WSU TRI-CITIES
Institute for Northwest Energy Futures

Electric Grid – Past, Present and Future

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WSU Tri-Cities Institute for Northwest Energy Futures (INEF)

Developing a Systems Approach to Energy Ecosystem

- New state-supported institute headquartered on WSU Tri-Cities campus with faculty, staff and facilities working across energy ecosystem
- Leveraging 26 energy-related entities for research, education, and outreach across the WSU System
- Working together with regional industry, communities, national laboratories and other higher education partners to implement resilient and reliable energy system roadmap

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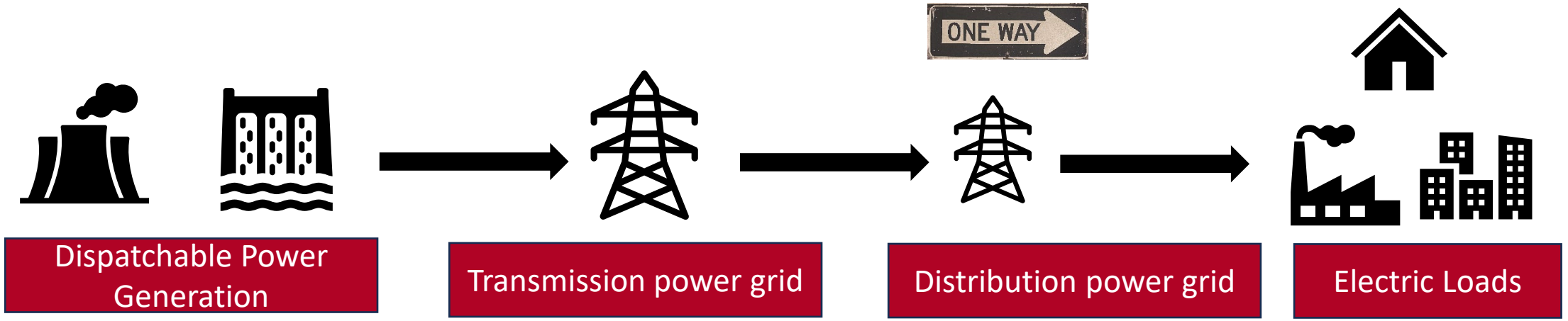
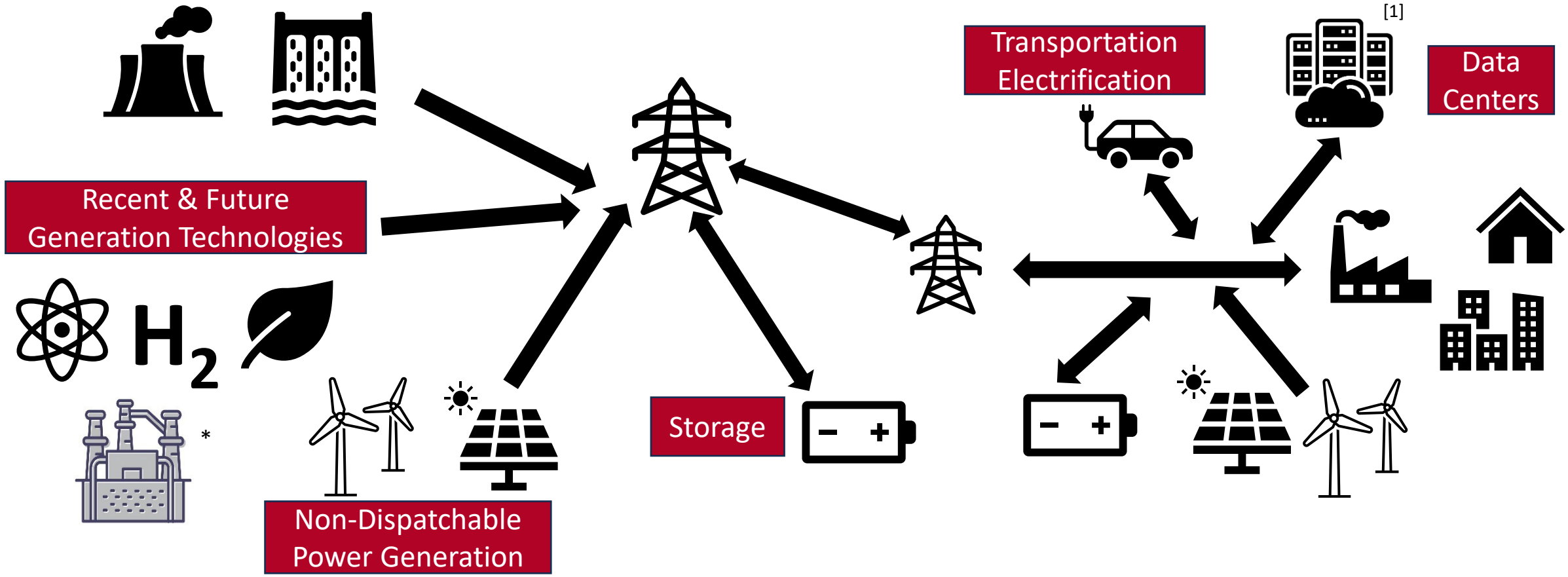
Electric Power Grid

