Casey Burleyson

- Earth Scientist, Level 4
- 12.5 years with PNNL
- Research Interests
  - Weather impacts on power systems
    - IM3, GODEEEP, FORESIGHT
  - Energy system planning
    - GDO, NTPS, NAERM, WOW-TS
  - Open science
    - MSD-LIVE
- Personal Interests
  - Shannon, Grant (7), and Reid (5)!
  - Baseball
  - Optimized wine and BBQ pairings
  - Non-fiction books (biographies, military history, and other things Shan considers boring)
  - Running

Pacific Northwest
NATIONAL LABORATORY

Translating Your Science to the Grid

Casey Burleyson

U.S. DEPARTMENT of ENERGY BATTELLE

PNNL is operated by Battelle for the U.S. Department of Energy

My Transition into the Weather-to-Grid Space

Ship-Based Observations of the Diurnal Cycle of Southeast Pacific Marine Stratocumulus Clouds and Precipitation

CASEY D. BURLEYSON

North Carolina State University, Raleigh, North Carolina

SIMON P. DE SZOEKE

Oregon State University, Corvallis, Oregon

SANDRA E. YUTER AND MATT WILBANKS

North Carolina State University, Raleigh, North Carolina

W. ALAN BREWER

NOAA/Earth System Research Laboratory, Boulder, Colorado

(Manuscript received 27 December 2012, in final form 11 July 2013)

Quantifying Diurnal Cloud Radiative Effects by Cloud Type in the Tropical Western Pacific

CASEY D. BURLEYSON, CHARLES N. LONG,* AND JENNIFER M. COMSTOCK

Pacific Northwest National Laboratory, Richland, Washington

(Manuscript received 29 October 2014, in final form 3 March 2015)

Applied Energy 380 (2025) 124948

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

When do different scenarios of projected electricity demand start to meaningfully diverge?

Casey D. Burleyson [a,*], Zarrar Khan [a,b,c], Misha Kulshresta [a,d,e], Nathalie Voisin [a,e], Mengqi Zhao [a], Jennie S. Rice [a]

[a] Pacific Northwest National Laboratory, Richland, WA, USA
[b] Joint Global Change Research Institute, College Park, MD, USA
[c] Abt Global, Rockville, MD, USA
[d] University of California - Santa Barbara, Santa Barbara, CA, USA
[e] University of Washington, Seattle, WA, USA

Energy 208 (2020) 118312

Contents lists available at ScienceDirect

Energy

journal homepage: www.elsevier.com/locate/energy

Future western U.S. building electricity consumption in response to climate and population drivers: A comparative study of the impact of model structure

Casey D. Burleyson *, Gokul Iyer , Mohamad Hejazi , Sonny Kim , Page Kyle , Jennie S. Rice , Amanda D. Smith , Z. Todd Taylor , Nathalie Voisin , Yulong Xie

Pacific Northwest National Laboratory, Richland, WA, USA

Applied Energy 205 (2017) 1408–1418

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

Evaluating penalized logistic regression models to predict Heat-Related Electric grid stress days

L.M. Bramer[a,*], J. Rounds[a], C.D. Burleyson[a], D. Fortin[a], J. Hathaway[a], J. Rice[b], I. Kraucunas[a]

[a] Pacific Northwest National Laboratory, 902 Battelle Blvd, Richland, WA 99352, USA
[b] Smarter Decisions, LLC, 7057N Omaha Ave, Portland, OR 97217, USA

Applied Energy 209 (2018) 516–528

Contents lists available at ScienceDirect

Applied Energy

journal homepage: www.elsevier.com/locate/apenergy

Simulated building energy demand biases resulting from the use of representative weather stations

Casey D. Burleyson*, Nathalie Voisin, Z. Todd Taylor, Yulong Xie, Ian Kraucunas

Pacific Northwest National Laboratory, Richland, WA, United States

My Transition into the Weather-to-Grid Space

Improved Decarbonization Planning Through Climate Resiliency Modeling

OSTEN ANDERSON[1], (Member, IEEE), CAMERON BRACKEN[2], CASEY D. BURLEYSON[2], ALEX PUSCH[3], AND NANPENG YU[1], (Senior Member, IEEE)
[1]Department of Electrical and Computer Engineering, University of California at Riverside, Riverside, CA 92521, USA
[2]Pacific Northwest National Laboratory, Richland, WA 99354, USA
[3]Southern California Edison, Rosemead, CA 91770, USA

What Technical Choices Matter to Characterize Heat Wave and Cold Snap Events in Support of Bulk Power Grid Reliability Studies?

Heng Wan[1], Casey D. Burleyson[1], and Nathalie Voisin[1,2]

Investigating the effects of cooperative transmission expansion planning on grid performance during heat waves with varying spatial scales

Kerem Ziya Akdemir[a,*], Kendall Mongird[a], Jordan D. Kern[b], Konstantinos Oikonomou[a], Nathalie Voisin[a,c], Casey D. Burleyson[a], Jennie S. Rice[a], Mengqi Zhao[a], Cameron Bracken[a], Chris Vernon[a]

Intensifying Renewable Energy Droughts in the Western U.S. Amid Evolving Infrastructure and Climate

C. Bracken[1], N. Voisin[1,2], K. Mongird[1], C. D. Burleyson[1], and K. Oikonomou[1]

Energy storage planning for enhanced resilience of power systems against wildfires and heatwaves☆

Konstantinos Oikonomou*, Patrick R. Maloney, Saptarshi Bhattacharya, Jesse T. Holzer, Osten Anderson, Xinda Ke, Jan Westman, Casey D. Burleyson, Sohom Datta, Jeremy B. Twitchell, Di Wu

