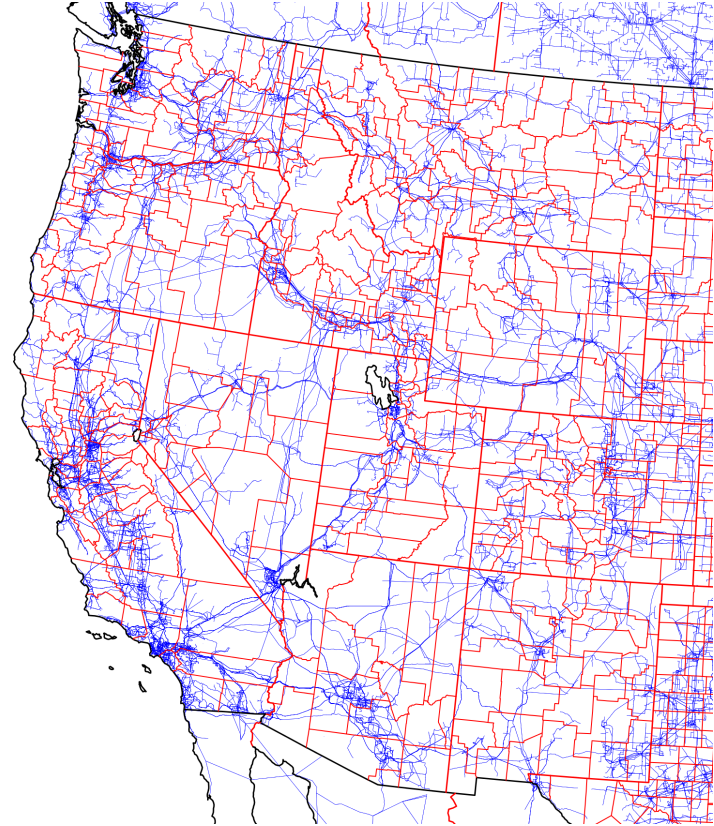
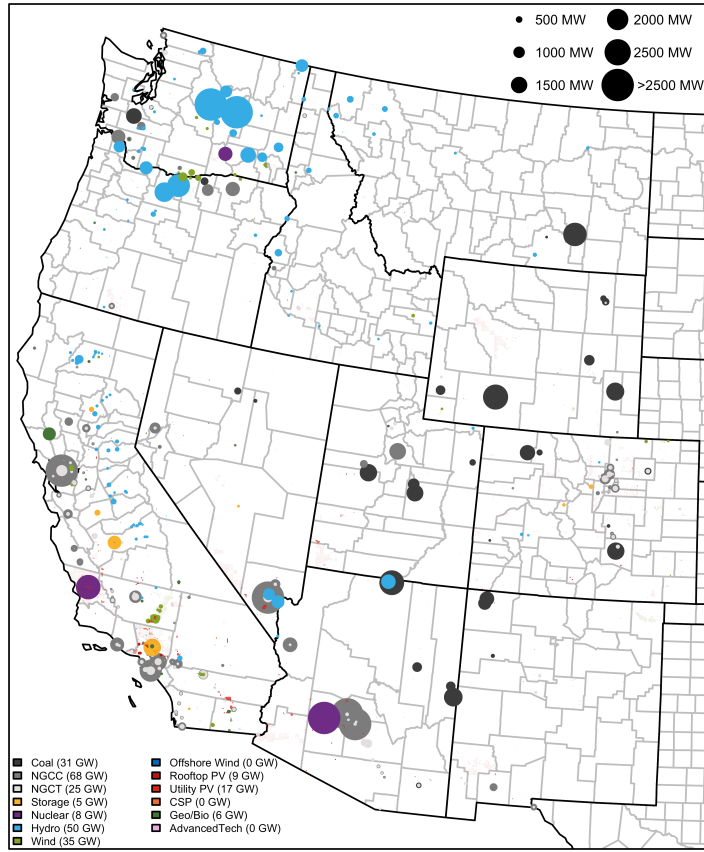
- **Reduce the cost of electricity** & help evolve economies to near zero emissions;
- **Co-optimize** transmission, generation, storage, & distributed resources;
- Increase the understanding of **how Variable Generation impacts & alters the electricity grid** and model it more accurately;
- **Agnostically 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.