Past



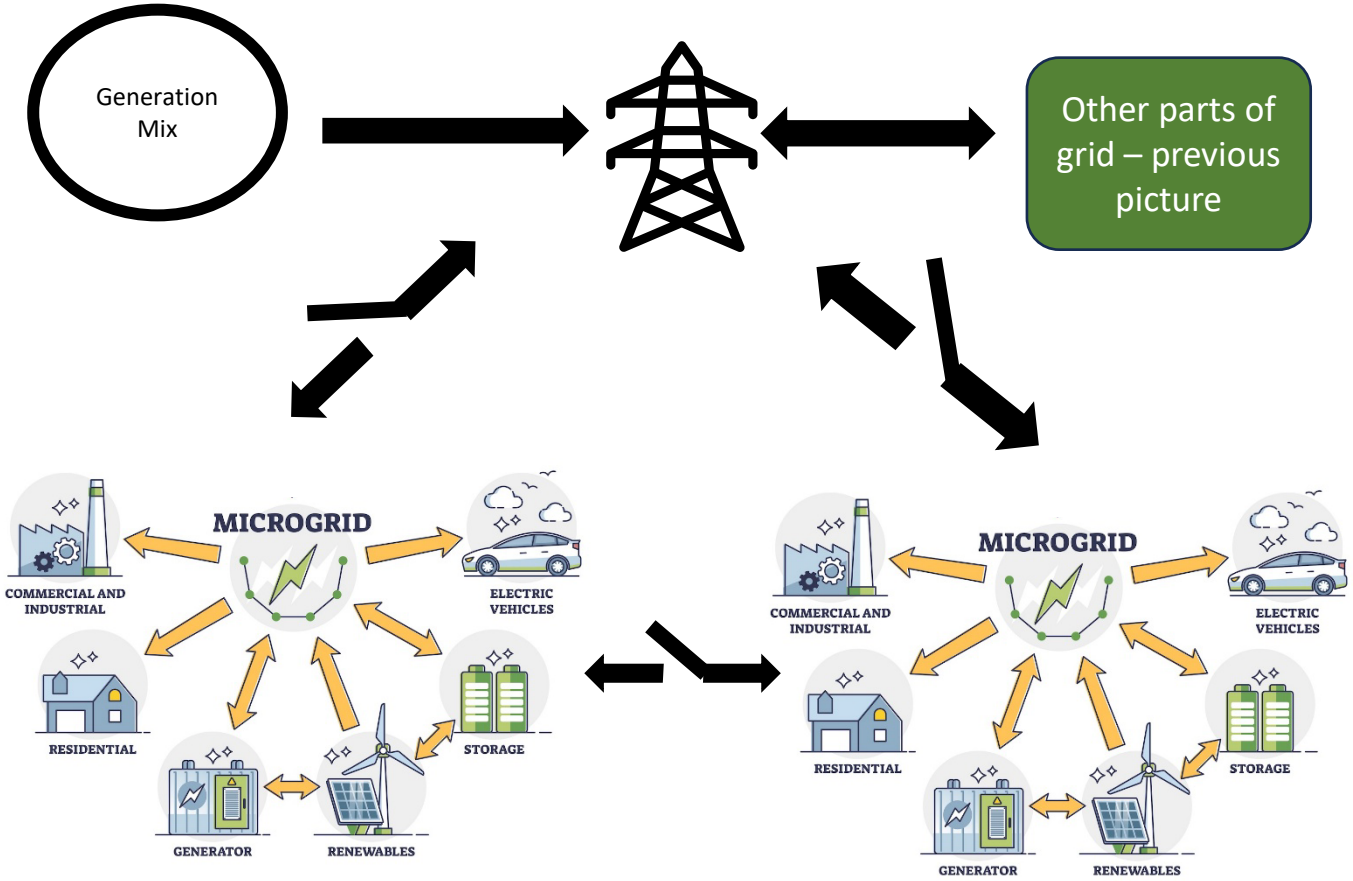
Electric Power Grid – Electron Highway

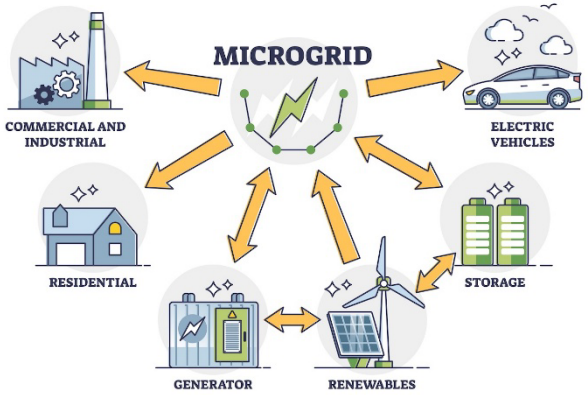
Present and Future – Moving towards reliable and resilient energy goals



* https://www.vecteezy.com/vector-art/14024128-geothermal-energy-vector-icon

Electric Power Grid – Microgrids

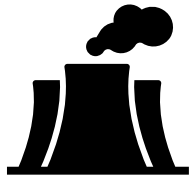




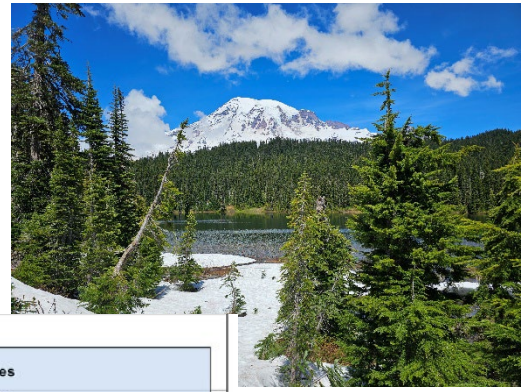
*Microgrid graphic https://www.deutz.com.au/resources/what-is-a-microgrid-and-how-do-they-work/