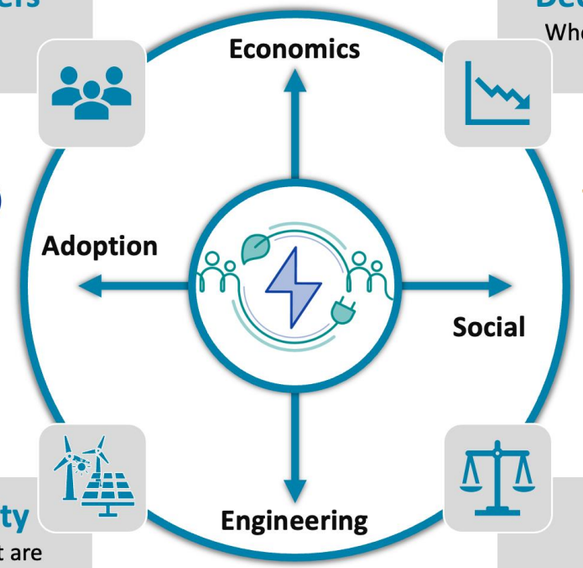
More land is needed for solar and wind infrastructure under a high renewables scenario in the Western US by 2050

Check for updates

Kendall Mongird, Cameron Bracken, Casey D. Burleyson, Konstantinos Oikonomou, Yang Ou, Jennie S. Rice, Travis Thurber & Nathalie Voisin

Empowered Stakeholders
Transfer of methods, tools, datasets, and use cases

Decarbonization Pathways
Whole economy decarbonization with interactions across global markets



GODEEEP
Grid Operations, Decarbonization, Environmental and Energy Equity Platform

Resilience and Reliability
Infrastructure and operations that are responsive to climate change

Justice and Equity
Environmental and energy equity impacts of decarbonization

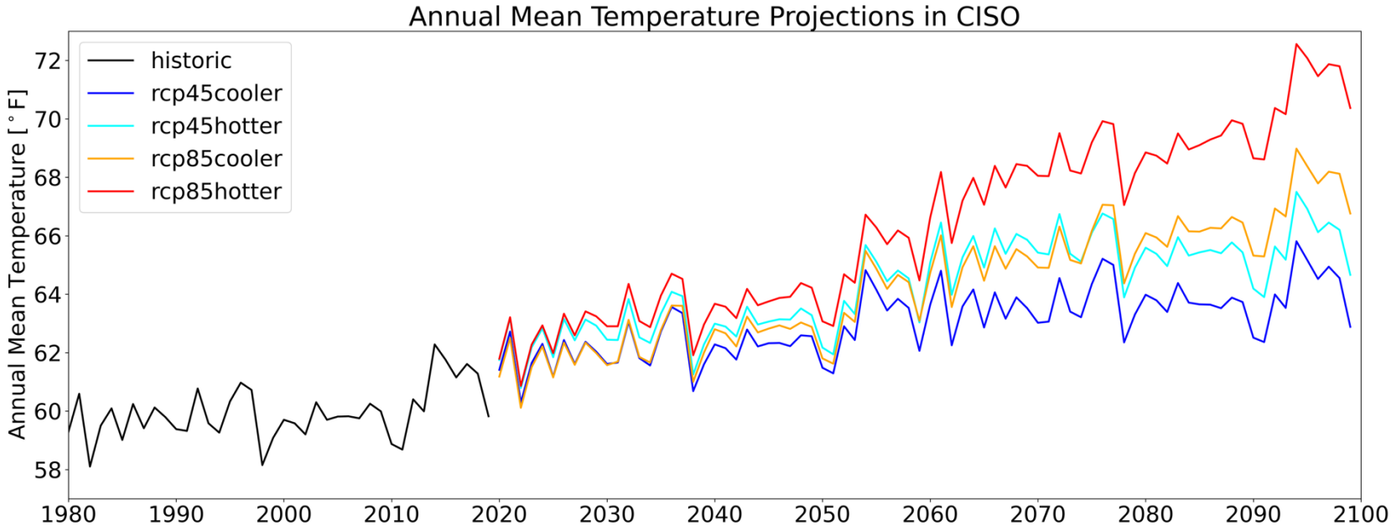
The effects of renewable energy scaling on sub-annual air pollution emission dynamics from the power sector: a Western U.S. case study

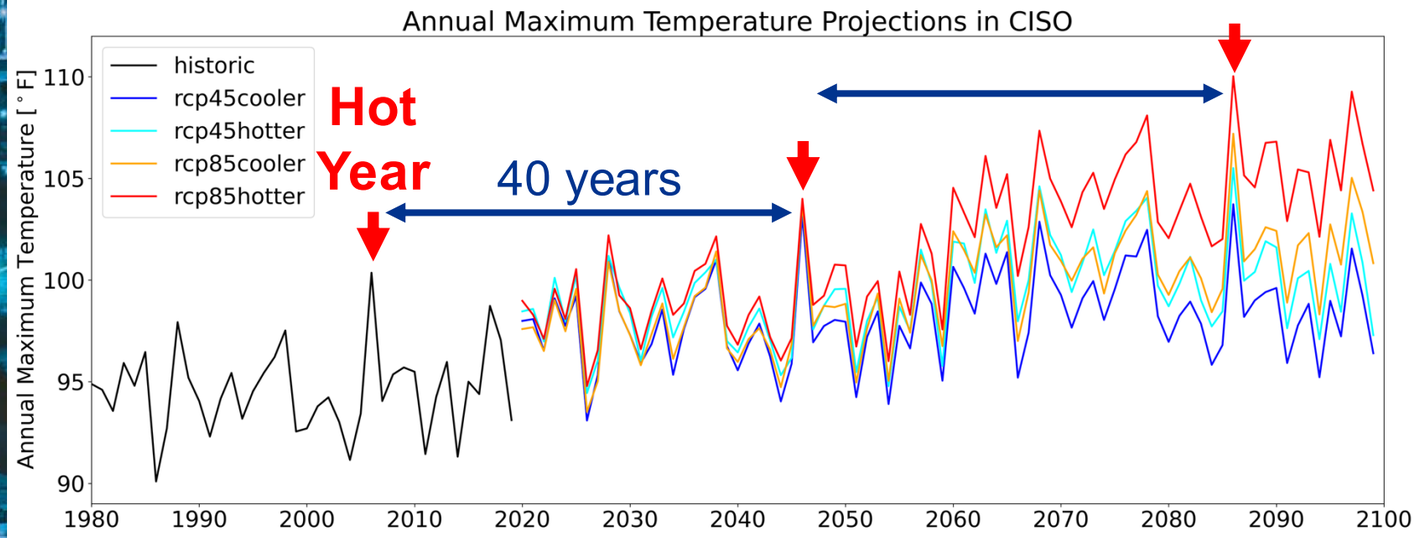
Amir Zeighami[1], Jordan D Kern[2,*], Cameron Bracken[3], Casey D Burleyson[3] and Wei Peng[4]