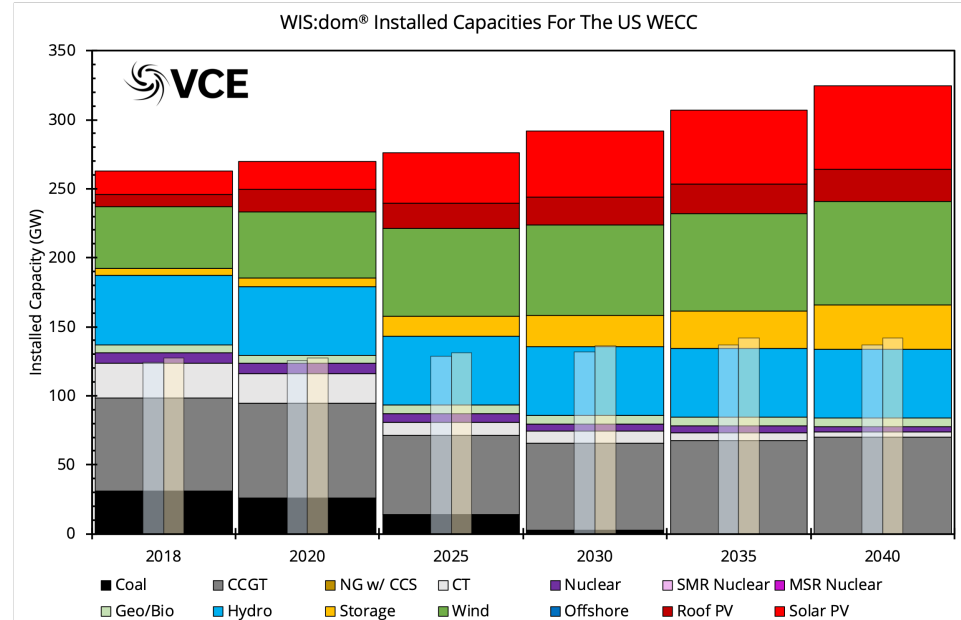
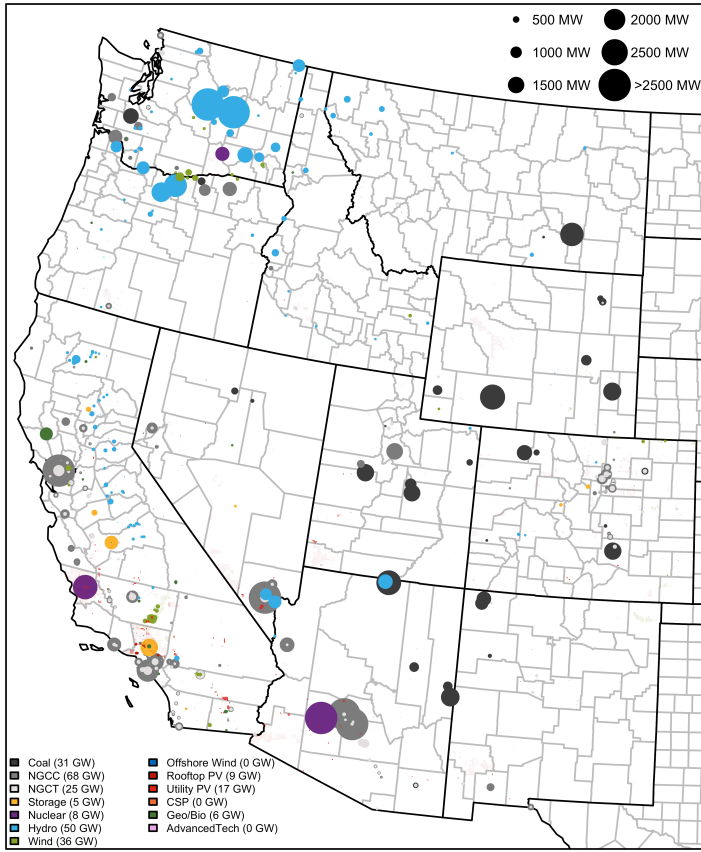
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Iteration 28 did 2 central corrections 1225 vars
Refinement: orig 4.66e+08, refined 4.66e+08, target 3.64e+09, 0 iter
28 -2.570101e+11 2.308001e+11 6.14e+09 0.00e+00 3.25e+10 4.00e+01
2854.51s (216827.49 ticks) for iteration (1332.01s, 314223 Mflops for lin. solve)
Iteration 29 did 3 central corrections 1462 vars
Refinement: orig 9.76e+08, refined 9.76e+08, target 3.13e+09, 0 iter
29 -2.594378e+11 2.321702e+11 5.20e+09 0.00e+00 3.25e+10 4.10e+01
2894.01s (216200.25 ticks) for iteration (1329.56s, 314623 Mflops for lin. solve)
Iteration 30 did 10 central corrections 1100 vars
Refinement: orig 1.13e+08, refined
30 -1.003063e+11 2.205070e+11
2244.42s (217630.34 ticks)
Iteration 31 did 10 central corrections
Refinement: orig 4.87e+08, refined
31 -1.4681267e+11 2.4034920e+11
2449.43s (217333.45 ticks)
Iteration 32 did 10 central corrections
Refinement: orig 6.57e+08, refined
