Electrification Introduction

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NARUC Electrification and Load Forecasting Training

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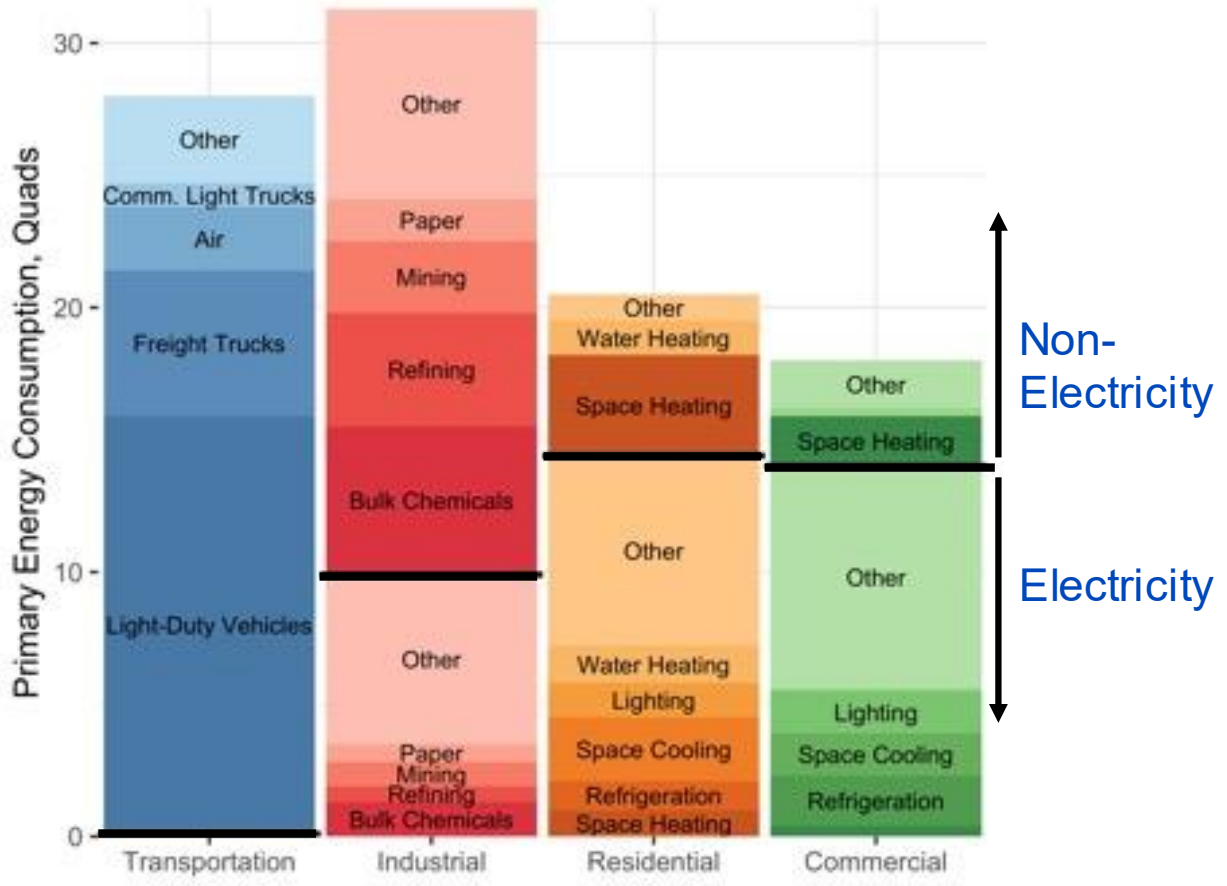
ESIG
ENERGY SYSTEMS INTEGRATION GROUP