Standardized benchmark of historical compound wind and solar energy droughts across the Continental United States

Cameron Bracken*, Nathalie Voisin, Casey D. Burleyson, Allison M. Campbell, Z. Jason Hou, Daniel Broman

Key Tools: TGW and TELL

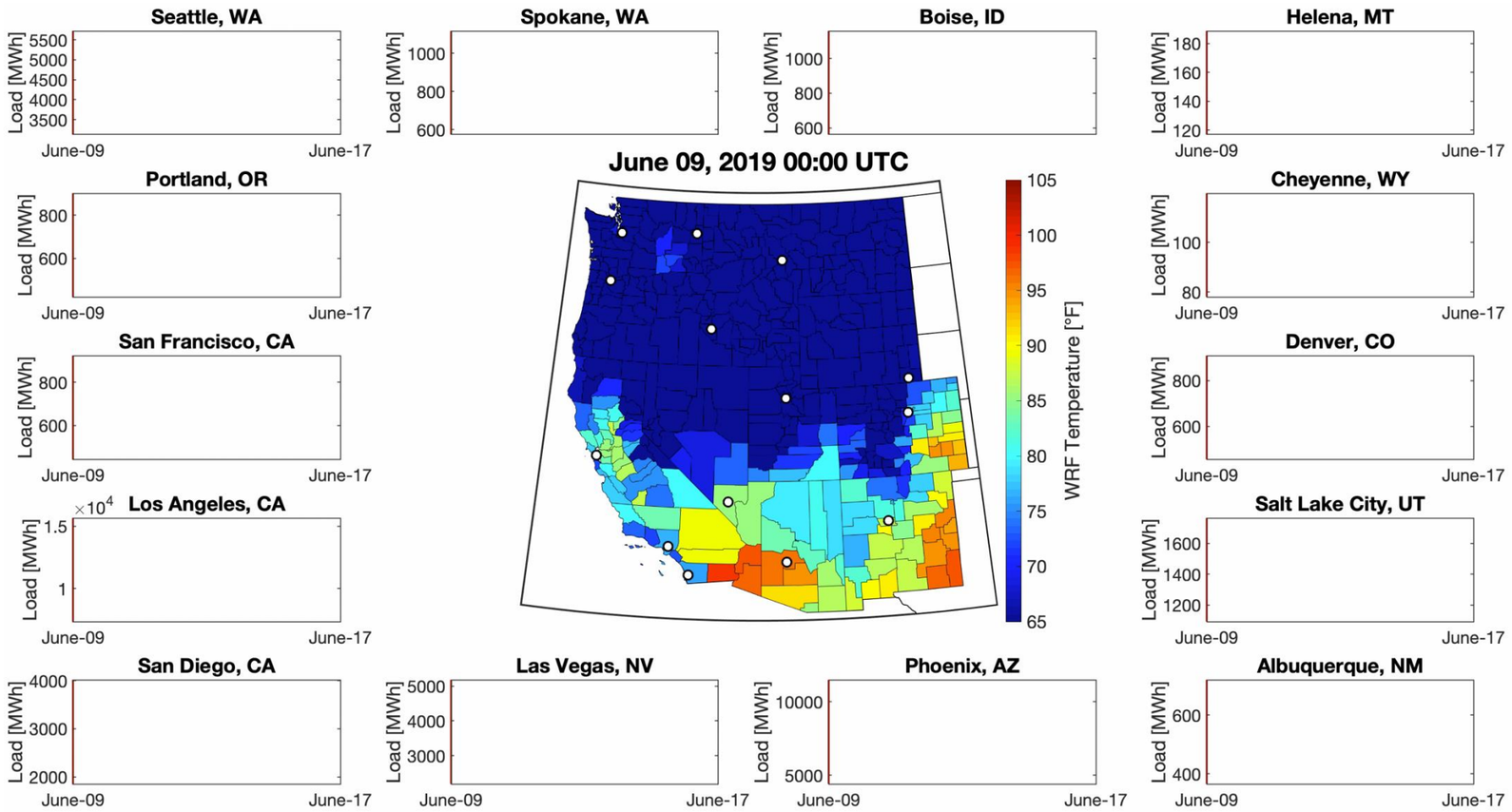




The Thermodynamic Global Warming (TGW) simulations were a joint effort between the IM3 and HyperFACETS projects. The TGW data is actively leveraged in a half-dozen DOE Office of Electricity projects examining extreme weather impacts on the electric grid.