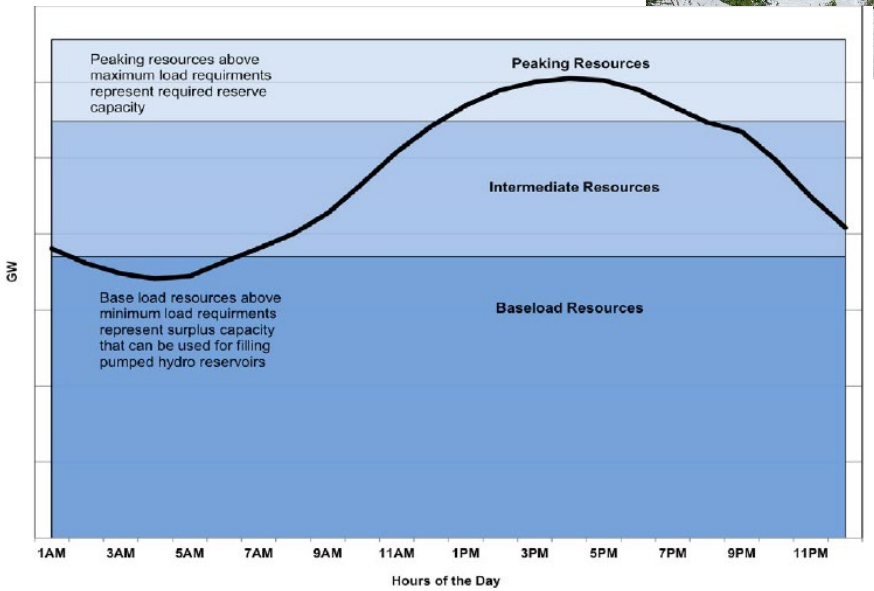
Not all kilowatts are created equal

Dispatchable Power Generation



- Controllable
- Often base load
- Limitations for ramping up and ramping down
- Climate change effects on hydrogeneration





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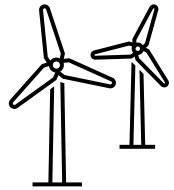
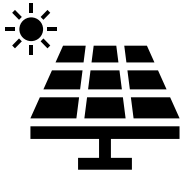
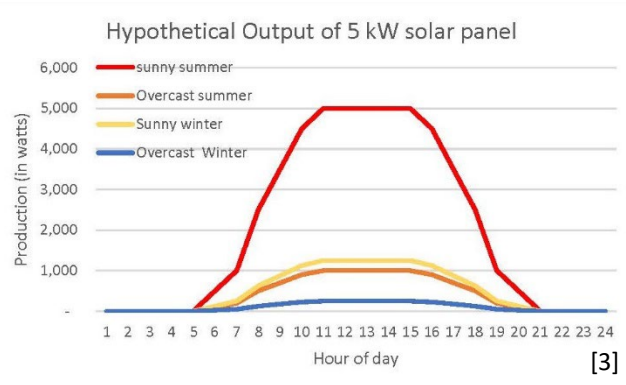
Non-Dispatchable Power Generation





- Not controllable
- Weather dependent
- Name plate value is maximum amount
- Amount of generation changes with time of day and seasons



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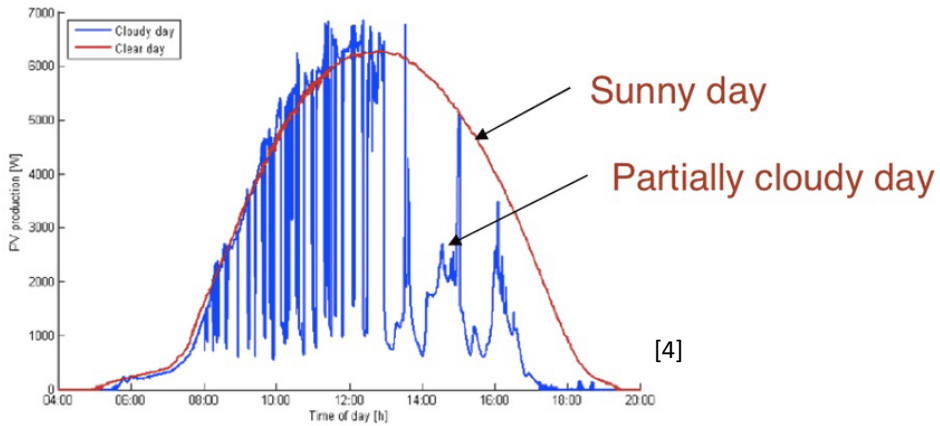