32 -1.225509e+11 2.356123e+11
2657.35s (217333.45 ticks)
Iteration 33 did 10 central corrections
Refinement: orig 3.08e+08, refined
33 -1.0134367e+11 2.3090238e+11
2416.47s (217333.39 ticks)
Iteration 34 did 4 central corrections
Refinement: orig 0.00e+00, refined
34 -2.262700e+10 2.288171e+11
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Iteration 35 did 10 central corrections
Refinement: orig 2.12e+08, refined
35 -2.8756647e+09 2.2306442e+11
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Adapted From Original Version November 1st, 2016
Final Version August 31th, 2017
Weather-Informed energy Systems: design, operations and markets
WIS:dom (Planning and Dispatch Modes)
EDF National Variant
Written to depict the transition of the US electric sector
Particular attention is paid to the nuclear plants
Version 1.4
Dr Christopher T M Clark
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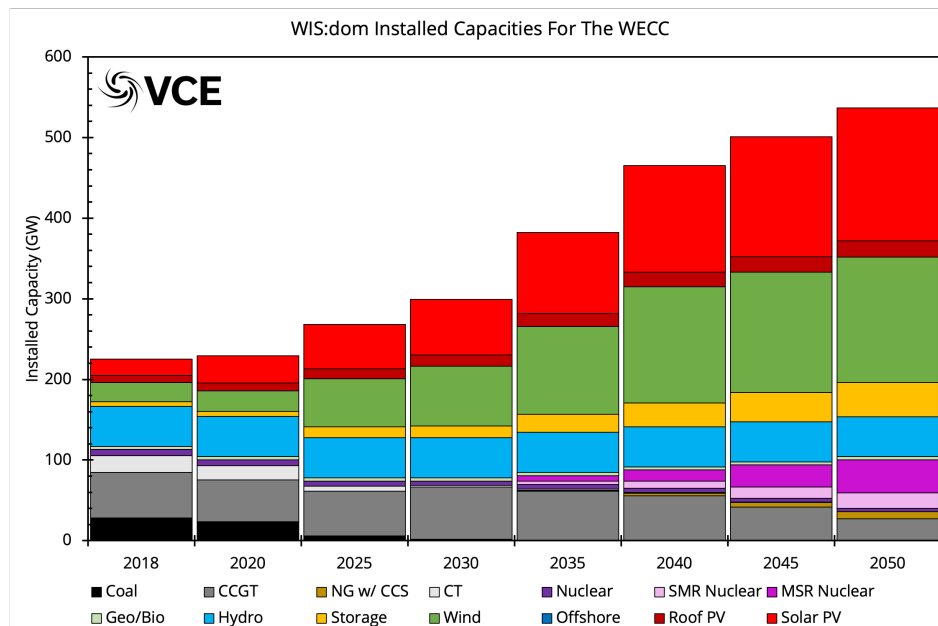
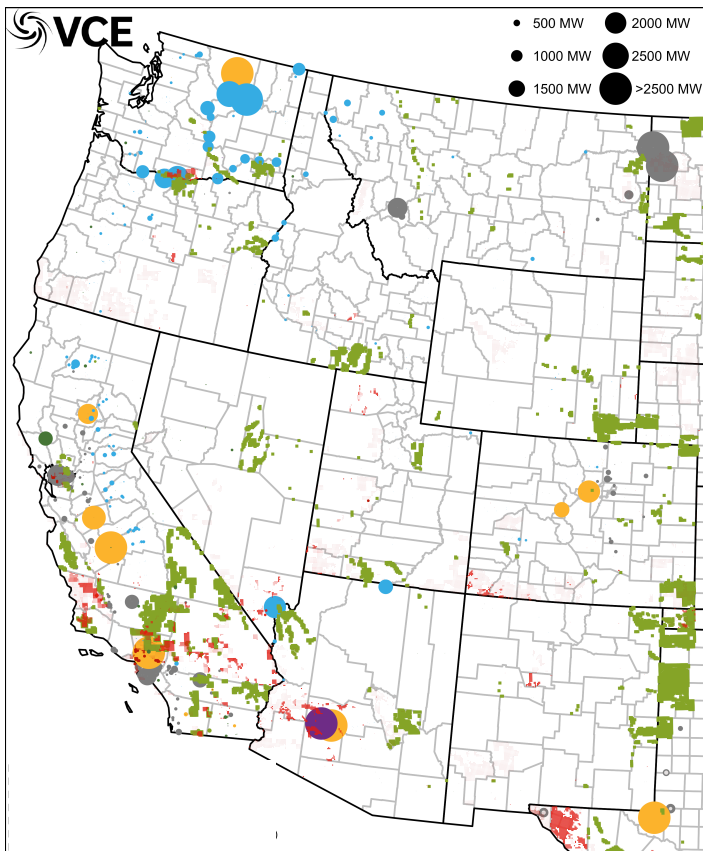
The Western Grid in 2018