Key Tools: TGW and TELL

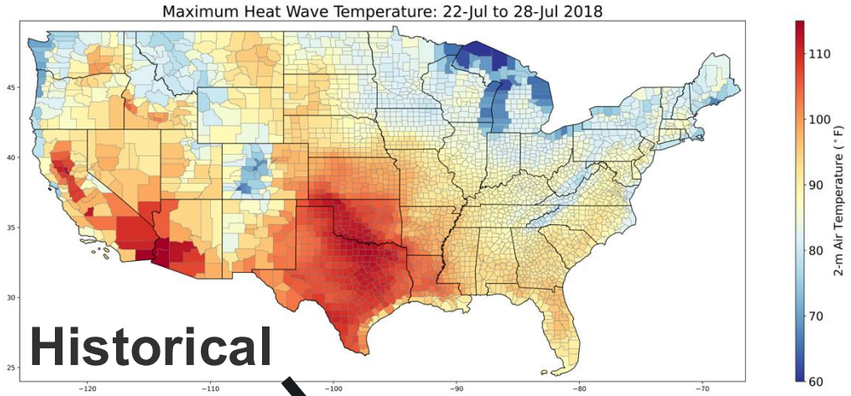
- TELL projects the evolution of hourly electricity demand in response to changes in weather and climate
- Based on a series of machine learning models trained on historical demands and meteorology
- Output is projections of hourly electricity demand at the county-, state-, and BA-scale that are conceptually and quantitatively consistent
- Released as an extensively documented open-source code base:
  https://github.com/IMMM-SFA/tell

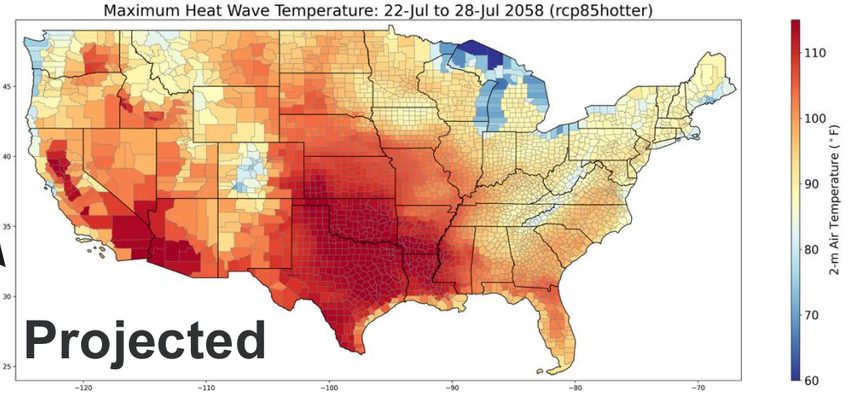


McGrath, C., C. Burleyson, Z. Khan, A. Rahman, T. Thurber, C. Vernon, N. Voisin, and J. Rice, 2022: tell: a Python package to model future electricity loads. *Journal of Open-Source Software*, 7(79) 4472, https://doi.org/10.21105/joss.04472

Basic Science Can Inform Policy Studies

Projects like the National Transmission Planning Study (NTPS) used the historical and future TGW dataset along with the TELL model to test the resilience of their projected system to extreme weather events.





Click or tap here to enter text.

National Transmission Planning Study: Stress Analysis

March 2024

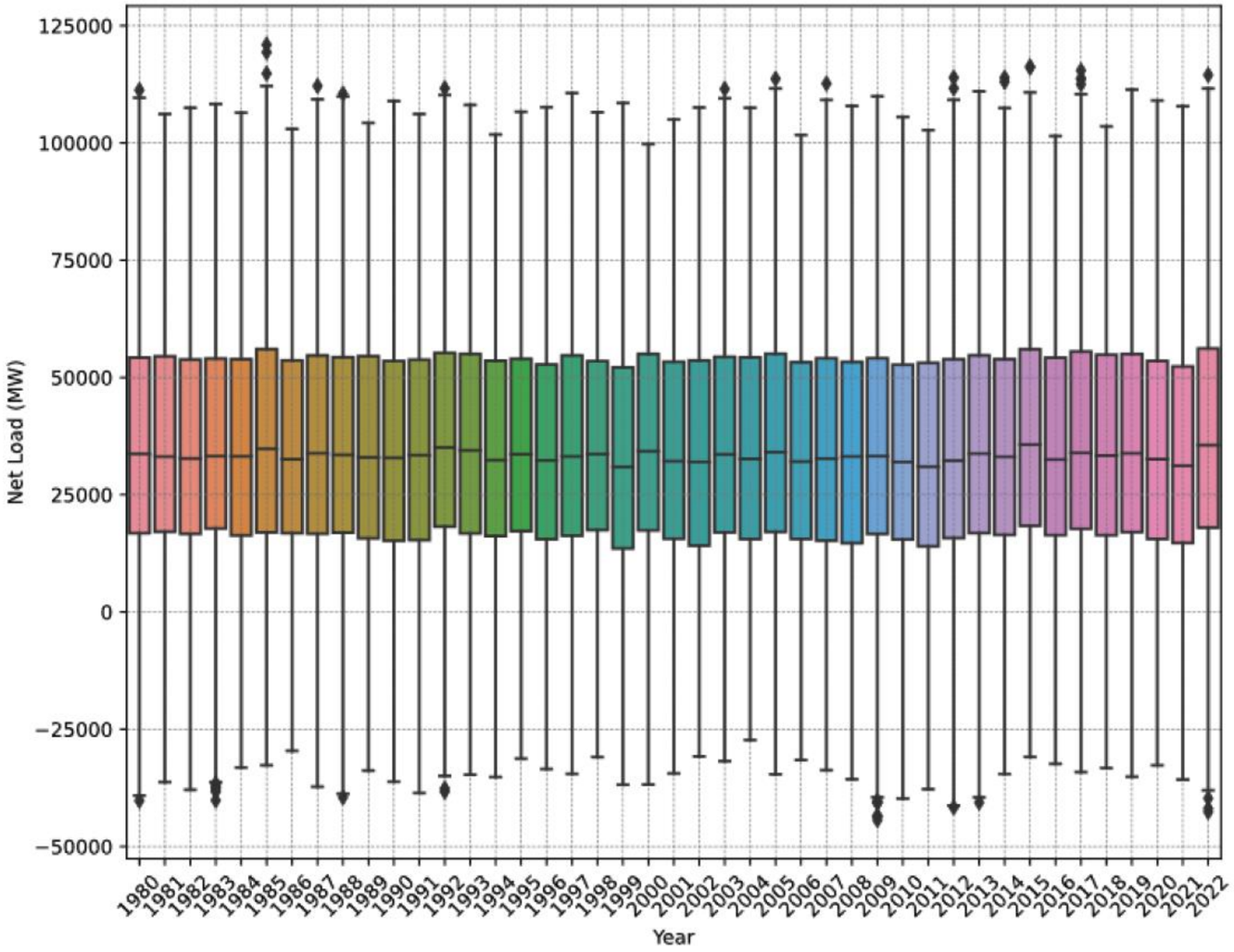
Konstantinos Oikonomou, Kyle Wilson, Mark Weimar, Abhishek Somani, Casey D. Burleyson, Cameron W. Bracken, Fernando Bereta dos Reis, Nathalie Voisin
Pacific Northwest National Laboratory