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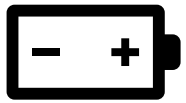
Not all kilowatts are created equal

Storage

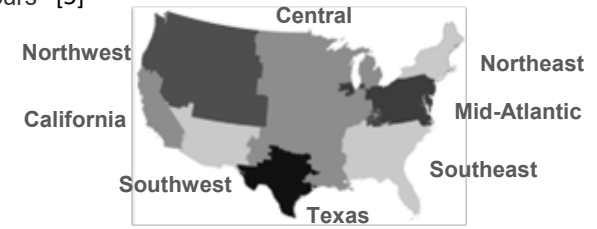


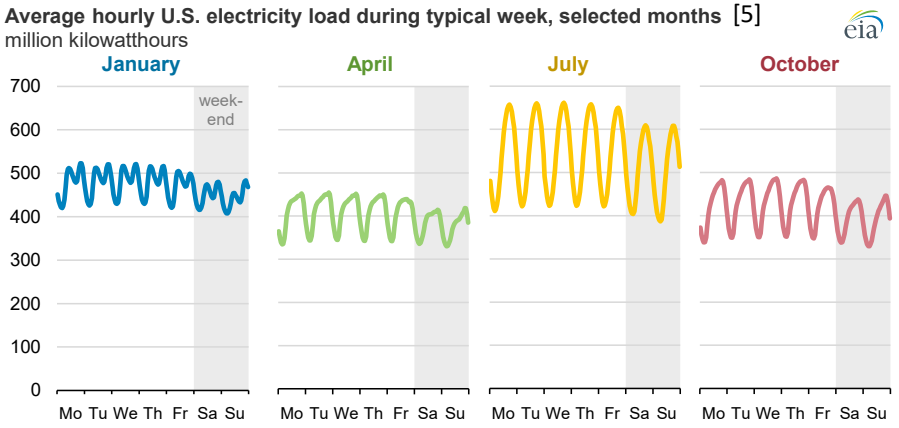
- Batteries
  - Short-term solution (~4 hr)
  - Work well with renewable energy sources
  - Changing characteristics while discharging
  - Many made with rare earth materials
- Other Storage techniques
  - Pumped Hydro Storage
  - Thermal
  - Hydrogen production

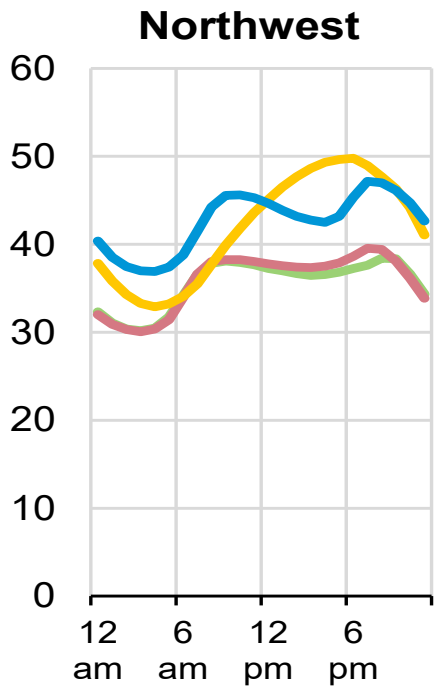
Power versus Energy

Kilowatts versus Kilowatt-hours

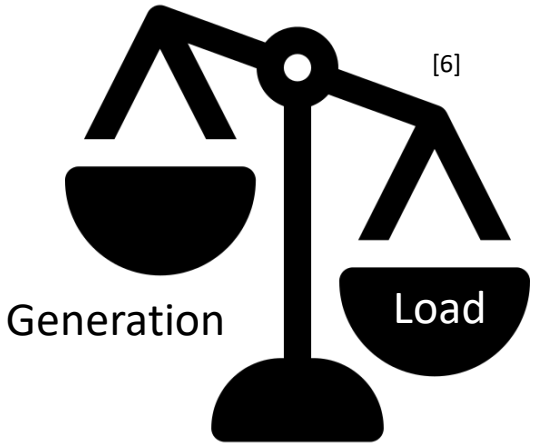
Average hourly electricity load during typical day by region, selected months
million kilowatthours [5]