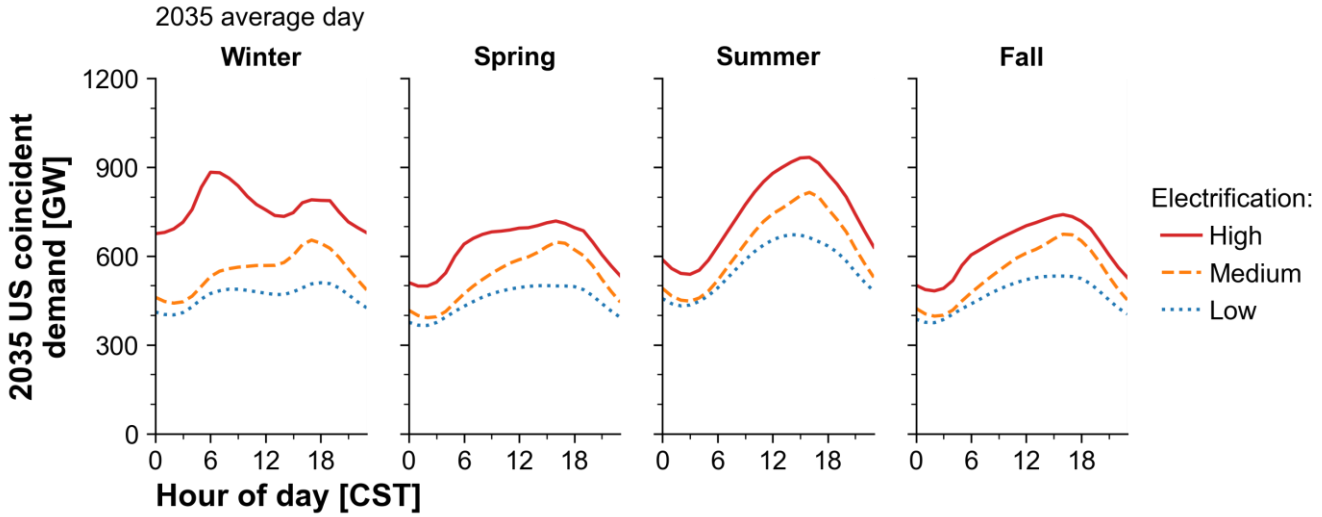
Electrification – Pathway to Economy-wide Decarbonization

- Electrification is viewed as the clearest path to decarbonize as much as half of all non-electric primary energy consumption.
  - Light-duty vehicles
  - Commercial vehicles
  - Space heating
  - Water heating
- Green hydrogen demand as a pathway to decarbonize other non-electric energy consumption
- Many studies suggest a doubling of electric demand by 2050 is possible

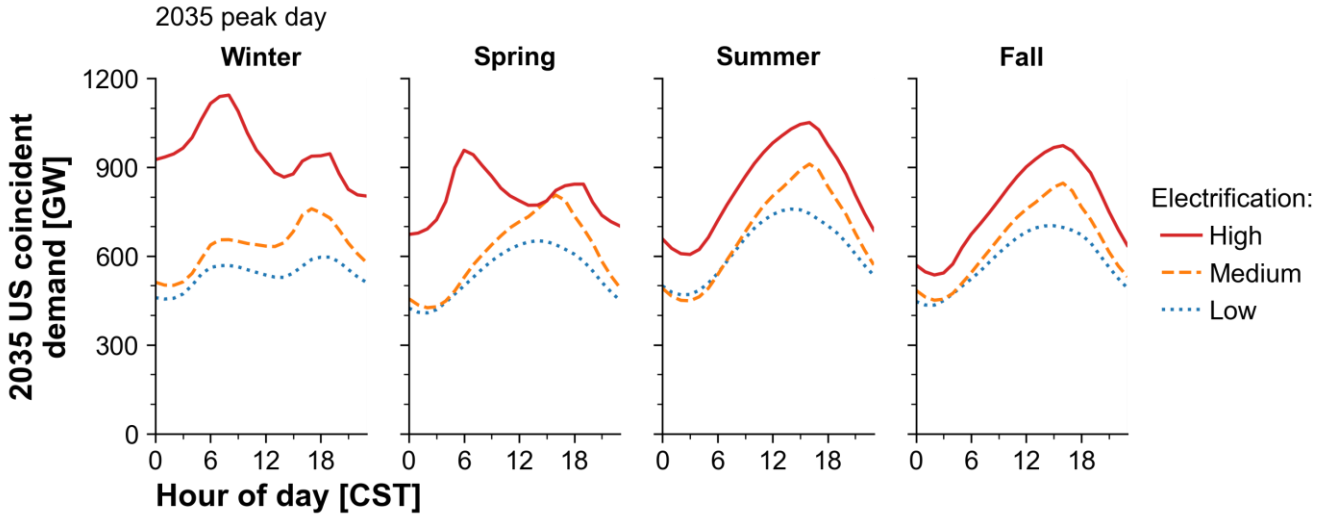


Mai, Trieu, et al. 2018. Electrification Futures Study: Scenarios of Electric Technology Adoption and Power Consumption for the United States. Golden, CO: National Renewable Energy Laboratory. NREL/TP-6A20-71500. https://www.nrel.gov/docs/fy18osti/71500.pdf