B&R Code: TF0000000-05300-3123796
DOE Program Manager: Kelly Kozdras, Adria Brooks

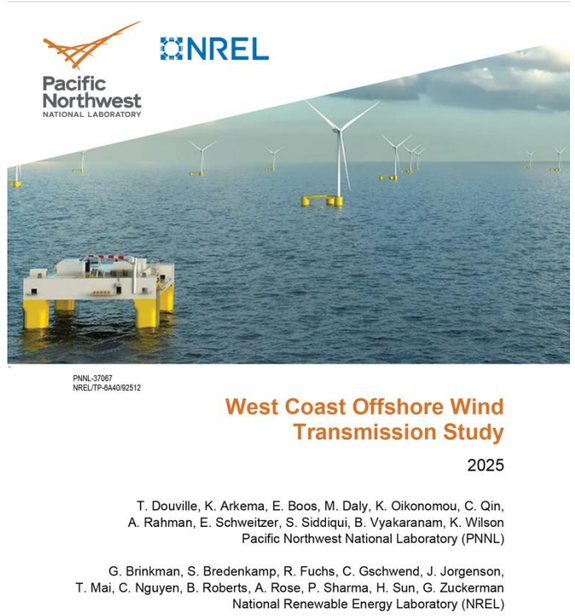
U.S. DEPARTMENT OF ENERGY | Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

U.S. Department of Energy, Grid Deployment Office. 2024. *The National Transmission Planning Study.* Washington, D.C.: U.S. Department of Energy. https://www.energy.gov/gdo/national-transmission-planning-study.

Basic Science Can Inform Policy Studies



The West Coast Offshore Wind Transmission Study (WOW-TS) used the TGW data and a variation of TELL to push 43 years of weather variability through their regional resource adequacy analysis.



ENERGY | Prepared for the U.S. Department of Energy under Contract DE-AC05-76RL01830

Policy Studies Can Inform Basic Science

"The purpose of the TPL-008-1 standard is to establish transmission system planning performance requirements to develop a Bulk Power System (BPS) that will operate reliably during extreme heat and extreme cold temperature events."

HOME NEWS & INSIGHTS

NERC Approves New Extreme Weather Planning Standard

R2. Each Planning Coordinator shall identify the zone(s) to which the Planning Coordinator belongs to under Attachment 1 and shall coordinate with all Planning Coordinators within each of its identified zone(s), to identify one common extreme heat benchmark temperature event and one common extreme cold benchmark temperature event for each of its identified zone(s) when completing the Extreme Temperature Assessment. The benchmark temperature events shall be obtained from the benchmark library maintained by the ERO or developed by the Planning Coordinators. Each benchmark temperature event identified by the Planning Coordinators shall: *[Violation Risk Factor: High] [Time Horizon: Long-term Planning]*

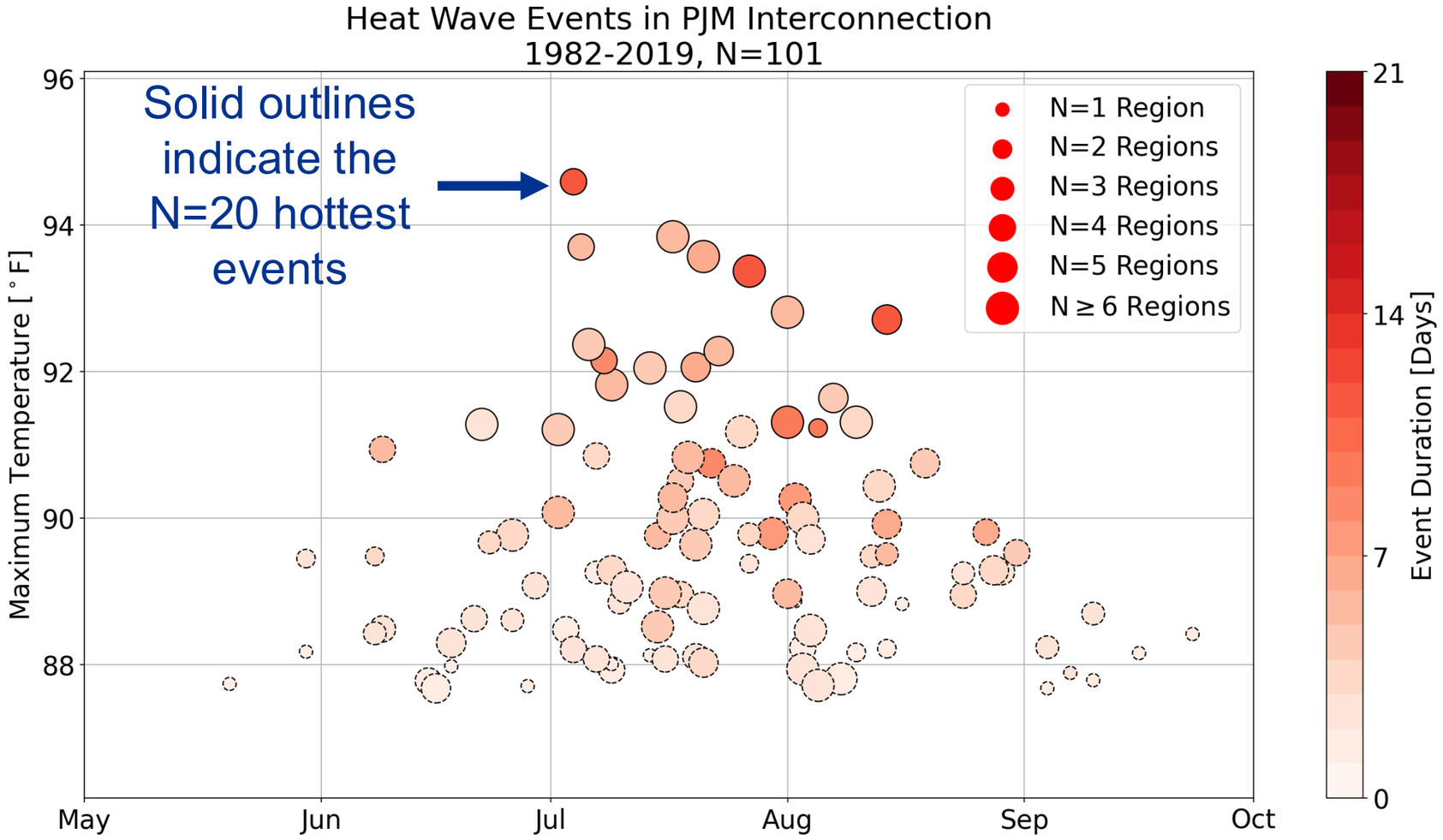
2.1. Consider no less than a 40-year period of temperature data ending no more than five years prior to the time the benchmark temperature events are selected; and