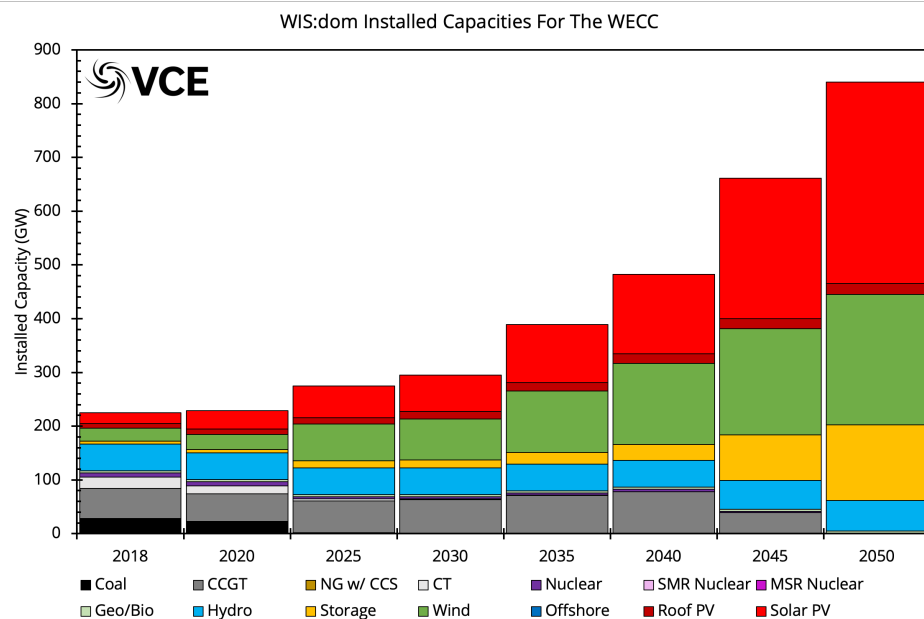
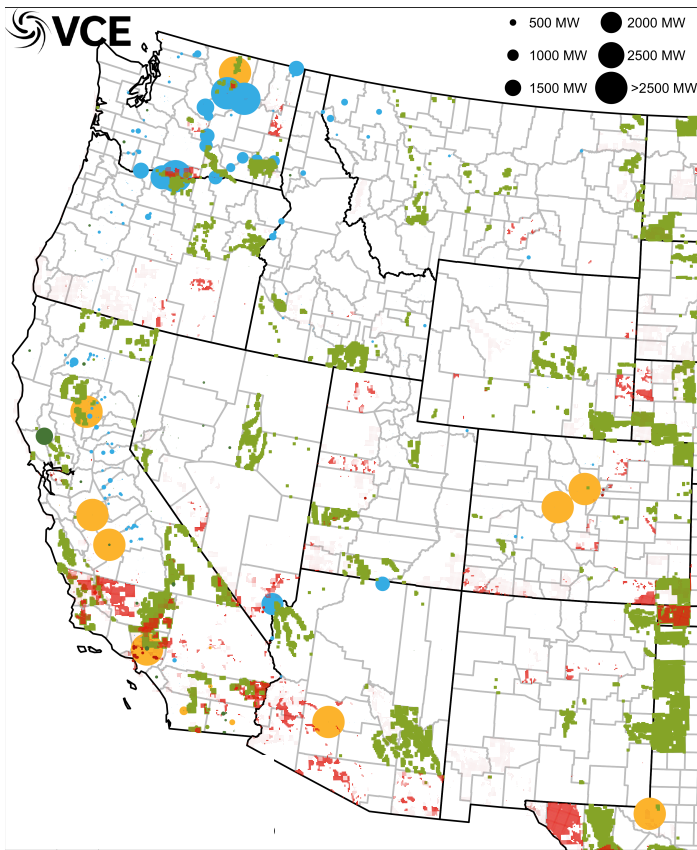
The Western Grid under "BAU" to 2040