Electrification and System Planning Uncertainty



Most U.S. regions are **summer peaking** today and expected to remain so without significant electrification.



Electrification raises average demand throughout the year and could shift **demand peaks could shift to winter**, particularly electrified space and water heating.

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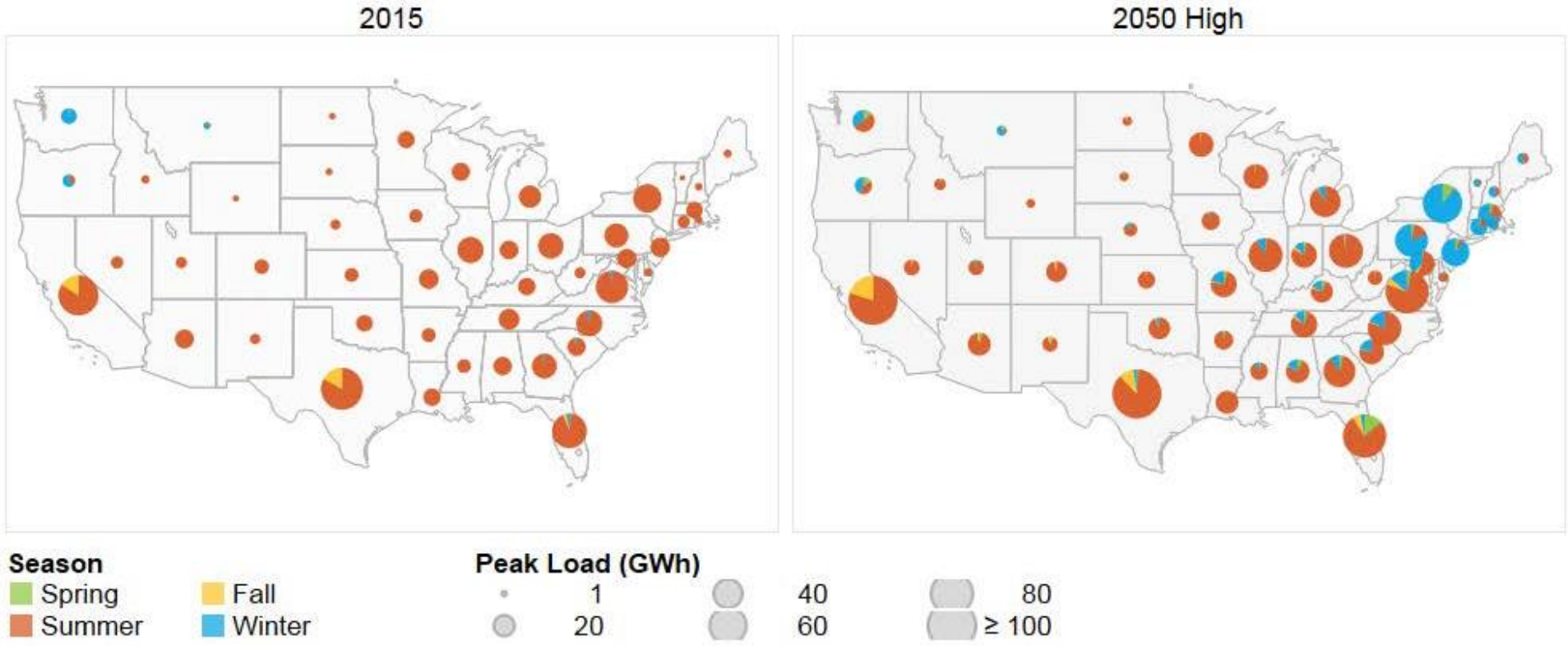