2.2. Represent one of the 20 most extreme temperature conditions based on the three-day rolling average of daily maximum (heat) or daily minimum (cold) temperature across the zone.

Wan, H., C. Burleyson, and N. Voisin, 2026: What technical choices matter to characterize thermal events in support of bulk power grid reliability studies? *Earth's Future,* 14, e2025EF006623, https://doi.org/10.1029/2025EF006623.

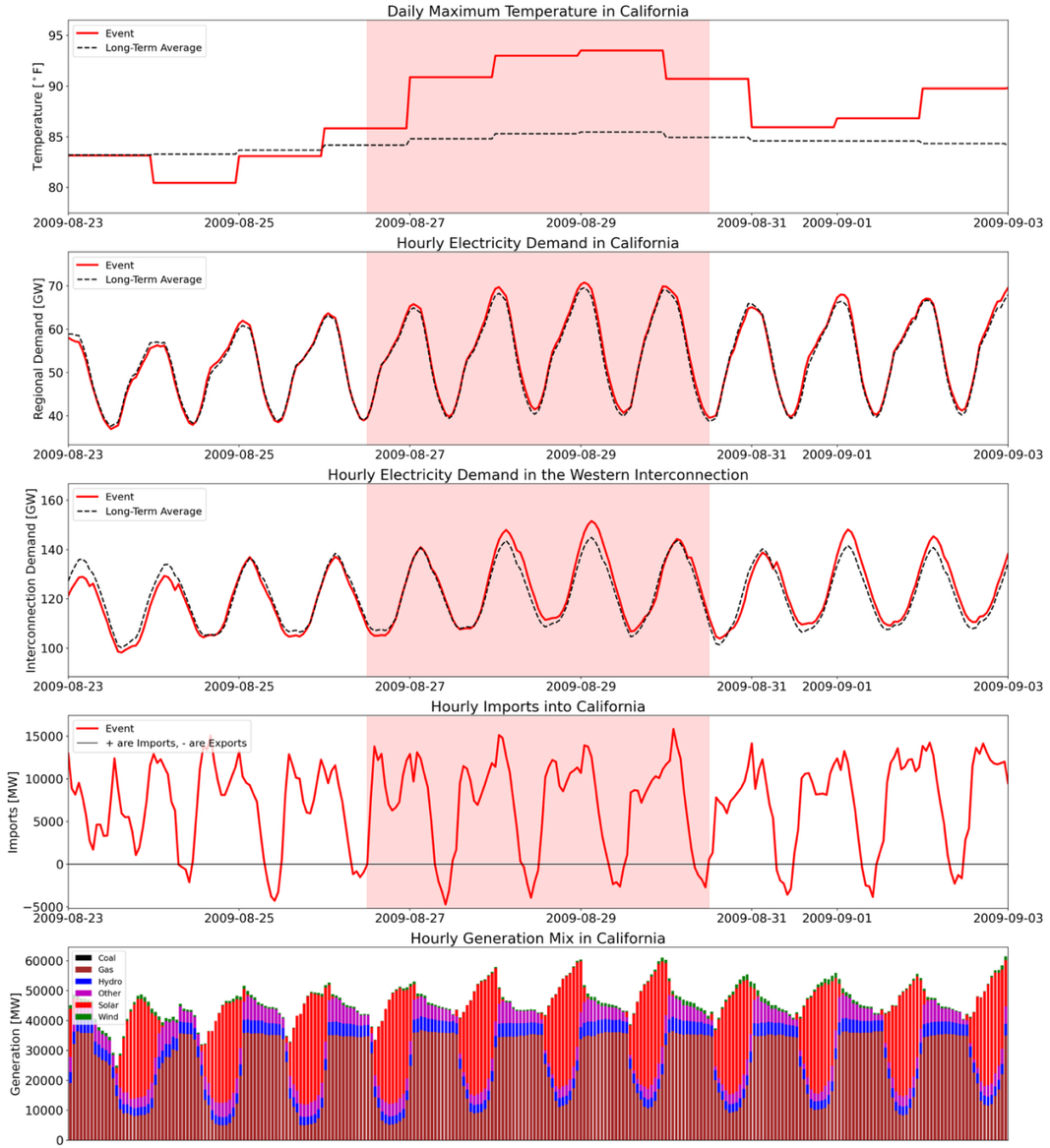
Burleyson, C., N. Voisin, O. Anderson, H. Wan, and C. Bracken, 2026: Characterizing diversity in heat wave and cold snap responses for assessing grid reliability. Submitted to *Applied Energy* – April 2026.

