**The Electrification Dilemma: Wind, Water, and Solar Power (WWS): Can the Intermittency Challenge of Renewables be Overcome?**

Could North America have a reliable [electricity supply](https://www.eia.gov/energyexplained/us-energy-facts/) from WWS, without using fossil fuel generation?

Background: how are WWS distributed, and is there enough?

US [wind map](https://en.wikipedia.org/wiki/Wind_generation_potential_in_the_United_States#/media/File:United_States_Wind_Resources_and_Transmission_Lines_map.jpg)

US [solar map](https://www.nrel.gov/gis/solar.html)

US [wave map](http://www.geni.org/globalenergy/library/renewable-energy-resources/world/sources_world/Ocean%20wave%20Energy_files/wave_small_100104_1022.jpeg)

How to do it:

1. Have a fully integrated continental scale grid with high geographic and source type diversity
2. Use conventional hydropower (dams) to fill in gaps
3. Use [pumped storage hydropower](https://www.energy.gov/eere/water/pumped-storage-hydropower)
4. Use industrial scale batteries ([Tesla Australian example](https://www.engineering.com/story/after-one-year-of-operation-teslas-australian-mega-battery-is-doing-just-fine))
5. [Overbuild solar and wind capacity](https://pv-magazine-usa.com/2020/05/14/overbuilding-solar-at-up-to-4-times-peak-load-yields-a-least-cost-all-renewables-grid/#:~:text=Solar%20capacity%20reaching%20up%20to,regions%20across%20the%20United%20States.)
6. Use overbuilt WWS generation capacity, when overproducing, to split hydrogen from water (electrolysis). [Hydrogen](https://rmi.org/the-truth-about-hydrogen/) can later be either combusted or used in fuel cells to make electricity as needed.
7. [Use distributed smart grid of plugged in electric vehicles to store and release electricity](https://www.forbes.com/sites/jeffmcmahon/2020/01/29/electric-vehicle-batteries-could-dwarf-the-grids-energy-storage-needs/?sh=5ae65ac65929) as needed
8. Demand side management including time-of-day pricing
9. Other promising approaches (eg. compressed air, flywheels, hybrid desalination systems and more)
10. Last resorts…