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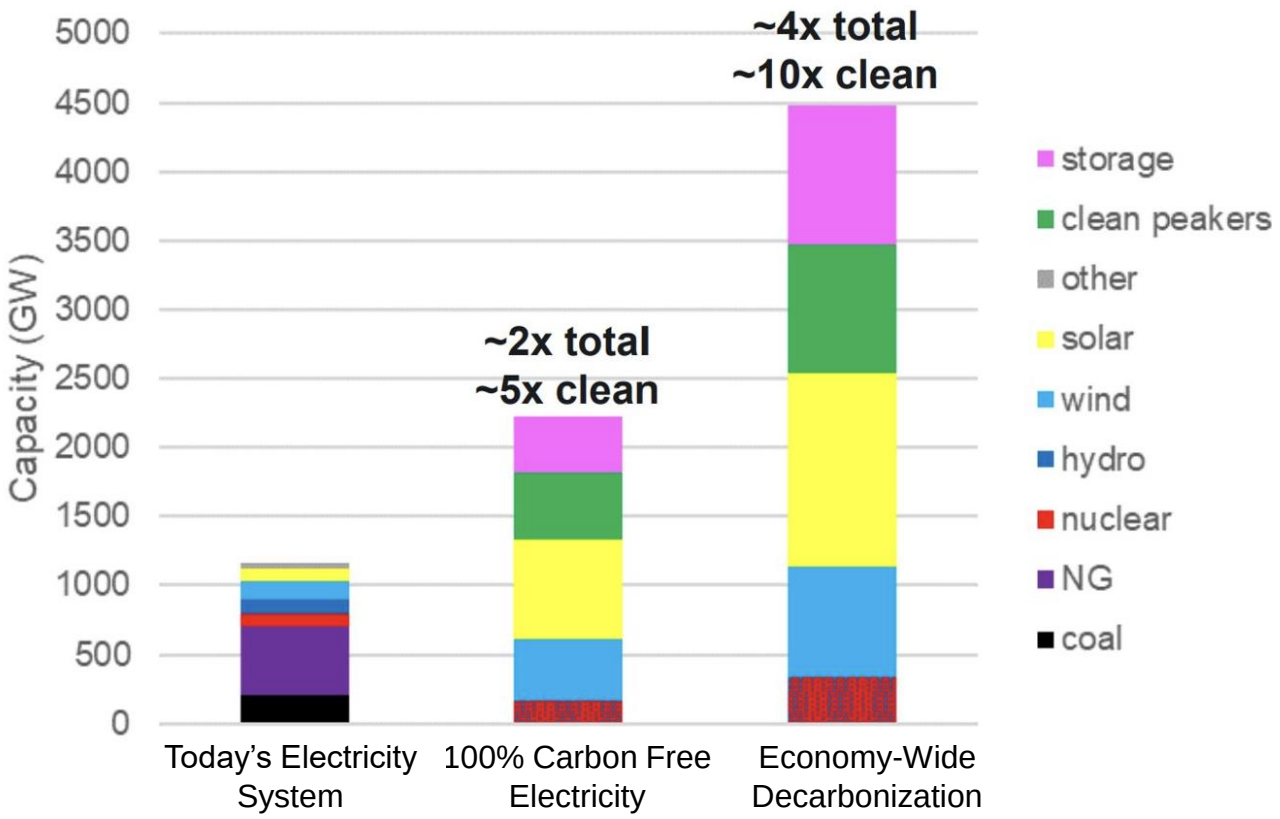