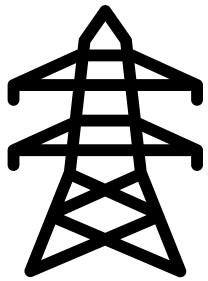


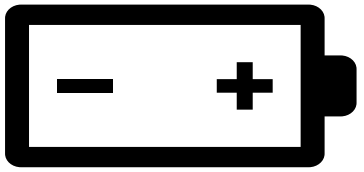
What are grid challenges from the changing energy landscape?



Generation Adequacy Challenges

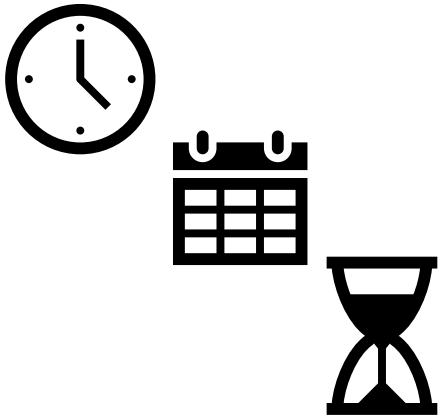
Transmission Line Congestion



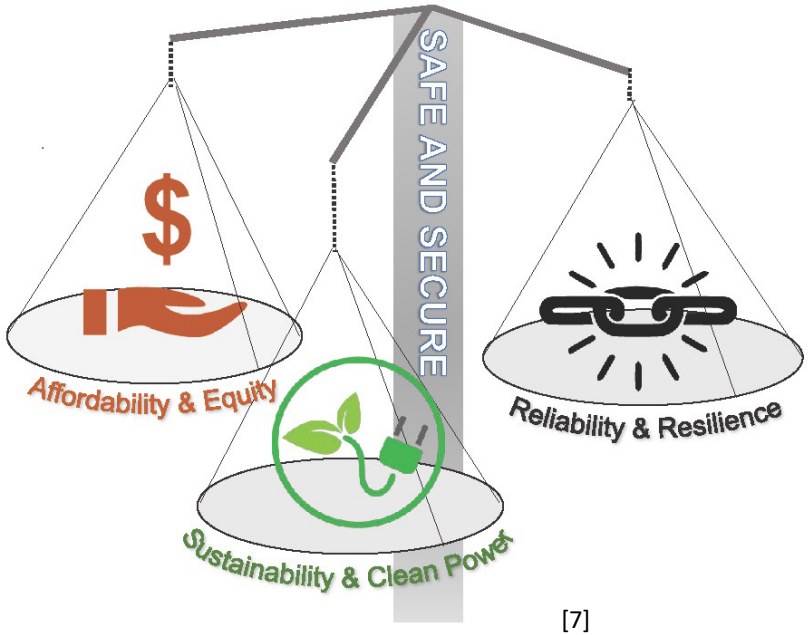


Lack of grid-scale and long term storage

Timeline for infrastructure improvements and new generation transition from research to implementation