We created a catalogue of heat wave and cold snap events for every region from 1982-2019



The thermal events in the catalogue have significant variability in severity, time of year, spatial extent, and duration.

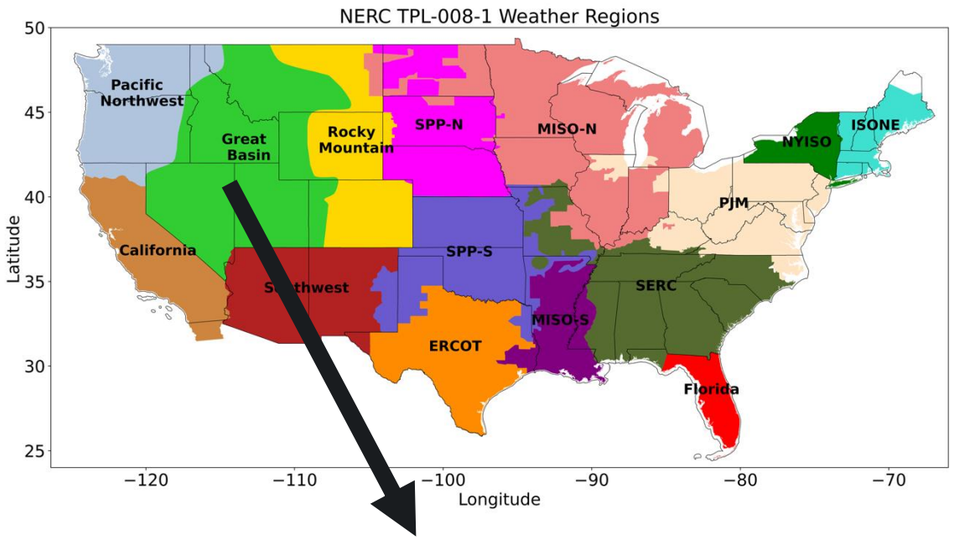
We simulated all 38 historical weather years to understand how the events impacted the grid

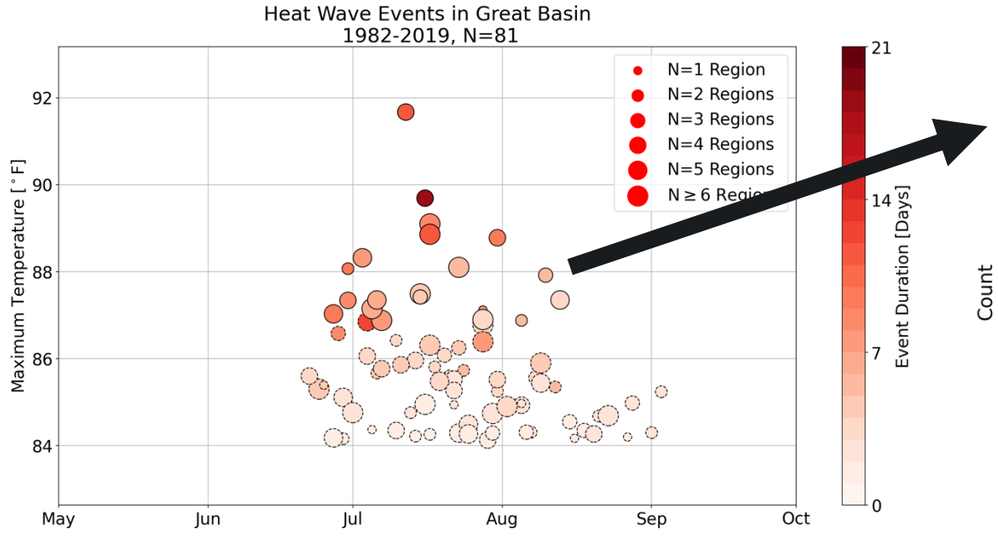


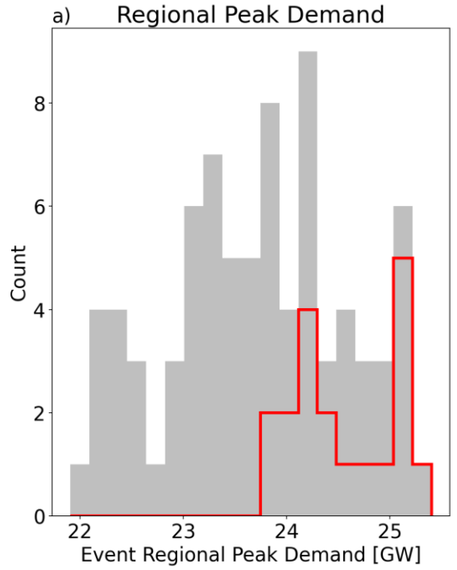
Production Cost Model (PCM) Simulations

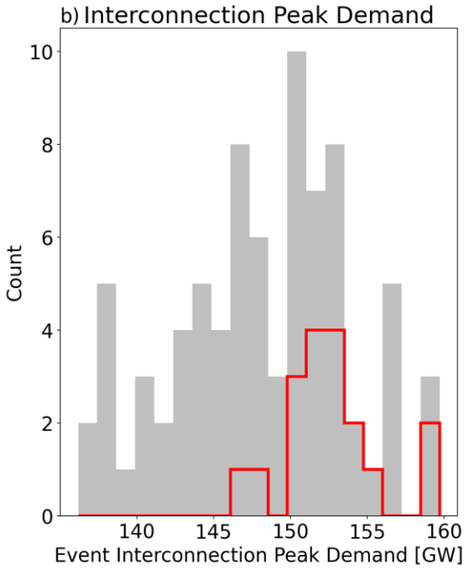
- Hourly meteorology was converted into coincident hourly load, wind, solar, and hydropower potential
- We projected all variables onto the WECC 2032 ADS system to reflect how the event might impact a future version of the grid
- Hourly simulations were conducted using GridView to measure the grid's response to the events