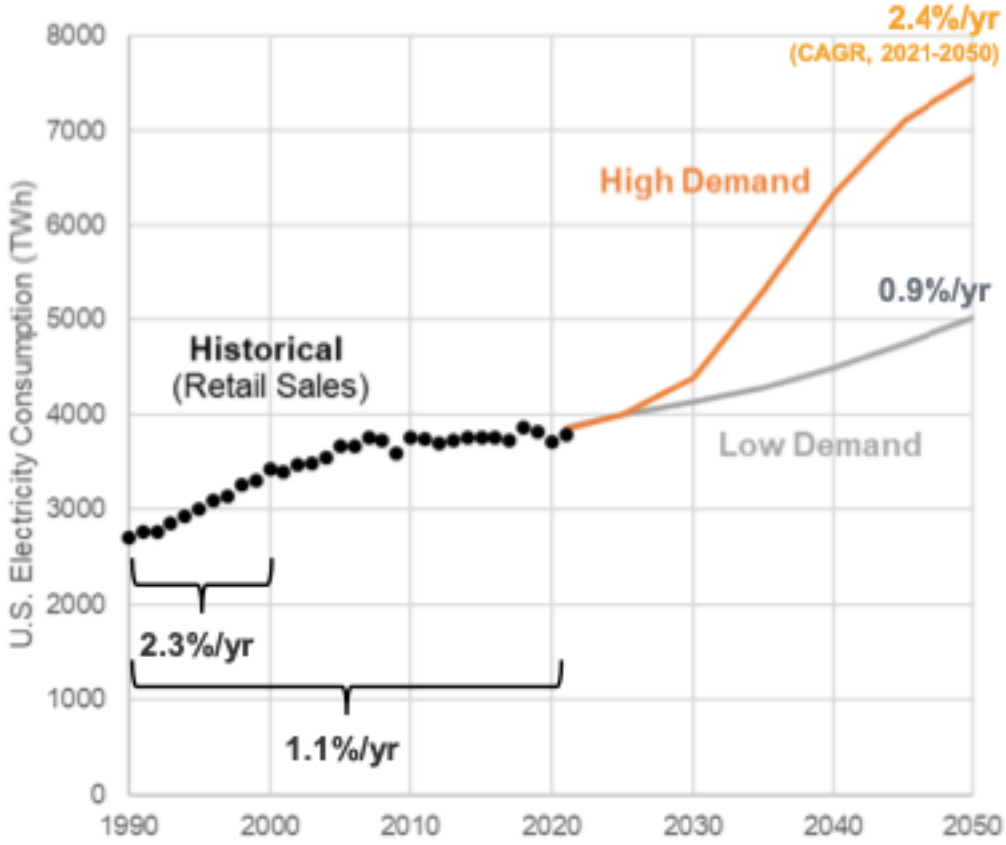

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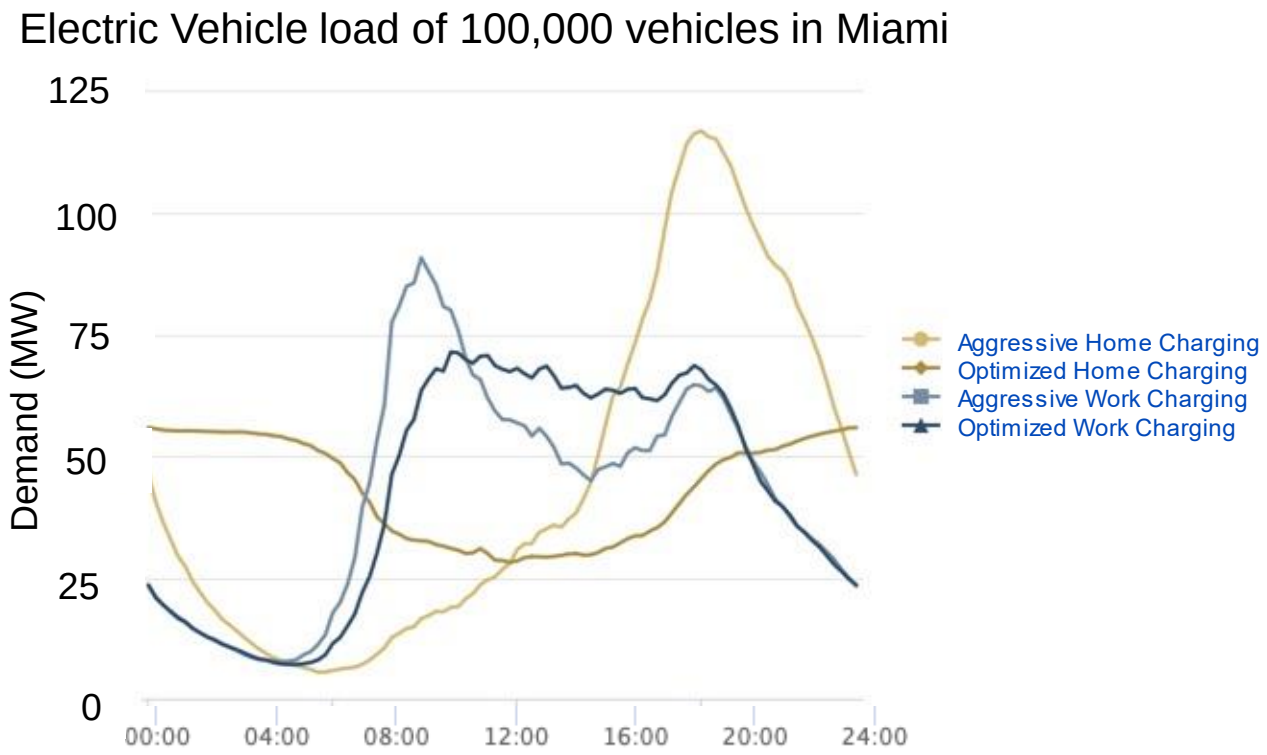
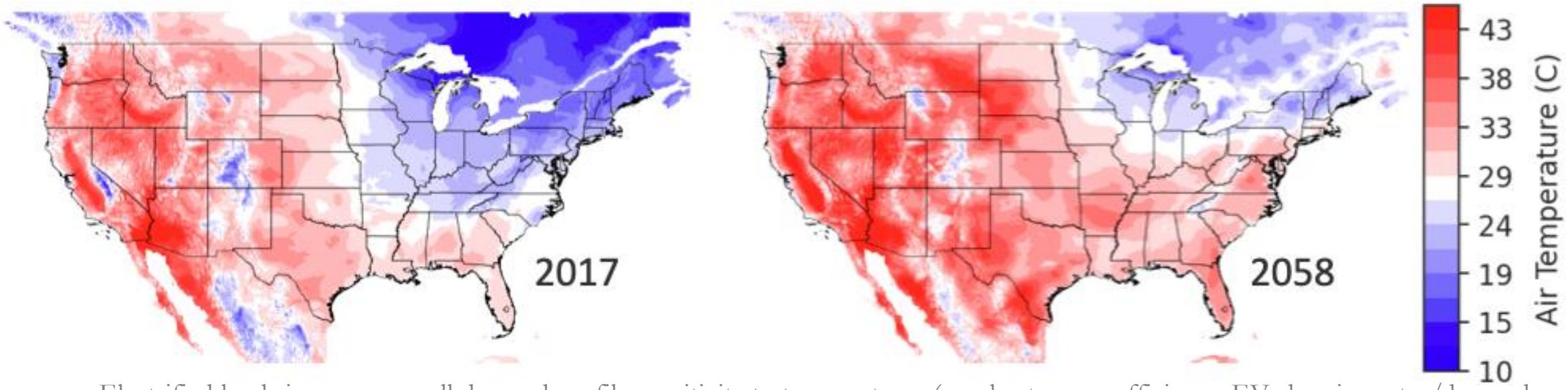


- Electrified loads increase efficiency and flexibility of demand
- Large incentive to reduce peak demands by tapping into flexibility
- Requires response/control of many distributed small loads.

Electric Vehicle Infrastructure Projection Tool (EVI-Pro) https://afdc.energy.gov/evi-pro-lite