Maintaining Grid Reliability and Resilience



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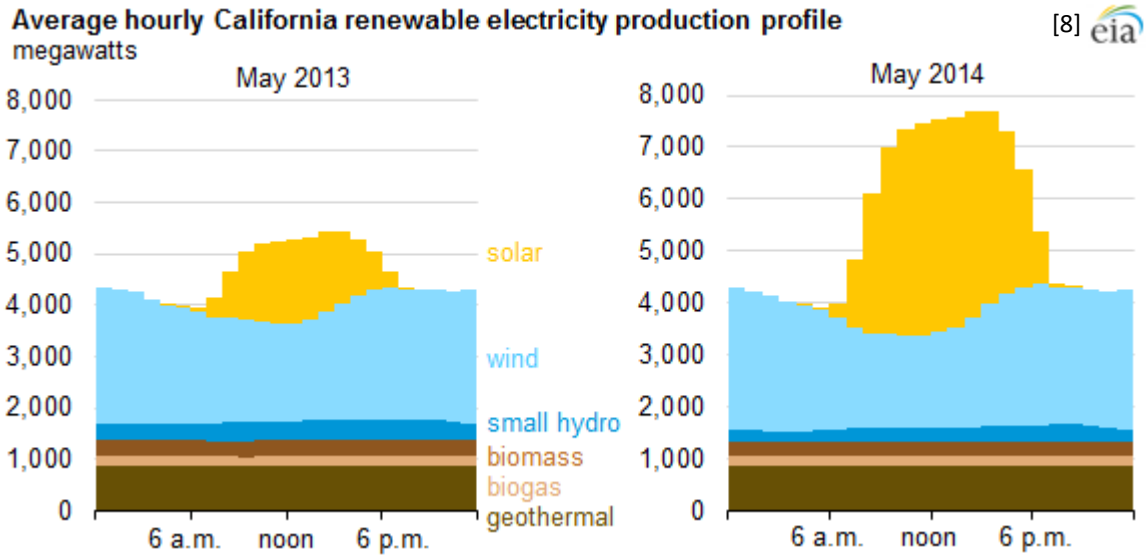
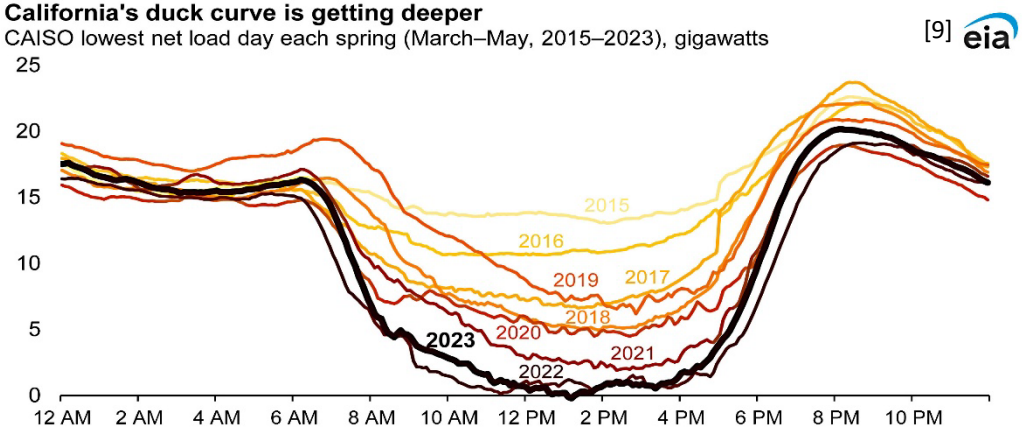
The National Academies of | SCIENCES ENGINEERING MEDICINE

The Future of Electric Power in the United States, 2021



[8] eia



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Summary

- Many new energy solutions revolve around electrification of systems and forecasts show large increases in electricity demand
- US power grid is over 140 years old – evolving with changing technologies for generation, transmission, distribution, storage and loads
- As shown, an effective electric grid system is a very complex challenge that differs across different parts of US (and even WA) as well as over time
- It is important to collaborate across the energy ecosystem with new ideas and projects to avoid unintended consequences on other parts of the system
- Our future resilient and reliable energy solutions will be a set of technologies

Thank you WPPA for the opportunity to share about electric power grids!

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