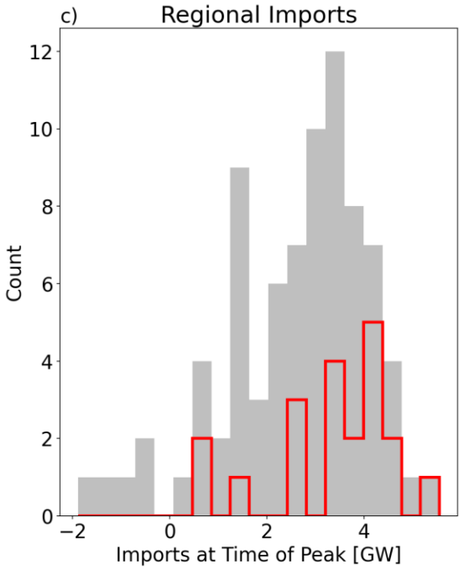
Heat waves and cold snaps create diverse stress responses on the grid

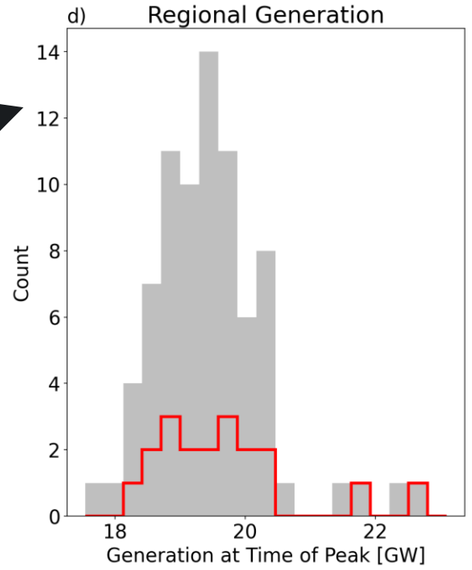


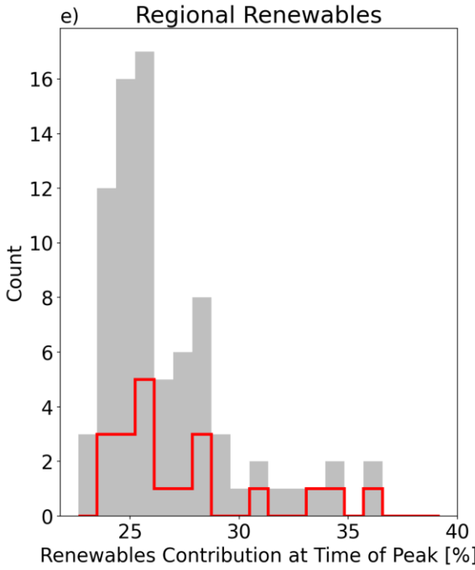


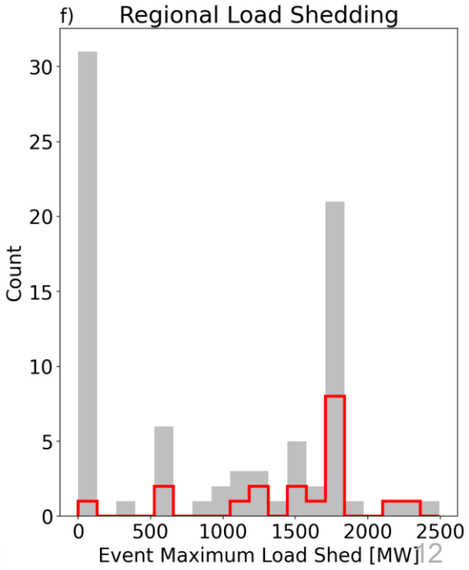












People Doing Interesting Work

- Hannah Bloomfield, Newcastle University, https://hcbloomfield19.github.io/
- Grant Buster, NLR, https://research-hub.nlr.gov/en/persons/grant-buster/
- Michael Craig, University Michigan, https://www.assetlab.org/
- Delavane Diaz, EPRI, https://esca.epri.com/research-staff/delavane-diaz/
- Ana Dyreson, Michigan Tech, https://www.mtu.edu/mechanical-aerospace/people/faculty/dyreson/
- Jordan Kern, NC State, https://ise.ncsu.edu/people/jkern/
- Josh Rhodes, UT-Austin, https://www.me.utexas.edu/people/faculty-directory/rhodes
- Hari Sundar, NLR, https://research-hub.nlr.gov/en/persons/hari-sundar/
- Julia Szinai, LBNL, https://climatesciences.lbl.gov/profile/jszinai/
- Nathalie Voisin, PNNL, https://www.pnnl.gov/people/nathalie-voisin
- Tom Wall, ANL, https://www.anl.gov/profile/thomas-a-wall

Potentially Useful Insights

- Basic to applied is a loop not an arrow. We can learn things by propagating knowledge in both directions. This is our superpower.
- Weather is complex. The grid is complex. Your weather-to-grid science questions should reflect this.
- Applied offices don’t typically care about papers. This impacts rewards.
- There are different expectations surrounding fidelity when $B are at stake.
- Your tools are more flexible than you think. If you expand your network, you might find new, impactful ways to apply them.

“I don't care about what anything was designed to do, I care about what it can do.”