Climate Change and Electrification

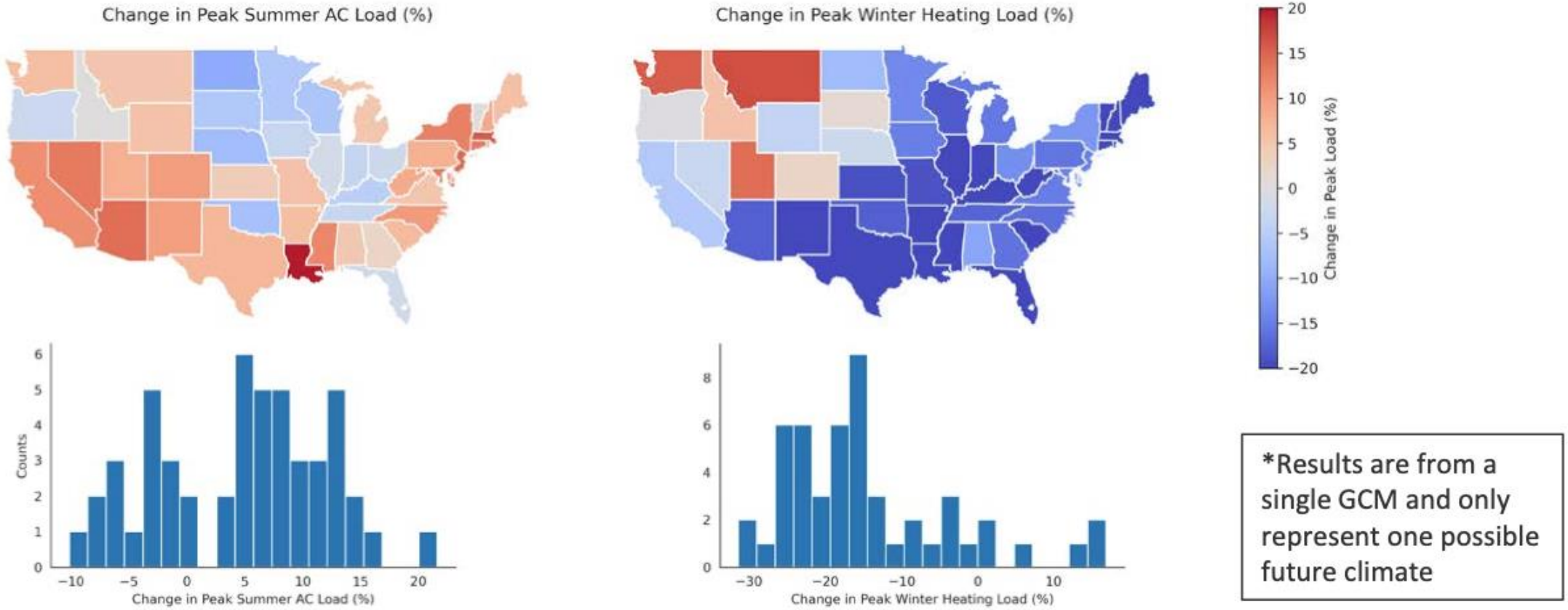


- Electrified loads increase overall demand profile sensitivity to temperatures (e.g., heat pump efficiency, EV charging rates/demand, etc.)
- Uncertainty in temperature due to climate change further complicates system planning for electrification.
- Maps are examples of work done at NREL to downscale Global Climate Models into hourly and finer spatial resolution data sets to be used for grid modeling.
  - Other DOE Labs and research institutions (e.g., EPRI) have similar modeling, analysis, and data sets

Buster, Grant et al. 2023. "Spatiotemporal Super-Resolution with Generative Machine Learning for Creating Renewable Energy Resource Data Under Climate Change Scenarios." Innovations in Climate Resilience. https://www.nrel.gov/docs/fy23osti/85711.pdf

Jones, A. D., Rastogi, D., Vahmani, P., Stansfield, A., Reed, K., Thurber, T., Ullrich, P., & Rice, J. S. (2022). IM3/HyperFACETS Thermodynamic Global Warming (TGW) Simulation Datasets (v1.0.0) [Data set]. MSD-LIVE Data Repository. https://doi.org/10.57931/1885756

Climate Change and Electrification



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Electrification Introduction

- Large potential for economy-wide decarbonization through electrifying end-uses
- Electricity system planning must consider wide ranging uncertainties to prepare for coming increased demand from electrification:
  - Total magnitude of new electricity demand
  - Changing peak times and demand shapes
  - Flexibility and efficiency opportunities from the demand side
  - Climate change and temperature sensitivities
- Wide ranging incentives from IRA to accelerate electrification in many sectors:
  - Electric Vehicle tax credit
  - Residential rebates for heat pumps, electric stoves, etc.
  - Clean hydrogen
- ESIG electrification activities:
  - Demand Forecasting Workshop (June 13 - 15, Denver, CO)
  - Ongoing ESIG Task Forces focused on vehicle and building electrification.