The Western Grid under “Deep Decarbonized” to 2050

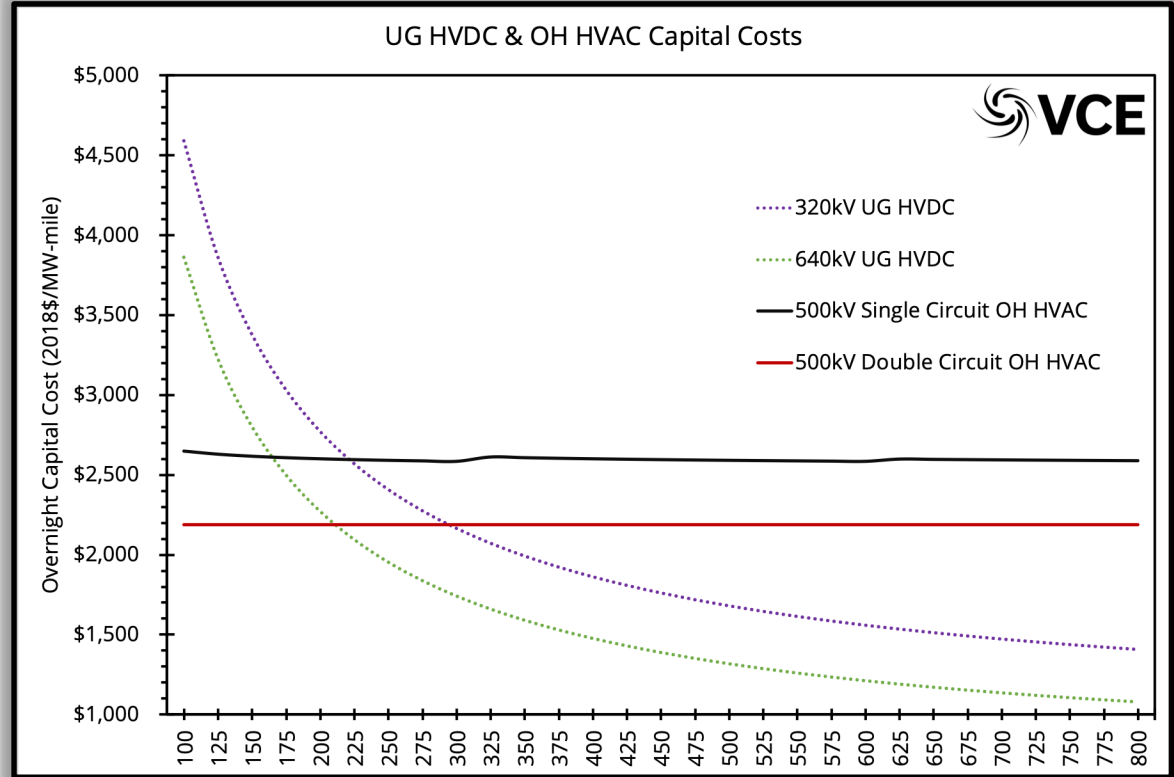


The Western Grid under “100% Renewables” to 2050

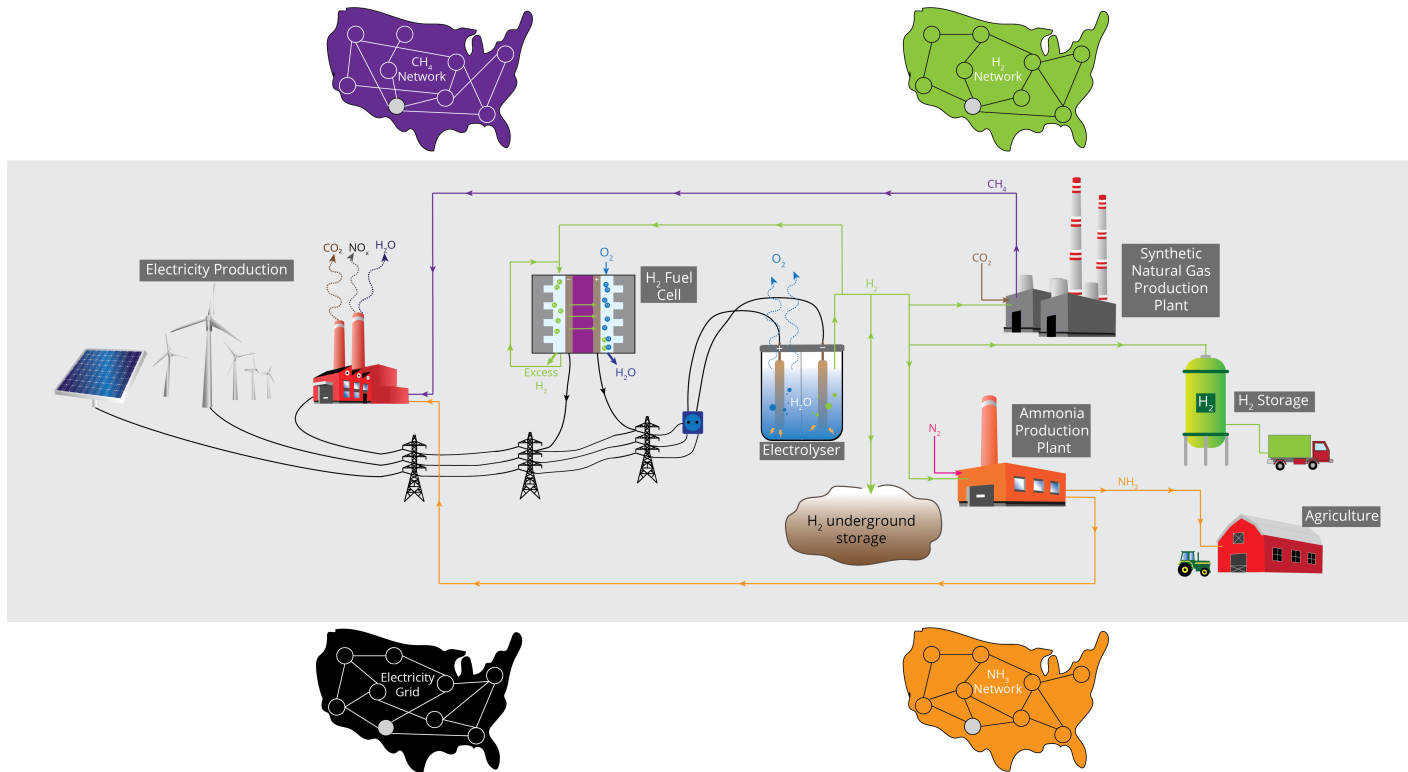


Key Enabling Features For Regional Grid Over the West

- *UG HVDC backbone to move electrons long distances away from Climate Change risk factors (see costs to right).*
- *Battery storage to reduce volatility in market pricing and optimize transmission, generation and demand matching.*
- *Wind, solar & innovation for new clean technologies (if decarbonization is goal).*
- *New market structures for ultra-low-marginal cost dominated grids.*



Cross-sectoral integration will drive demand growth & new paradigms for integration



Thank You

Dr Christopher T M Clack
CEO Vibrant Clean Energy, LLC

Telephone: +1-720-668-6873
E-mail: christopher@vibrantcleanenergy.com
Website: VibrantCleanEnergy.com
Twitter: @DrChrisClack